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Ventilator-Associated Pnuemonia Prevention: Barriers and Facilitators of Provider Guideline Adherence

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VENTILATOR-ASSOCIATED PNEUMONIA PREVENTION: BARRIERS AND FACILITATORS OF PROVIDER GUIDELINE ADHERENCE

by

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Ventilator-Associated Pneumonia Prevention:

Barriers and Facilitators of Provider Guideline Adherence

by

Hiroko Kiyoshi-Teo

Various clinical guidelines have been developed to prevent ventilator-associated pneumonia (VAP). However, the availability of guidelines does not ensure adherence by clinicians to recommended strategies. Studies indicate prevention practices for VAP differ across settings. To date, there has been no study that comprehensively describes factors that influence VAP guideline adherence, nor the relationship between provider guideline adherence and VAP occurrence.

The purpose of this study was to identify factors that influence VAP prevention guideline adherence. The specific aims were to: (a) describe guideline user-related factors, guideline qualities, and contextual factors associated with guideline adherence; (b) test the relationships among these factors and guideline adherence rates; and (c) explore the relationships between adherence rates and VAP occurrence. This study examined institution specific VAP prevention guidelines and non-pharmacologic VAP prevention interventions (oral hygiene, head of bed elevated patient positioning, spontaneous breathing trial, and hand hygiene).

A cross-sectional descriptive study was guided by a conceptual model. A survey was created to capture guideline user characteristics, qualities of the clinical guideline, and contextual factors that influence clinicians' guideline adherence.

A total of 576 critical care nurses and 15 directors of infection control, critical care educators, and nurse managers from eight hospitals participated in the study. Each hospital had unique VAP prevention guidelines. In general, nurses had positive attitudes and reported to adhere to the guidelines always to most of the time. However, there were variations among the units.

Also, factors associated with guideline adherence were different by intervention. The guideline user attitude scale was the strongest and most consistent predictor of guideline adherence across interventions (OR 3.89-19.68). Guideline quality and context indicators were also significant predictors (OR 1.54-3.57). For unit level analyses, VAP rates were correlated with HOB adherence scores (-.52, $p \leq .05$).

Use of clinical guidelines has become a norm in patient care. To maximize the benefit of guideline implementation, efforts must be made to enhance nurses' attitudes, guideline quality, and environmental support.

Table of Contents

Acknowledgements iii
Ventilator-Associated Pneumonia Prevention: Barriers and Facilitators of Provider Guideline Adherence iv
Table of Contents vi
CHAPTER 1 1
The Study Problem 1
Purposes of the Study 1
Specific Aims 2
Hypotheses 2
Overview of the Study 3
Significance of the Study 4
Ventilator-Associated Pneumonia. 4
Provider Guideline Adherence 6
Funding 8
CHAPTER 2 9
Literature Review and Conceptual Frameworks 9
Pathophysiology of Ventilator-Associated Pneumonia 9
Prevention Strategies for VAP 10
Hand Hygiene. 11
Oral Hygiene. 12
Head of Bed Elevated Patient Positioning (Semi-Recumbent Positioning). 14
Weaning Protocols (Sedation Interruption and Spontaneous Breathing Trial). 16
Summary. 17
VAP Prevention Guidelines 17
Provider Guideline Adherence. 19
Terminologies 19
Factors Affecting Provider Guideline Adherence 21
VAP Guideline Adherence Studies 24
Nursing Adherence to VAP Interventions 25
Reasons for Non-Adherence 27
Summary 28
Conceptual Framework 29
Diffusion of Innovation Theory 30
Theory of Complex Adaptive System 32
CAS and DOI Theories to Explain VAP Guideline Adherence 33
Proposed Conceptual Framework for VAP Guideline Adherence Study 34
Assumptions and Propositions 35
Benefits of the Proposed Model 36
CHAPTER 3 39
Research Methodology 39
Assumption of This Study 40
Study Design 41
Sample 41
Data Collection Procedure 43

Human Subjects Protection 44
Development of the “P-VAP” Survey 45
Models for "P-VAP Survey" 45
Components of the "P-VAP Survey" 46
Reliability and Validaty of "P-VAP Survey" 48
Infection Control and Critical Care Unit Interviews 51
Data Analysis 52
Analytical Strategies for Specific Aim 1 52
Analytical Strategies for Specific Aim 2 54
Analytical Strategies for Specific Aim 3 55
CHAPTER 4 56
Results 56
Sample 56
Types of Institutional VAP Prevention Guidelines 61
Accessibility of Institutional VAP Prevention Guidelines 63
Contents of Institutional VAP Prevention Guidelines 63
Correct Knowledge of Institutional VAP Prevention Guidelines 65
Results of Specific Aim 1 67
Self-Reported Adherence 69
Guideline User Characteristics 75
Guideline Quality 65
Contextual Factors 77
Results of Specific Aim 2 80
Nurses’ Professional Characteristics and Guideline Adherence 81
VAP Context Index, Nurses’ Professional Characteristics, Quideline Quality, and Adherence 82
Guideline User Attitudes, Guideline Quality, and Contextual Factors 85
Variable Selection for the Regression Analyses 88
Multi-Level Logistic Analyses 89
Summary 96
Results of Specific Aim 3 99
Adhrence Rates and VAP Occurence 99
Types of Guidelines and Adherence Rates 100
Possible Predictors of VAP Rates 101
Evaluation of Hypotheses 103
Summary 106
CHAPTER 5 108
Discussions 108
Guideline Adherence and Factors Associated with Adherence 109
Oral Hygiene 109
Head of Bed Elevated Patient Positioning 111
Spontaneous Breathing Trial 112
Hand Hygiene 114
Overall VAP Prevention 116
Summary 117
Evaluation of the Conceptual Framework 118

Study Limitations 121
Design Limitations 121
Sampling Limitations 122
Analysis Limitations 123
Study Strengths 123
Study Implications 126
Conclusions 126
References 162

List of Tables

Table 4.1. *Survey Participants* 57
Table 4.2. *ICU Nurses' Education, Training, and Clinical Experience* 60
Table 4.3. *Overview of Institution Specific VAP Prevention Guidelines* 62
Table 4.4. *Correct Knowledge of Institutional VAP Prevention Guidelines* 66
Table 4.5. *Percent Adherence by VAP Interventions* 69
Table 4.6. *Percent Agreement for Attitude Scale Components* 70
Table 4.7. *Cronbach Alphas and Mean Scores of Attitude Scales* 71
Table 4.8. *Percent Agreement for Guideline Awareness* 72
Table 4.9. *Percent Agreement for Level of Prioritization* 73
Table 4.10. *Percentage Agreement for Role Expectations* 74
Table 4.11. *Percent Agreement for Guideline Quality Index Components* 75
Table 4.12. *Mean Guideline Quality Index Scores across VAP Interventions* 76
Table 4.13. *Percent Agreement for Attitudes toward Overall VAP Guideline* 77
Table 4.14. *Percent Agreement for Contexts of Individual VAP Preventions* 78
Table 4.15. *Percent Agreement with VAP Context Index Components* 80
Table. 4.16. *Correlation Matrix: Nurses' Professional Characteristics and Guideline Adherence* 82
Table 4.17. *Correlation Matrix: VAP Context Index, Nurses' Professional Characteristics, Guideline Adherence, Attitude Scales, and Guideline Quality Indices* 84
Table 4.18. *Correlation Matrix: Oral Hygiene Guideline Adherence* 85
Table 4.19. *Correlation Matrix: Head of Bed Elevated Patient Positioning Guideline Adherence* 86
Table 4.20. *Correlation Matrix: Spontaneous Breathing Trial Guideline Adherence* 87
Table 4.21. *Correlation Matrix: Hand Hygiene Guideline Adherence* 88
Table 4.22. *Model Testing for Factors Associated with Oral Hygiene Guideline Adherence* 91
Table 4.23. *Model Testing for Factors Associated with Head of Bed Elevated Patient Positioning Guideline Adherence* 92
Table 4.24. *Model Testing for Factors Associated with Spontaneous Breathing Trial Guideline Adherence* 94
Table 4.25. *Model Testing for Factors Associated with Hand Hygiene Guideline Adherence* 96
Table 4.26. *Selected Odds Ratios for OH, HOB, SBT, and HH Guideline Adherence* 99
Table 4.27. VAP Rates across Units 100

Table 4.28. *Correlation Matrix: Unit VAP Rates, Guideline Adherence, Attitude Awareness, Attitude Scales, Guideline Quality Indices, and VAP Context Index* 102

Appendix 1: *Original P-VAP Survey* 128
Appendix 2: *Revised P-VAP Survey* 139
Appendix 3: *Infection Control Interview Guide* 149
Appendix 4: *Critical Care Unit Interview Guide* 152
Appendix 5: *Survey Domains, Questions, and Studied Interventions* 156
Appendix 6: *Changes from Original to Revised Survey* 158
Appendix 7: *Interview Informed Consent (UCSF)* 159

List of Figures

Figure 2.1. *Relationships among Guideline-User, Guideline Qualities, and Contextual Factors* 38
Figure 4.1. *Percentage of Adherence by the VAP Intervention* 68
Figure 5.1. *Revised Relationships among Guideline-User, Guideline Qualities, and Contextual Factors* 120

CHAPTER 1

The Study Problem

Ventilator-associated pneumonia (VAP) is the most common nosocomial infection in critical care units (Richards, Edwards, Culver, & Gaynes, 2000; Safdar, Dezfulian, Collard, & Saint, 2005) and it has devastating consequences. Various clinical practice guidelines have been developed to prevent its occurrence (American Association of Critical-care Nurses, 2010; Centers for Disease Control and Prevention, 2010; Coffin et al., 2008; Institute of Healthcare Improvement, N/A-b) and many hospitals have responded to the seriousness of VAP by instituting these guidelines. However, it has been shown that the availability of guidelines and institutional adoption of these guidelines does not ensure adherence to these guidelines in the clinical practice setting and VAP continues to be a significant problem in our critical care units (Cason, Tyner, Saunders, & Broome, 2007; Crunden, Boyce, Woodman, & Bray, 2005; Heyland, Cook, & Dodek, 2002; Kaynar et al., 2007; Rello et al., 2002; Ricart, Lorente, Diaz, Kollef, & Rello, 2003).

Purposes of the Study

This study is one of a few to examine the facilitators and barriers of clinician adherence to VAP prevention guideline. Specifically, the study obtained and analyzed survey data from critical care nurses in Northern California about perceptions of VAP prevention guidelines and the contextual factors that affect guideline usage. The study focused on common non-pharmacologic VAP interventions including oral hygiene (OH), head of bed elevated patient positioning (HOB), spontaneous breathing trials (SBT), and hand hygiene (HH). The findings from this research will provide

directions to improve quality and safety of healthcare using guidelines as one of the tools. Understanding how users interact with the guideline will help influence the creation of user-friendly guidelines as well as facilitate change in work environments to supports the utilization of the guideline recommendations. Also, this study can provide insights into how guidelines can be better utilized in preventing other adverse events.

Specific Aims

The three specific aims of this study are:

1) To describe VAP prevention guideline adherence and guideline user factors, guideline qualities, and contextual factors for each of four VAP interventions studied (OH, HOB, SBT, and HH).

2) To test the relationships between these factors and VAP guideline adherence for each of VAP interventions.

3) To explore the relationships between VAP guideline adherence and VAP incidences at the unit level.

Hypotheses

The six hypotheses tested in this study are:

Individual analyses.

A) OH adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher (higher score indicates the presence of facilitators).

B) HOB adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher.

C) SBT adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher.

D) HH adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher.

E) Overall VAP prevention guideline adherence rates will be higher when guideline user, guideline quality, and contextual factor scores are higher.

Unit level analyses.

F) Unit VAP rates will be lower when the unit mean guideline adherence score is higher.

Overview of the Study

This study is a cross-sectional, descriptive study using survey methodology. The study is guided by a proposed conceptual framework based on theory of diffusion of innovation and complex adaptive theory. The survey instrument named "Preventing-VAP (P-VAP) Survey" was modeled after the "Attitudes Regarding Practice Guidelines" survey (Larson, 2004; Quiros, Lin, & Larson, 2007).

The study was initially proposed as a two phase study in order to examine the feasibility of the study design and to establish survey instrument reliability and validity prior to data collection. Instead, the study was conducted in a step-wise fashion with less distinction between the test study site and the main data collection sites. Eight hospitals were enrolled instead of targeted 27 hospitals. After the preliminary assessment of study processes at the Hospital 1, a decision was made to only include ICU nurses and exclude respiratory therapists (RTs) and physicians (MDs) due to recruitment challenges. The survey instrument was slightly revised after

the Hospital 1 data collection; however, Hospital 1 data were included in the final analyses where appropriate. Analyses were conducted for the each VAP intervention: OH, HOB, SBT, and HH. For each of the interventions studied, the outcome of interest was self-reported adherence to the guideline recommendations.

There were three predictor domains. The first domain, the guideline user domain, addressed the awareness and attitudes of the guideline user toward the guidelines. The second domain, the guideline domain, addressed the relative advantage, complexity, and compatibility of the guideline. Lastly, the contextual domain identified hospital and unit characteristics, communication method, and patient factors. A scale and indices were created to best represent the domains. Then, Spearman's correlations were used identify variable to be entered into multi-level logistic regression model. Also, mean guideline adherence scores for each unit were calculated to examine the relationship between adherence and VAP incidences using Spearman's correlations.

Significance of the Study

Ventilator-Associated Pneumonia

In 2002, health-care associated infections (HAI) affected 1.7 million people , and resulted in 99,000 deaths in the United States (Lucado, 2010). HAI are the most common adverse events patients experience and are increasingly considered indicators of patient safety (Burke, 2003; Peterson, 2006). VAP is one of the deadliest HAI and affects mechanically ventilated patients in critical care units (ICUs). VAP is defined as pneumonia arising 48 hours or longer after endotracheal intubation (American Thoracic Society and Infectious Diseases Society of America, 2005). Safdar et al (2005) found VAP occurred in 10-23% of patients on mechanical ventilation for more

than 48 hours (2005); other studies document that VAP accounts for almost half of the infections (Cason et al., 2007; Richards et al., 2000). Most recent VAP rates are 0.5 to 10.7 per 1,000 ventilator days depending on types of ICUs (Edwards et al., 2009).

VAP increases the duration of mechanical ventilation and prolongs ICU stay by an average of 6 days. Added costs for each patients, including diagnosis and treatment, are estimated to be between $10,019-$13,647 (Safdar, Dezfulian et al., 2005). Most importantly, VAP has the highest rate of case fatality compared to other HAI. Reported crude mortality rate is as high as 30% (Chastre & Fagon, 2002). Attributable mortality rates range from non-significant to 50% (Safdar, Dezfulian et al., 2005).

Hospitals are incentivized to minimize rates of VAP for patient safety but also for external reasons. For example, hospitals have benchmarks to compare their VAP rates. The National Healthcare Safety Network (NHSN) (formerly National Nosocomial Infections Surveillance) was established in 2006 as part of the CDC and plays an influential role in HAI prevention by publishing benchmark data voluntarily reported by 1,545 hospitals in the U.S (Edwards et al., 2009).

VAP rates are being disclosed as quality measures. Eleven states mandate disclosure of NHSN reported HAI to the respective state agencies (Edwards et al., 2009). Currently California does not mandate health-care associated infection reporting; however, many hospitals voluntarily participate in NHSN and California Hospital Assessment and Reporting Taskforce (CHART). CHART was founded in 2004 with funding from California Healthcare Foundation to create a standardized

"report card" on hospital quality. CHART is supported by influential agencies such as The Joint Commission and The California Office of Statewide Health Planning and Development (California Healthcare Foundation, 2009). Over 240 hospitals participate in CHART voluntarily, representing 86% of the average daily census in California (California Healthcare Foundation, 2009). CHART collects information on ICU process and outcome measures, including incidents of VAP and observation of placing patients in semi-recumbent position to prevent VAP (CHART, 2010), and reports these publically reported through CalHospitalCompare.org website (CalHospitalCompare.org).

Lastly, VAP rates are considered as another CMS quality indicators (Centers for Medicare and Medicaid Services, n/a). This has stirred controversy as some suggest that VAP diagnosis may be inaccurate even when using CDC's definitions (Klompas, 2007) and thus should not affect the reimbursement from CMS. These changes in the healthcare quality reports are increasing reasons for hospitals to stay focused on VAP prevention.

Provider Guideline Adherence

Reliable use of clinical guidelines improves quality and safety of care (Gurses et al., 2010; Larson, 2003; Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). Clinical guidelines are created to facilitate evidence-based practices and to decrease inappropriate variations in care processes and health outcomes (Larson, 2003; Sackett et al., 1996). However, despite the availability of evidence-based guidelines, health care providers do not routinely adhere to them (Cabana et al., 1999; Grol & Wensing,

2004; Titler & Everett, 2001). Grol and Gwimshaw (2003) estimates 30-40% of patients do not receive care according to current scientific evidence.

Poor adherence to VAP guidelines is well documented (Bird et al., 2010; Cason et al., 2007; Christenson, Hitt, Abbott, Septimus, & Iversen, 2006; Crunden et al., 2005; DuBose et al., 2008; Heyland et al., 2002; Kaynar et al., 2007; Manangan, Banerjee, & Jarvis, 2000; Rello et al., 2002; Ricart et al., 2003). However, there is a lack of information about the barriers that contribute to the implementation of these guidelines. Little is known about providers' practice (VAP guideline adherence), contributing factors for varying adherence (why providers do or do not practice VAP prevention strategies as recommended in the guideline), and the effect of adherence on patient outcomes (VAP rates).

A few studies have examined factors related to suboptimal VAP guideline adherence rates, and the reasons for non-adherence by nurses (Kaynar et al., 2007; Ricart et al., 2003). These studies support the examination of the work environment to identify how a nurse's clinical performance is influenced by organizational and contextual factors (Ploeg, Davies, Edwards, Gifford, & Miller, 2007).

Various theoretical perspectives are valuable when considering barriers to change and strategies to promote change (Grol & Grimshaw, 2003). Diffusion of Innovation theory (Rogers, E.M., 1995) and Complex Adaptive System perspectives (Plsek & Wilson, 2001) were incorporated to create a new conceptual model to guide this study by taking into account the dynamic interaction between the guideline user, the guideline, and the clinical context.

In summary, VAP is a common, deadly, and costly complication of hospital care. Strategies to prevent VAP are well documented in the literature. However, the translation into clinical practice is sub-optimal with our current guidelines and work environment. Identifying facilitators and barriers to enhance providers' guideline implementation is critical to optimize safe patient outcomes.

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CHAPTER 2

Literature Review and Conceptual Framework

This chapter describes the state of science for VAP guideline adherence, starting with the pathophysiology of VAP and the supporting evidence for common non-pharmacologic interventions (OH: oral hygiene, HOB: head of bed elevated patient position, SBT: spontaneous breathing trial, and HH: hand hygiene), and ending with some professional VAP recommendations. Second, provider guideline adherence in general and the studies on VAP prevention guideline adherence will be examined. Lastly, a conceptual framework for this study will be discussed.

Pathophysiology of Ventilator-Associated Pneumonia

The development of nosocomial pneumonia usually requires virulent organisms to first enter the lower airway and then to overcome layers of host defenses from mechanical (ciliated epithelium or mucus), hormonal (antibody and complement), and cell-level factors (polymorphonuclear leukocytes, macrophages, lymphocytes, and their respective cytokines) (American Thoracic Society, 1996). Then, bacterial adherence to oropharyngeal epithelial cells occurs, creating bacterial colonization (Fleming, Balaguera, & Craven, 2001).

Common pathogens of VAP include aerobic gram-negative bacilli, such as *Pseudomonas Aeruginosa*, *Staphylococcus aureus (Methicillin-sensitive and methicillin-resistant),* and *Acinetobacter* species (Koulenti et al., 2009). It is known that the stomach and gastrointestinal tract are likely sources of oropharyngeal and tracheal pathogens particularly in late-onset VAP (Driks et al., 1987; Prod'hom et al., 1994) which occurs on or after 4 days of mechanical ventilation (Collard, Saint, &

Matthay, 2003) and is commonly caused by multi-drug resistant strains of aerobic gram-negative bacilli such as methicillin resistant *Staphylococcus Aureus* (MRSA) which further complicates the treatment.

There are several known patient related factors that are associated with risk of VAP. These factors include male gender, hospital admission following trauma, severity of underlying illness, immunodeficiency, and treatment with heavy sedation (Fleming et al., 2001; Rello, Ausina, Ricart, Castella, & Prats, 1993). When patients are exposed to extrinsic risk factors such as invasive procedures and breaches in infection control, risks of nosocomial pneumonia increase. Furthermore, the risk of gastric colonization increases dramatically in older adults, and people with achlorhydria, various gastrointestinal diseases, malnutrition, use of antacids and histamine type 2 (H2) blockers, and enteral feeding (Driks et al., 1987). Also, aspiration is more frequent in patients with pathologically altered consciousness, abnormal swallowing, depressed gag reflexes, delayed gastric pumping, or decreased gastrointestinal motility, thus resulting in higher aspiration risk (Huxley, Viroslav, Gray, & Pierce, 1978).

Prevention Strategies for VAP

VAP is a common and deadly complication for mechanically ventilated patients. Consequently, there have been numerous studies on VAP and its prevention. Fortunately, epidemiology and pathogenesis of VAP are well captured. However, most effective and easy-to-implement prevention strategies are still being investigated. Some clinicians disagree with recommendations such as use of specialized endotrachial tubes, selective gastrointestinal decontamination, use of antimicrobial

rinse, or use of kinetic beds because lack of sufficient evidence (Krein et al., 2008). The following sections describe evidence, prevalence, and issues related to established non-pharmacologic VAP prevention strategies: Hand hygiene, oral hygiene, head of bed elevated patient positioning, and spontaneous breathing trial.

Hand Hygiene

Hand hygiene is a general term referring to any action of hand cleansing (The Joint Commission, 2009) and includes hand wash with antimicrobial soap and water or using alcohol-based antiseptic (Tablan et al., 1994). In a review of experimental and non-experimental studies identified from 423 articles, Larson (1988) identified that except for specificity, all elements of causality including temporality, strength, plausibility, consistency of the association, and dose response were present between hand hygiene and reduced risk of infection. Later, Larson updated the review (1999) by including 16 quasi-experimental studies from 1977-1998 and found improved hand hygiene practices reduced transmission of infections. In this article, she discusses the limitations of study types for hand hygiene due to infeasibility in the patient care setting for randomization or blinding of hand hygiene practices.

Currently, it is widely recognized that direct contact between health care staff and patients is considered to be the primary route for nosocomial infection (Beggs et al., 2006; Tschudin-Sutter, Pargger, & Widmer) and hand hygiene practices is the basic prevention measure to prevent nosocomial infections (Lautenbach, 2001; Tablan et al., 1994; The Joint Commission, 2009). For VAP prevention, gram-negative bacilli and *Staphylococcus aureus,* common causative agents, are often cross transmitted to patients through the healthcare provider (Fleming et al., 2001; Safdar, Crnich, & Maki,

2005). The World Health Organization published “My five moments for hand hygiene” (2006 to overcome misleading language and complicated descriptions by identifying five key moments for hand hygiene. Regardless, increasing the compliance for hand hygiene practices among healthcare providers is still a challenge (Beggs et al., 2006; The Joint Commission, 2009).

Oral Hygiene

While there is a lack of standardization, oral hygiene or oral care practices, typically includes daily assessment of oral cavity, routine brushing of teeth, routine oral cleansing (i.e., using swab stick or sponge), providing moisture to mouth, suctioning, and use of oral rinse (Cutler & Davis, 2005). Oral hygiene has long been a part of standard practice for nurses. Critically ill patients are especially at risk to lose a protective substance called *fibronectin* from tooth surface which leads to formation of dental plaque (Berry, Davidson, Masters, & Rolls, 2007). Dental plaque serve as reservoir for bacterial colonization (El-Solh et al., 2004). For mechanically ventilated patients, their salivary secretions decrease, and self-cleaning of the oral cavity is significantly decreased leading to bacterial colonization of oropharynx (Fourrier et al., 2005; Mori et al., 2006). Microbial colonization of the oropharynx and of dental plaque has been associated with various complications, such as cardiovascular disease, chronic obstructive pulmonary disease, endocarditis, and bacterimia (Munro & Grap, 2004), and especially VAP (Cutler & Davis, 2005; Fourrier et al., 2005). Reducing micro-organisms in the mouth will decrease the risk of translocation and colonization of bacteria and thus reduce risk of VAP (Munro & Grap, 2004).

Although many reports suggest possible relationship with poor oral care and higher incidence of VAP, evidence is limited (Bearman, Munro, Sessler, & Wenzel, 2006; Cutler & Davis, 2005; Fields, 2008; Pobo et al., 2009). Use of chlorhexidine as part of oral care is most extensively studied. Chlorhexidine is an antiseptic agent which acts rapidly at multiple target sites and may be less prone to induce drug resistance compared with antibiotics (Chan, 2007). This broad spectrum antimicrobial is known to be highly effective against aerobic and anaerobic gram-positive and gram-negative bacteria (Genuit, Bochicchio, Napolitano, McCarter, & Roghman, 2001). It is low cost, easy-application intervention with a low level of adverse effects (Pobo et al., 2009). Because of low systematic absorption, "oral decontamination" is gaining more popularity compared to selective decontamination of the digestive tract, a controversial VAP intervention. Multiple meta-analyses were published indicating the reduction of VAP with chlorhexidine (Beraldo & Andrade, 2008; Carvajal et al., 2010; Chan, 2007; Chlebicki & Safdar, 2007). Most recently, Carvajal et al. (2010) conducted a systematic review of the controlled clinical trials studying the effects of oral hygiene on VAP prevention. Ten articles included in this review concluded lack of uniformity in the chlorhexidine application but nevertheless, there was a reduction in the risk of VAP in the chlorhexidine group versus control (OR: 0.56, 95% CI: 0.44-0.73).

Despite the increasing evidence that oral hygiene can reduce VAP, only a few institutions use a written oral care policy that specifies frequency and tools for intubated patients (Cason et al., 2007; Sole et al., 2003; Sona et al., 2009). And nurses commonly consider oral hygiene to be a comfort care (thus less priority) or are

reluctant to perform oral care due to limited oral cavity space because of the endotracheal tube or for the fear of dislodging or displacing the tube (Munro & Grap, 2004). Thus, frequency of tooth brushing is less than optimal at 58-65% for patients on mechanical ventilation (Cason et al., 2007; Sole, Poalillo, Byers, & Ludy, 2002). In the study by Krein et al. (2008), 40% of 719 surveyed hospitals regularly used antimicrobial mouth rinse. In conclusion, there is increasingly strong evidence to conduct comprehensive oral care; however, optimal oral hygiene practice is yet to be identified. Many hospitals lack written oral hygiene protocol for intubated patients and oral hygiene is less than optimally practiced.

Head of Bed Elevated Patient Positioning (Semi-Recumbent Positioning)

Positioning patient in upright position has been shown to reduce VAP by reducing gastric reflux and subsequent aspiration. One randomized prospective study (Drakulovic et al., 1999) compared patient positioned at ≥45° versus supine position and found significant reduced risk of pneumonia by >25% (N = 86). Since the cost of positioning patients is negligible and it is a safe practice for patients, this study has frequently been cited as rationale to position patients with their heads elevated for intubated patients. When radioactive labeled enteral feeding were used to measure the effect of gastric reflux and aspiration events for patients in the semi-recumbent position, researchers found less radioactive material in bronchial secretion thus suggesting that head of the bed elevation ≥45° is beneficial (Orozco-Levi et al., 1995; Torres et al., 1992). Most recently, in the systematic review by Niel-Weise et al (2011) which included only three RCTs, 22 experts recommended elevating the head of bed to 20 to 45 degrees.

Despite the expert consensus, feasibility of positioning patients at ≥45° in clinical practice has been questioned. Van Nieuwenhoven and colleagues (2006) conducted a prospective multicenter trial and found that random allocation of patients to ≥45° position resulted in average of 28° head of bed elevation (N = 221). Thus, the goal of ≥45° position was not achievable even during the study period when the degree of the head of the bed elevation was measured every 60 seconds using a transducer with a pendulum. Also, when they compared actual patient positions at an average of 28° with those at a 10° position (common positioning for ICU patients), there was no significant difference in development of VAP. Authors concluded that 30° is not enough for VAP prevention; alternatively, 10° might be sufficient for prevention (van Nieuwenhoven et al., 2006). They also find that incidents of pressure ulcer, a frequent concern for placing patients in semi-recumbent position were 28-30% and did not differ between groups.

Positioning mechanically ventilated patients in a semi-recumbent position at 30-45 degrees if clinically possible is the one intervention that is consistently included in the professional guidelines (American Association of Critical-care Nurses, 2008, 2010; American Thoracic Society and Infectious Diseases Society of America, 2005; Institute of Healthcare Improvement, N/A-b; Tablan, O. C., Anderson, L. J., Besser, R., Bridges, C., & Hajjeh, R., 2004b). In the study by Krein et al. (2008), 83% of 719 surveyed hospitals regularly used head of bed elevation. In summary, head of bed elevation is considered as core VAP intervention measure. Future studies are needed to assess the concern for patients' comfort, risk for pressure ulcers, or patients slipping out of bed along with feasibility of the positioning.

Weaning Protocols (Sedation Interruption and Spontaneous Breathing Trial)

Studies have indicated that daily assessment of the readiness to wean by daily sedation interruption (also known as *sedation vacation, sedation stop,* or *spontaneous awakening trial*) and spontaneous breathing trial resulted in reduced time on mechanical ventilation, thus decreasing the risk of VAP (Boles et al., 2007; Ely et al., 1996; Girard et al., 2008; MacIntyre et al., 2001). An RCT by Kress et al (2000) found a significant decrease the duration of mechanical ventilation when patients received daily interruption of sedative infusions (4.9 days vs. 7.3 days, $p \leq .01$). Later, Girard et al (2008) conducted an RCT with 336 mechanically ventilated patients to examine the effect of a paired spontaneous awakening trial (SAT) and spontaneous breathing trial (SBT). They found that patients in the intervention group spent more time off mechanical ventilation (14.7 days vs. 11.6 days, $p=0.02$) and had shorter ICU (9.1 days vs. 12.9 days, $p=0.01$) and hospital stay (14.9 days vs. 19.2 days, $p=0.04$). The study authors pointed out the complexity of coordinated SAT and SBT efforts as these are truly interdisciplinary effort involving nurses, respiratory therapists, and physicians. In conclusion, they support implementation of combined SAT and SBT protocol to better facilitate the patient weaning process.

There is uncertainty about the optimal ventilator setting to wean patients from mechanical ventilation (Dries, McGonigal, Malian, Bor, & Sullivan, 2004). Also, some clinicians fear the risks of self-extubation, pain, anxiety, or complications (Blackwood et al., 2009; Ely et al., 2001). However, Schweickert et al (2004) found daily sedation interruption decreased complications due to shorter duration of mechanical ventilation. Also, there is growing evidence that nurse/respiratory

therapist driven weaning protocols lead to more consistent practice in ICUs and can reduce the duration of mechanical ventilation (Ely et al., 2001; Quenot et al., 2007; Robertson et al., 2008).

Summary

Interventions to prevent VAP are commonly studied. Hand hygiene and head of bed elevated patient positioning are the most established interventions. In comparison, oral hygiene and use of weaning protocols are theoretically supported with some strong evidence. More studies have been published recently that support comprehensive oral hygiene program and weaning guidelines by non-physician personnel. Each critical care unit must review these evidence in order to make a decision on the appropriate practices for their patient population.

VAP Prevention Guidelines

To incorporate evidence into practice, numerous guidelines have been developed. Clinical practice guidelines aim to improve the quality of care by decreasing inappropriate variations and expediting the application of effective advances to everyday practice (Pogorzelska & Larson, 2008). Content of VAP prevention guidelines from influential professional organizations, such as the CDC (Tablan, Anderson, Besser, Bridges, & Hajjeh, 2004a), the Institute of Healthcare Improvement (IHI)(Institute of Healthcare Improvement, N/A-b), the American Thoracic Society (ATS) and Infectious Disease Society of America (IDSA)(American Thoracic Society and Infectious Diseases Society of America, 2005), and the American Association of Critical-care Nurses (AACN)(American Association of Critical-care Nurses, 2008, 2010) have been reviewed. Of note, IHI, a non-

governmental organization founded by Donald Berwick in the 1980's to promote safer healthcare and has been most influential to hospitals for VAP prevention. IHI's recognition exploded through "100, 000 Lives Campaign" across the U.S. in 2004. In their more recent "5 Million Lives Campaign," over 4,000 hospitals participated in the two-year period (Institute of Healthcare Improvement, n/a-a).

Table 2.1. *Comparison of Evidence Based Professional Clinical Guidelines*

Recommendations	CDC (2003)	ATS/IDSA (2005)	SHEA/IDSA (2008)	IHI (2010 rev)	AACN (2008/2010 rev)
Head of bed elevated patient positioning	YES	YES	YES	YES	YES
Hand hygiene	YES	YES	YES	N/C	N/C
Oral hygiene	YES[b]	N/C	YES[b]	YES[b]	YES
Weaning protocol[a]	N/C	YES	YES	YES	N/C

Notes.
CDC (Centers for Disease Control and Prevention), IHI (Institute of Healthcare Improvement), ATS (American Thoracic Society), IDSA (Infectious Disease Society of America), AACN (American Association of Critical-care Nurses), SHEA (Society for Healthcarel Epidemiology of America). N/C : Not commented in the guideline. [a] Weaning protocols including daily sedative interruption/ spontaneous breathing trials [b]These recommendations are mentioned but without specifications. This table was created based on most recent information as of April 17th 2011.
(American Association of Critical-care Nurses, 2008, 2010; American Thoracic Society and Infectious Diseases Society of America, 2005; Institute of Healthcare Improvement, N/A-b; Tablan et al., 2004b)

Table 2.1. indicates that there are inconsistencies in guideline recommendations even for commonly practiced VAP prevention strategies. Only head of bed elevated positioning is consistently recommended across all guidelines. Oral hygiene is now recommended by IHI after May 2010 revision to include daily oral care with chlorhexidine to their "VAP Bundle." Now, the "VAP Bundle" consists of

elevation of head of the bed, the daily "sedation vacations" and an assessment of readiness to extubate, and peptic ulcer thrombosis prophylaxis (Institute of Healthcare Improvement, n/a-c). However, specifics of oral hygiene recommendations lack in many of these guidelines. The findings from this table is consistent with Lorente, Blot, and Rello's (2010) review of VAP prevention guidelines including the British Society for Antimicrobial Chemotherapy, the Canadian Critical Care Society, the European Respiratory Task Force, and the SHEA/IDSA guidelines.

With inconsistent guidelines and ever emerging new evidence, translation of evidence into clinical practice is a very complicated task. Leadership of critical care units must combine and adjust professional VAP prevention guidelines to create the best practice guidelines. For example, at University of California San Francisco Medical Center, "VAP Prevention Standard of Care" is based on four recommendations by the IHI (head of bed elevated patient positioning, daily assessment to wean, peptic ulcer prophylaxis, and deep vein thrombosis prophylaxis). Since the IHI guideline did not comprehensively address other nursing roles such as oral hygiene at the time this Standard of Care was created in 2005, they incorporated AACN recommendations of oral hygiene as well. Moreover, hand hygiene, suction supply maintenance, endotracheal tube management, and care related to patient transport were added to the standard of care as well to comprehensively address multiple components of ICU care (Schell-Chaple, Clinical Nurse Specialist at UCSF Medical Center, personal communication, July 1, 2009).

Provider Guideline Adherence

Reliable use of clinical guidelines improves quality and safety of care (Gurses et al., 2010; Larson, 2003; Sackett et al., 1996). However, despite the availability of

guidelines, health care providers do not routinely adhere to evidence-based recommendations (Cabana et al., 1999; Grol & Wensing, 2004; Titler & Everett, 2001). Grol and Gwimshaw (2003) estimate that 30-40% of patients do not receive care according to current scientific evidence, while 20% or more of the care provided is not needed or potentially even harmful. Furthermore, barriers contributing to the use of guidelines are rarely described. Of the few studies that examined VAP guideline adherence, use of guidelines have been less than optimal (Cason et al., 2007; Crunden et al., 2005; Heyland et al., 2002; Kaynar et al., 2007; Rello et al., 2002; Ricart et al., 2003). There is a lack of understanding of the relationships between providers' practice (VAP guideline adherence), contributing factors for varying adherence (why providers do or do not practice VAP prevention strategies), and patient outcomes (VAP rates).

Terminologies

Numerous names exist for clinical guidelines and adherence. This section describes the background and definitions used for this study.

Guidelines. In this study, clinical guidelines are defined as "systematically developed statements to assist practitioner and patient decisions about appropriate healthcare for specific clinical circumstances" (Institute of Medicine, 1994). A variety of guidelines exist, the content of which depends upon the type of user and application of the guideline (p. 38). Some researchers argue that practice guidelines are different from clinical pathways and protocols (Bergman, 1999). However, this study takes the view of the IOM statement (1994) that "pathway guidelines, or practice algorithms, boundary guideline, appropriateness criteria, and practice parameters" are variations

of practice guidelines. In this study, guidelines under study include institution- or unit-specific policies and procedures, standards of care, protocols, or other systematically developed documents based upon best current evidence and clinical experience that is adapted for local implementation (Sinuff, Cook, Giacomini, Heyland, & Dodek, 2007).

Adherence. Adherence is a multi-dimensional concept which encompasses psychosocial and behavioral components. In this research, adherence is defined as "supporting a clinical practice and making behavior changes accordingly" (Kaynar et al., 2007, p. 1688). However, only a few studies clearly define their use of adherence or compliance. Adherence is typically measured by the ratio of the number of specific actions taken given the number of opportunities (The Joint Commission, 2009). Adherence is typically considered to include the active decision making process of an individual, whereas compliance is passive (Lutfey & Wishner, 1999). Compliance has traditionally been used in patient treatment compliance literature and implies that following the standard/recommendation is applicable most of the time (i.e., hand hygiene). On the other hand, the act of adherence may not be appropriate at all times and involves more active decision making to follow/act upon/implement (i.e., sedation titration). Although there is this difference between adherence and compliance, adherence is used interchangably with compliance in previous literature (Francke, Smit, de Veer, & Mistiaen, 2008b).

Factors Affecting Provide Guideline Adherence

Systematic reviews. Many clinical guidelines exist to influence providers' behavioral change; however, there are consistent issues with slow implementation of

guidelines and difficulty with behavioral change (Cabana et al., 1999; Chastre et al., 1998; de Vos et al., 2010; Grol & Grimshaw, 2003; Rello et al., 2002; Ricart et al., 2003). In the PubMed search alone, the MeSH terms "guideline adherence," "practice guidelines," and "critical pathways," "critical care" resulted in 138 English publications in the period 2001-April 2011. Common topics identified from this search were sepsis, sedation, nutrition, central-lines related infections, tracheostomy/suction, and VAP. The following sections describe quantitative and qualitative studies that provided insights into comprehensive understanding of guideline adherence in general.

Francke and colleagues (2008a) published a meta-review of systematic literature reviews. These reviews were identified from a systematic search conducted in November 2006 for all relevant literature in multiple databases (PubMed, Cinahl, Cochrane library, Embase, NIVEL catalogues, and GIN-website) without restriction on language or year. Most of the literature reviews examined in this study evaluated physicians' guideline adherence to preventative and curative interventions. Only three studies examined nursing guideline adherence. Other than using Cabana and colleagues' work (1999) to categorize their findings, no other theoretical frameworks were explicitly mentioned. In conclusion, the following categories were identified as influencing guideline adherence: guideline characteristics, implementation strategies, professional autonomy, patient and environment characteristics.

De Vos et al. (2009) conducted another systematic review on implementing quality indicators. From the review of 21 studies, they perceived barriers for quality initiatives as unawareness, lack of credible data, lack of management support for

physicians, and lack of resources. Facilitating factors were supportive or collaborative management, administration support, use of detailed and credible feedback data.

New approaches. There are newer perspectives in studying guideline adherence. DeVos et al (2010) conducted a survey study with intensivists, ICU nurses, and managers. They found that behavior related constraints such as time constraint were most common across professions. For nurses, education was the most important facilitating factor. Consistent with previous findings, the need to examine contextual factors is reiterated.

Grol and Wensing (2004) proposed guideline adherence be examined at six levels: the innovation itself, the individual professional, the patient, the social context, the organizational context, and the economic and political context. As clinical guidelines are a type of innovation (Davis & Taylor-Vaisey, 1997; Grilli & Lomas, 1994), attributes of the guideline itself should also be examined.

Findings from a qualitative study by Gurses and colleagues (2008) are especially intriguing. They employed a systems approach "to understand guideline compliance as a consequence of the interactions between care providers across time, location, and patients, while simultaneously taking into account the physical and cultural components of an ICU as a system" (p. 351). They identified five ambiguities related to tasks, responsibilities, methods, expectations, and exceptions to explain non-compliance with guidelines, and provide recommendations to overcome these ambiguities. For example, they explain that *task ambiguity* occurs when there is a lack of clarity on when and which tasks need to be completed. Process-oriented information tools (i.e., posters in patient's room or one page check list on patient status) would be

helpful in addressing this ambiguity. *Responsibility and exception ambiguity* occurs when roles and responsibility of care providers, authority and accountability for non-compliance with guidelines are unclear. In this case, decision support tools to "deviate" from a particular guideline would be valuable. *Method ambiguity* occurs when availability and easy access of supplies, equipment, guidelines, and infection control personnel are hindered. Lastly, *expectation ambiguity* occurs when expectation of providers is not clear. Informing providers how compliance will be assessed at the individual and unit level, participatory education, and use of visual cues to indicate the status of patients would be helpful. This study illustrated how "ambiguity" was created by interactions between care providers and the ICU "system" which incorporates physical and cultural components of the unit.

Summary. Factors associated with guideline adherence have been studied, yet the answers are still unclear. There are novel approaches such as examining contextual factors, employing systems perspectives, and examining guideline attributes. These new approaches will be beneficial to understanding nurses' guideline adherence.

VAP Guideline Adherence Studies

This section will review guideline adherence studies specific to VAP prevention. Ten studies, published between 2001 and 2010 measured VAP guideline adherence rates or factors related to VAP guideline adherence (Bird et al., 2010; Cason et al., 2007; Christenson et al., 2006; Crunden et al., 2005; DuBose et al., 2008; Heyland et al., 2002; Kaynar et al., 2007; Manangan et al., 2000; Rello et al., 2002; Ricart et al., 2003). Synthesis of these studies was difficult because different types of VAP interventions were studied. Elevation of patients' head of bed was most

commonly studied, along with hand hygiene, daily assessment to wean, ventilator-circuit maintenance, and oral care. All studies reported adherence rates (percentage of adherence) for the individual VAP prevention recommendations. Most studies focused on provider adherence rates only, and rarely were both the provider adherence and patient outcome evaluated together. Pre-post studies (Bird et al., 2010; Crunden et al., 2005; DuBose et al., 2008) did examine patient outcomes such as VAP rate, ICU length of stay, and duration of mechanical ventilation as well as adherence rates. Most of the analyses were conducted with provider as the unit of analysis (Cason et al., 2007; DuBose et al., 2008; Kaynar et al., 2007; Ricart et al., 2003). None of the studies conducted unit-level or hospital-level analyses to examine the difference in adherence performance.

Nursing Adherence to VAP Interventions

In a study by Cason et al. (2007), only 56% of the respondents had an oral care protocol at their hospital. Provider adherence for oral care using a swab was 72% , while the frequency of chlorhexidine mouth rinse use was 20-73% (Cason et al., 2007; Ricart et al., 2003). Semi-recumbent patient positioning was practiced 35-86% of the time (Bird et al., 2010; Cason et al., 2007; DuBose et al., 2008; Kaynar et al., 2007; Ricart et al., 2003). Weaning trial was practiced for 29-98% of the patients (Bird et al., 2010; Christenson et al., 2006; Crunden et al., 2005; DuBose et al., 2008). And adherence for hand hygiene was 82-98% (Bird et al., 2010; Cason et al., 2007; Kaynar et al., 2007).

Table 2. 2. *Reported Adherence Rates by VAP Interventions*

Intervention	Adherence rates	Methodology	Barriers
Hand hygiene	82-98%*	Survey, Selected observation	Time, convenience, sink/antiseptic availability
Oral hygiene	Toothbrush 34% Oral Swab 72%	Survey, Observation	Lack of gold standard for assessment/practice, concern for tube dislogement. Patient condition.
Semi-recumbent patient positioning (>30)	35-86%	Survey, Observation	Concern for patient's discomfort, risk for pressure ulcers, or falls. Patient condition.
Weaning trial	29-98%	Chart review	Concern for self-extubation, pain, anxiety. Patient condition.

(Bird et al., 2010; Christenson et al., 2006; Crunden et al., 2005; DuBose et al., 2008; Kaynar et al., 2007; Ricart et al., 2003)

The study by Cason and colleagues (2007) was the most comprehensive and evaluated adherence to non-pharmacologic VAP prevention strategies. They surveyed 1,200 ICU nurses at a critical care nursing conference before the discussion of VAP-related topics. Cason and colleagues (2007) found extremely low compliance rates for VAP prevention strategies recommended by the CDC; only half of the respondents reported head of bed elevation position or having an oral hygiene protocol. They also measured specifics of oral hygiene practices and found that more nurses utilize oral swabbing which is known to be less effective than tooth brushing (Berry & Davidson, 2006). Only 34% of respondents reported practicing tooth brushing every 8-12 hours

as recommended by the Association of American Critical-care Nurses (2007). Surprisingly, 20% of nurses did not practice tooth brushing at all or rarely practiced.

Overall, VAP guideline adherence studies did not report reliability testing results or detailed survey instrument properties. Only Cason and colleagues (2007) reported some preliminary results of reliability testing (test-retest) and content validation. It was not clear from many articles how adherence was measured (such as by "Yes/No" question or by a Likert-type scale then dichotomized for analysis) (Kaynar et al., 2007; Rello et al., 2002; Ricart et al., 2003). In addition, none of the studies were explicit in their theoretical underpinnings, thus they did not contribute to testing a theory nor to creating a conceptual model.

Reasons for Non-Adherence

Three studies that examined barriers associated with VAP guideline adherence used multiple-choice questions and asked about *barriers* to VAP guideline adherence (Kaynar et al., 2007; Rello et al., 2002; Ricart et al., 2003). Barriers were limited to pre-selected reasons: disagreement with guideline recommendations; unavailability of supplies/resources; concern for adverse effect on the patient; nursing convenience; cost; patient discomfort; and a combination of these reasons. Other reasons, such as not being aware of the guidelines or lack of administrative support, were not included.

Professional priorities. Ricart and colleagues' (2003) examined nurses' reasons for non-adherence. They surveyed critical care nurses using Rello and colleagues' (2002) instrument for studying physicians. Researchers found that both nurses and physicians reported *lack of resources* and *disagreement* as top reasons for non-adherence. They also found that nurses have different reasons for not using VAP

prevention strategies compared to physicians. Nurses reported patient-related barriers such as concern for patient discomfort and fear of adverse consequences significantly more than physicians did ($p \leq 0.05$).

Effectiveness and adherence. When Ricart and colleagues (2003) compared their findings with Rello and colleagues'(2002) results, they found that effective interventions had higher physician adherence rates compared to nurses. Kaynar and colleagues' (2007) compared adherence to effective and ineffective strategies by surveying nurses and respiratory therapists. The compliance rate for effective strategies (i.e., adequate handwash, oral intubation, or continuous subglottic suctioning) were high at 83%, whereas ineffective strategies (e.g., routine change of ventilator circuit, and dedicated use of disposable suction catheters) were lower at 62% (Kaynar et al., 2007).

Summary

The following findings were identified from nurses' VAP guideline adherence studies. First, VAP adherence rates were measured against professional association guidelines which may not reflect the actual guidelines used in their practice settings. Also, most of the analyses were conducted with provider as a unit of analysis. Adherence rates for head of bed elevation position, sedation holiday, and oral hygiene guidelines varied from 20-98%. Reasons for non-adherence were limited because barrier choices were limited to six options predetermined by the researchers. Barrier factors such as quality of guidelines (complexity, compatibility, or relative advantage) or contextual factors were not evaluated other than resource availability such as role of the infection control department or specialists (intensivists and clinical nurse

specialists). Common reasons for non-adherence were lack of resources and disagreement. Nurses also indicated concern for patient comfort and safety. Unavailability of resources could largely be affected by work environment or contextual factors, thus further exploration is needed.

Conceptual Framework

Various theoretical perspectives are valuable when considering barriers to change and strategies to promote change (Grol & Grimshaw, 2003). Research in guideline adherence has included investigators and scientists in fields as diverse as communication, health behavior and health education, as well as systems analysis and management. For example, the theory of planned behavior has been used to guide hand hygiene behaviors (O'Boyle, Henly, & Larson, 2001). Behavioral modeling theory has been used to understand the variation in the intention to use the guideline (Smith et al., 2005).

There has been an increase in publications to capture the factors associated with guideline adherence or quality indicators (Abbott, Dremsa, Stewart, Mark, & Swift, 2006; Grol & Wensing, 2004; Gurses et al., 2010). Of note, Gurses et al. (2010) provided the most comprehensive list of conceptual frameworks that may help explain various factors associated with guideline compliance. Included were theory of diffusion of innovation, theory of organizational change manager, PRECEDE (predisposing, reinforcing, and enabling constructs in educational aiagnosis and education Model) model, TRIP (translating research into practice) model, RE-AIM (reach, efficacy/effectiveness, adoption, implementation, and maintenance) model, and PRISM (the practical, robust implementation and sustainability) model, theory of

planned behavior, and promoting action on research implementation in health services model.

For this dissertation research, a conceptual framework was created based on the communication theory, "diffusion of innovation" by Everett Rogers and the theory of complex adaptive systems. These two theories were selected because of the potential capacity to explain and predict guideline adherence at multiple levels of the organization. In this section, terminology related to guideline adherence study is explained, then the proposed conceptual model is presented.

Diffusion of Innovation Theory

Everett M. Rogers' diffusion of innovation (DoI) theory is the most frequently cited theory in the guideline adherence literature (Cabana et al., 1999; Davis & Taylor-Vaisey, 1997; Grilli & Lomas, 1994; Grol & Grimshaw, 2003; Hader et al., 2007; Harting, Rutten, Rutten, & Kremers, 2009). DoI theory is a macro theory comprised of many concepts and theoretical frameworks used to better understand diffusion of innovation. This theoretical framework is innovation-seeking, meaning that the assumption is that change is better than previous practices. Rogers (1995) provides many insightful perspectives about innovation-decision process, generation of innovations, adopter categories, diffusion networks, the change agent, and consequences of innovations. Frequently cited aspects of DoI theory are concept of diffusion of innovation and attributes of innovation (Berwick, 2003; Grilli & Lomas, 1994; Titler & Everett, 2001). The proposed conceptual framework incorporates these two aspects.

Application to guideline adherence studies. A clinical guideline is a type of innovation which is expected to be communicated to clinicians and used in their practice. Thus, DoI theory can guide the understanding of the diffusion processes (Rogers, E. M., 1995). Grilli and Lomas (1994) conducted the first systematic literature review on guideline adherence using Rogers' framework for diffusion characteristics, complexity, trialability, observability, and complexity. Later, Davis and Taylor-Vaisey (1997) conducted a systematic review of adherence studies guided by Rogers' theory. Their review included RCTs and other studies that objectively measured provider or patient outcomes associated with guideline implementation. They reported comprehensive categories of non-educational variables affecting the adoption of clinical guidelines. These include: qualities of guidelines or practice change, characteristics of healthcare professional, characteristics of practice setting, incentives (legal, financial, other), regulation, and patient factors. Lastly, Cabana and colleagues (1999) conducted a comprehensive literature review (1966-1998) with a focus on provider characteristics and barriers to adoption of guidelines that are amenable to change by intervention. Based on previous works (Davis & Taylor-Vaisey, 1997; Grilli & Lomas, 1994), they created a conceptual framework for their findings (Figure 1), which is frequently cited (Francke et al., 2008b; Grol & Grimshaw, 2003; Hader et al., 2007; Larson, Quiros, & Lin, 2007). The hallmark for their findings was that Cabana and colleagues (1999) comprehensively described seven barriers that providers encounter from behavioral perspectives. Barriers identified were lack of familiarity, lack of awareness, lack of agreement, lack of outcome expectancy, lack of self-efficacy, lack of motivation, and external barriers.

DoI model has been used to provide a framework for evidence-based practices in nursing (Titler, 2007). Titler and Everett (2001) created a conceptual model and explained that diffusion of innovation is influenced by the nature of the innovation (such as evidence-based practice guidelines), and the manners and processes in which it is communicated to members (communication process) of a social system (i.e., nurses or physicians in healthcare organization, critical care unit).

Theory of Complex Adaptive System

The theory of complex adaptive systems (CAS) originated from systems theory. The traditional systems theory prevalent in 1960s and 1970's considered systems as closed and linear (Begun, Zimmerman, & Dooley, 2003). In healthcare, traditional systems perspectives have been frequently cited in patient safety literature (Institute of Medicine, 2000, 2001, 2004). In the most commonly cited reference, "Crossing the quality chasm" (Institute of Medicine, 2001), CAS is proposed as a new framework for understanding healthcare organizations. CAS is unique for its view of the organization as a non-linear and open system (Begun et al., 2003).

Plsek (2001) is introduced CAS into healthcare organizational research. CAS is defined as "a collection of individual agents with freedom to act in ways that are not always totally predictable, and whose actions are interconnected such that one agent's actions changes the context for other agents" (Plsek, 2001, p. 326). He explains that healthcare is comprised of microsystems like clinics or units, and macrosystems such as a hospital in a community. He argues that unlike traditional systems, healthcare systems have the ability to respond to stimuli in many different and unpredictable

ways, therefore CAS may provide insights into the complexity of change in clinical settings.

In a concept analysis paper by Holden (2005), the premise of CAS is explained as follows: independent agents (*users*) can have changing roles (*co-evolution*), and they adapt as the CAS evolves and the environment changes. In this process, interconnections are the key for learning, adaptation, and co-evolution. Also, this process proceeds in a manner of self-organization.

Application to guideline adherence studies. A study by Gurses and colleagues (2008) is one of the few published guideline adherence research studies that uses the systems perspective approach that is influenced by CAS theoretical frameworks. They conducted a well structured qualitative study of 20 semi-structured interviews and used the concept of ambiguity to explain non-compliance. They identified system ambiguity as "uncertainty or vagueness that may prevent the system from achieving its purpose" (p.353). Also, they identified five types of ambiguities: task, expectation, responsibility, method, and exception. (Their findings are explained in detail earlier in Chapter 2.)

CAS and DoI Theories to Explain VAP Guideline Adherence

CAS provides an alternative perspective from traditional, linear, mechanistic relationship between cause and effect in implementing organizational interventions (Leykum et al., 2007). The addition of CAS to DoI theoretical frameworks in studying guideline adherence is beneficial for these reasons: First, CAS complements DoI by providing more attributes and guiding relationships among major components of DoI. For example, users' adaptation to the innovation and environment could be explained

as the process of self-organization and co-evolution. Second, CAS can explain why tailored guidelines are used in local organizations. This can be understood as self-organizing or co-evolution attributes of CAS. This aligns with progressive theorists of DoI theory which view re-invention as a positive process for adopters rather than deviation from diffusion of innovation (Rogers, E.M., 1995). Lastly, CAS perspective entails that all systems need to exist within larger ones and need to analyze relationships across levels of systems. Some studies conducted organizational level analysis (Grol & Grimshaw, 2003; Hysong, Best, & Pugh, 2007); however, more studies are needed to examine guideline adherence as a product of individual-unit-hospital interactions. In summary, DoI provides integral structural components of understanding the process of guideline adherence, and the theory of CAS supports the need to understand the relationships between those components.

Proposed Conceptual Framework for VAP Guideline Adherence Study

The proposed conceptual framework is used to evaluate the guideline adherence process of clinicians by employing relevant concepts from DoI theory and CAS theory (Figure 2.1.). Roger's DoI theory suggested three domains: guideline user, guideline, and contextual factors. *Guideline user* domain includes user's awareness of the guideline and attitudes to understand likelihood of adherence. Attitudes include agreement with the guideline content, role expectations, professional autonomy, outcome expectancy, self-efficacy, and motivation (Cabana et al., 1999; Larson, 2004). The locally tailored *guideline* represents the innovation of interest. Locally tailored guidelines include clinical pathways, policies and procedures, manuals, and standards. Qualities of the guideline such as relative advantage, compatibility, and complexity

(Rogers, E. M., 1995) are incorporated into the model. Observability and trialability were excluded since there is little freedom for clinicians to observe or trial before making the decision to adopt the guideline. Nurses are expected to follow guidelines/policies unless there are justifications for not doing so. *Contextual factors* represent structural factors chosen from the literature to be associated with guideline adherence. Contextual factors include hospital and unit characteristics, role expectations, communication method, and patient characteristics.

CAS perspective is illustrated by *likelihood of adherence* as an interaction between the user and the guideline. User, guideline, and organizational context will affect the likelihood of adherence. In other words, guidelines must be accepted by the guideline user and supported by the organizational context, otherwise, unknown factors could become barriers for the implementation processes. For example, if a hospital posits increasing VAP guideline adherence as organizational priority (organizational context), providers may be more aware of the guideline use (user characteristics) and guidelines may be simplified or modified to be more compatible with current practices (guideline characteristics). The main benefit of adding CAS into DoI model is that re-innovation and dynamic process of diffusion of innovation are taken into account.

Assumptions and Propositions

Assumptions and propositions are needed for the conceptual framework (Walker & Avant, 2005). Assumptions of this conceptual framework stem from DoI and CAS theories. One assumption is the pro-guideline bias, that guideline use is

considered good and therefore is encouraged. Another assumption is that users actively learn and adapt.

Two propositions stem from this conceptual framework. These are: 1) adherence is a dynamic process. Thus, extent of adherence for the individual provider will be predicted by characteristics of users and guidelines. And 2) organizational context is associated with users and guideline characteristics. The limitations of this conceptual model are that relationships could only be identified among the items that were measured. And it is not clear if the dynamic relationships hold true only for the individual perceptions of guideline and organizational context or if it is sensitive enough to structural factors such as staffing or standardized surveillance.

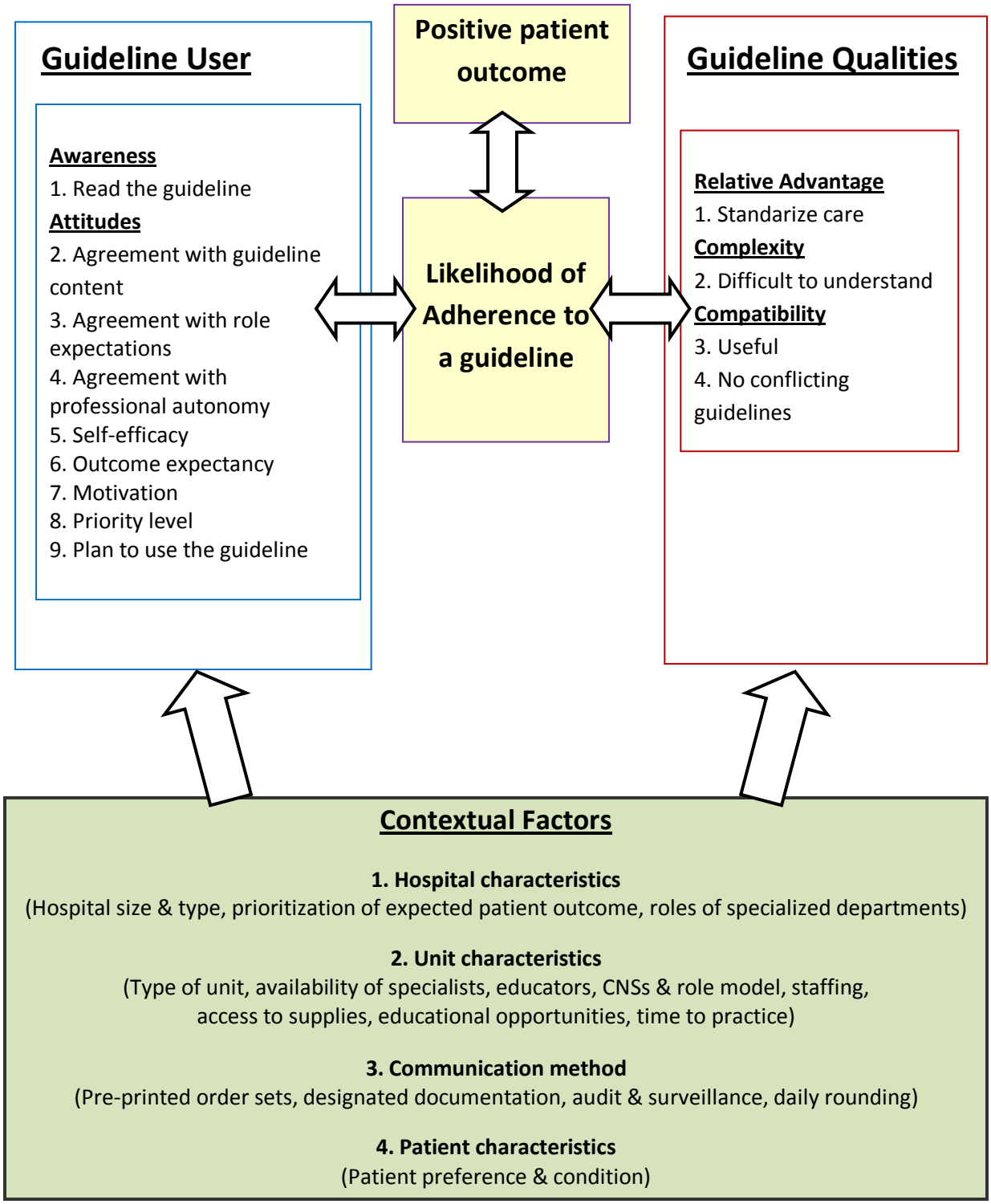
This conceptual framework was created to understand factors associated with nurses' VAP guideline adherence. Target users are critical care nurses and the guideline of interest is the VAP prevention guideline. Adherence is evaluated for hand hygiene, oral hygiene, semi-recumbent patient positioning (head of bed elevation), and daily assessment to wean patients from mechanical ventilation. Organizational context represents (a) work environment, (b) external forces affecting nurses' practice, and (c) characteristics of the guideline (involvement of the infection control department with VAP prevention, prioritization of VAP prevention, availability of audit and surveillance, etc).

Benefits of the Proposed Model

The proposed conceptual framework offers new perspectives and insights into guideline adherence research. First, this conceptual framework takes into consideration the attributes of the guideline as proposed in DoI. This builds on the study by Grill and

Lomas (1994) which evaluated guideline attributes of the innovation (complexity, trialability, and observability). Second, adherence is considered as product of an interaction between guideline user and guideline, which is affected by the organizational context. Third, this model will guide the analysis of guideline implementation at different levels of the healthcare organization, such as hospital, patient care unit, and individual nurse level. In summary, this model provided much needed theoretical validation to study organizational variables in guideline adherence research (Grol & Grimshaw, 2003). In other words, the traditional emphasis will be shifted away from individual psychology and behavior toward examining the interaction between the user and guideline in the organizational context. This novel approach will be an important and innovative contribution to understand guideline adherence.

Figure 2.1. *Relationships among Guideline-User, Guideline Qualities, and Contextual Factors*



CHAPTER 3

Research Methodology

The three specific aims of this study were to: 1) Describe VAP prevention guideline user factors, guideline qualities, and contextual factors associated with self-reported guideline adherence for each of four VAP interventions studied; 2) Test the relationships between these factors and VAP guideline adherence for each of VAP interventions; and 3) Explore the relationships between VAP guideline adherence and VAP incidences at the unit level.

This research study used the proposed conceptual framework to identify factors that potentially influence how clinicians use VAP prevention guidelines. The focus of this study was common non-pharmacologic VAP interventions: Oral hygiene (OH), head of bed elevated patient positioning (HOB), spontaneous breathing trial (SBT), and hand hygiene (HH). The guideline user characteristics (awareness and attitudes), qualities of clinical guidelines (relative advantage, complexity, and compatibility), and contextual factors (hospital and unit characteristics, communication methods, and patient characteristics) were examined.

This study obtained and analyzed survey data from critical care clinicians in Northern California to gain their perception of the VAP prevention guidelines and contextual factors affecting the guideline use. A total of six hypotheses were tested. For individual level analyses there were five hypotheses: A) OH adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher (higher score indicates presence of facilitators); B) HOB adherence score will be higher when guideline user, guideline quality, and contextual factor scores are

higher; C) SBT adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher; D) HH adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher; E) Overall VAP prevention guideline adherence rates will be higher when guideline user, guideline quality, and contextual factor scores are higher. For the unit level analysis, the sixth hypothesis was F) unit VAP rates will be lower when the mean adherence score of the unit is higher.

There have been two major changes since the inception of this study. First, the final sample consists of only ICU nurses. Respiratory therapists and physicians were excluded due to challenges associated with recruitment and variation in their professional responsibilities depending on the hospital. Second, eight hospitals were enrolled instead of the original plan of 27. This change was made because each hospital required institution specific Internal Review Board (IRB) permission for the key informant interviews and to collect the VAP data. This would have required significant resources. Thus, eight hospitals across the spectrum of hospital types and VAP outcomes were selected for this study. Of these, four were private not-for-profit hospitals, three were public local government owned hospitals, and one was an academic medical center.

Assumption for This Study

The assumption of this study is that it is beneficial when clinical care is guided by patient safety evidence reviewed by the experts in the field. Clinical practice guidelines are tools to assist this process. It is important, however, to underscore that guidelines are not meant to undermine clinicians' skills. In the author's view,

guideline adherence and professional autonomy should co-exist. With countless guidelines being used in the health-care setting, clinical knowledge and decision making skills are ever critical to understand the guideline recommendations and to know when it is appropriate to deviate from the guideline. In addition, evidence-based guidelines are not fault-proof; it is limited by the state of science and influenced by subjective interpretations. Thus, the potential of guidelines for resolving clinical questions should not be overstated (Natsch & van der Meer, 2003). Finally, there is a fine line between considering standardized clinical practice as professional accountability, and appreciating individual providers' unique contribution to patient care. As DeMonaco (2000) states in his editorial, standardization risks mediocrity and innovation could be halted. Thus, encouragement of guideline adherence must be done with caution. Moreover, it is more important to identify issues related to low adherence and avoid blindly aiming for 100% compliance.

Study Design

This study used a cross-sectional descriptive design with survey methodology to capture clinicians' perception of factors that influence VAP prevention guideline use. A cross-sectional survey was complemented by structured interviews with key infection control and critical care personnel.

Sample

Survey participants. Eight hospitals including 18 ICUs representing approximately 1,000 RNs were enrolled. Hospital enrollment focused on those hospitals within The Bay Area Patient Safety Collaboration (BEACON). With an intent to capture the wide range of VAP prevention practices, a representative from

BEACON assisted in identifying the hospitals with large numbers of mechanically ventilated patients (more than 1,000 ventilator days in 2009) and hospitals with low and high VAP rates without disclosing individual hospital's performance. RNs included full-time, part-time nurses, per-diem, and traveler nurses. Student nurses were excluded. Hospital 1 sample included RTs and MDs, however their enrollment was discontinued for Hospital 2-8 due to feasibility issues.

Interview participants. Interview requests were made via email or telephone (or in person) to critical care nurse educators (clinical nurse specialists or nurse managers) and infection control personnel. If CNS or nurse educators were not available, interviewees were selected based on recommendations by the nurse manager as the most knowledgeable about VAP prevention. Thus, depending on the unit, charge nurses and staff nurses who had worked on VAP prevention initiatives were interviewed. IRB approved questions were provided to the participants before the interview via email. Interview participants were consented using approved IRB forms prior to the interview. A maximum 1 hour interview took place at the interviewee's choice of location. A tape recorder was used with permission to ensure accurate data collection. Interviewees were compensated with $10 gift cards at the close of the interview. The critical care unit interview consisted of structured questions about unit organizational characteristics and VAP prevention materials and programs.

The directors of infection control were identified for each hospital and interviewed as well. The interview questions consisted of the following: VAP prevention related activities, patient characteristics of de-identified VAP cases,

number of VAP cases, and total number of the days that patients used mechanical ventilation at each of the ICUs for the most recent year.

Data Collection Procedure

The study was conducted at eight hospitals in Northern California. The "P-VAP Survey" was first distributed at an academic medical center in Northern California June 16th, 2010 to July 7th, 2010. The plan was to conduct a preliminary analysis of feasibility and instrument reliability testing before the larger scale distribution. Subsequent data collection occurred from November 23rd, 2010 to April 11th, 2011.

The author distributed surveys to RNs working in all types of adult ICUs (medical-surgical, neurological, cardiac, burn, trauma, medical-cardiac, and surgical). With the approval of the ICU managers, the author informed potential study participants about the study via fliers, staff meetings, emails, or in-person. Surveys were distributed in RN's mailboxes or placed in break rooms based on advices from the nurse managers or charge nurses. Participants returned the survey to a dedicated box located in the break rooms or nurse station; the box was checked weekly. Return of the survey indicated participant's consent to participate. The author gave out gift cards weekly through their work mailbox or through nurse managers. Participants at the first hospital received $3 gift cards and subsequent study participants received $5 gift cards. This survey was anonymous and approximately 1,000 RN surveys were distributed. Using an estimated response rate of 68% from a similar ICU clinician survey (Quiros, Lin, & Larson, 2007), approximately 680 responses were expected.

Hospital 1 served as a test study site. For Hospital 1 only, the author asked nurses to retake the survey for the test-retest reliability. Interests in retaking the survey were elicited via the last question in the survey. Re-test survey responses were matched with the previous responses using a personal identification code consisting of last four digits of their cell phone number and the first letter of their last name. Also for the Hospital 1 only, in addition to RNs, twelve ICU physicians (MDs) and sixty adult ICU respiratory therapists (RTs) were invited to participate in the survey. The "P-VAP Survey" wording was adapted to reflect each of the participating professions. Surveys were distributed via physicians' work mailbox in an envelope labeled with names and a $3 gift card. Director of critical care department sent email notifications to encourage MD participation. RTs were asked to participate in the survey similarly to RNs.

Human Subjects Protection

IRB approvals were obtained from each hospital before the data collection. Surveys were anonymous. Completion and return of the surveys implied consent to participate. Participants' names were voluntarily submitted separately from the survey responses in order to obtain the gift coupon. Interview participants were consented before the interview (Appendix 7). Interview participants' names were not kept with the interview notes. For the hospitals that kept detailed information on VAP cases, patient identifiable information was removed before the author obtained the VAP data.

Development of the "P-VAP" Survey

This research used a newly created survey instrument and interview guides. The development and overview of the tools are explained in the following sections. The sample surveys and interview guides are included in the appendix (Appendix 1-4).

Models for "P-VAP Survey"

The aim of the "P-VAP Survey" was to capture perceptions toward and factors surrounding four commonly used VAP non-pharmacologic interventions, OH, HOB, SBT, and HH. The "P-VAP Survey" was modeled after the "Attitudes Regarding Practice Guidelines" survey (Larson, 2004; Quiros et al., 2007). The permission to use the instrument was obtained from Dr. Larson. Larson's survey (2004) was based on six types of physicians' barriers for guideline adherence identified by Cabana and colleagues (1999). These barriers included were: lack of familiarity or awareness; lack of agreement with guidelines (general or specific); lack of outcome expectancy; lack of self-efficacy; lack of motivation; and external barriers such as patient or environmental factors. From exploratory factor analysis (principal component analysis and varimax rotation with Kaiser normalization), Quiros and colleagues (2007) identified three underlying factors for attitude towards guidelines (relevance, motivation, and outcome expectancy).

In addition to Larson's survey (2004), other oral hygiene practices were sought out to develop the "P-VAP Survey." Because oral hygiene policies and practices are known to vary by institution (Cason et al., 2007), efforts were made to capture current practices. Feider and Mitchell's "Oral Care Practice" survey instrument (2009) was the most comprehensive oral hygiene practice survey at the time. Unlike other oral hygiene surveys, Feider and Mitchell (2009) reported psychometrics of the instrument;

the content validity index score was 97.5%, interrater reliability scores were 0.86 and 0.83, test-retest reliability was 0.82-0.86. Questions from this survey addressing oral care tools used, frequency and duration of oral care, and oral cavity assessment were incorporated into the "P-VAP Survey." The permission to use the survey was obtained from Dr. Laura Feider.

Components of the 'P-VAP Survey"

The "P-VAP Survey" examined factors associated with OH, HOB, SBT, HH, and overall VAP guideline adherence (Appendix 2). SBT was chosen over "weaning protocol" to be more precise about the intervention of interest. Review of the literature and professional guidelines identified that "weaning" protocol consisted of various items and could have lead to confusion in the survey.

The survey aimed to measure four domains of interest: Guideline user attitudes, guideline quality, contextual factors, and guideline adherence (Figure 2.1.). Each of the VAP intervention sections followed the same pattern to address all four domains of interest (Appendix5). For example, a section would start with awareness and prioritization questions followed by a set of questions addressing user attitudes, guideline quality, and context surrounding VAP prevention. Each section concluded with a question about the guideline adherence. Possible facilitators and barriers were asked prior to the adherence questions to make adherence questions less threatening. Majority of scores were determined by the degree of perceived truth to the proposed statements in the survey ("true"=4 points, "not true" =1 points). Scores were assigned so that higher scores indicate positive attitude or facilitators of guideline adherence.

Negatively worded items were reverse scored so that higher score. Following sections explains variables studied in the survey.

Guideline adherence. One of the study outcomes is self-reported guideline adherence which was elucidated for each of the VAP interventions studied. The question for frequency for adherence were modeled after the Medical Outcomes Study (Rand Health, n/a). One question "I practiced ___ per guideline?" was asked for each OH, HOB, SBT, and HH. The response categories for the adherence question was "never," "some of the time," "most of the time," "always," and "not applicable."

Guideline user characteristics. *Guideline awareness* was a one item variable and respondents were asked how much they have read the guideline. *Attitudes* comprised eight items chosen for the following reasons. *Agreement with the guideline* is one of the concepts that were shown to be correlated with physician' guideline adherence (Rello et al., 2002). *Sense of responsibility* toward specific VAP interventions were created based on Gurses and colleagues' (2008) point of view about task ambiguities related to guideline adherence. *Self-efficacy* refers to the confidence that he/she can perform guideline recommendations (Ozer et al., 2004). *Priority* refers to level of importance for a specific intervention (Feider & Mitchell, 2009). *Plan to use this guideline* is the intention of the clinician to use the guideline when the appropriate opportunity arises (Pathman, Konrad, Freed, Freeman, & Koch, 1996). *Motivation/inertia of previous practice, outcome expectancy,* and *agreement with professional autonomy* were selected from Larson's survey (2004).

Guideline qualities. Guidelines were defined as any type of written statement that is distributed to ICU RN staff to provide recommendations for VAP preventions.

Examples include institution or unit specific policies and procedures, standards of care, protocols, or other systematically developed documents including pre-printed core MD orders in this study. Guideline quality items were selected based on innovation characteristics by Rogers (1995). Guideline quality indicators are the *complexity* of the guideline (easy to understand the guideline?), *compatibility* of the guideline with the clinical practice (practical to use?), and if there's any *conflicts* with the use of the guideline.

Contextual factors. Contextual factors surrounding VAP prevention are expected to influence the guideline adherence. Variables examined are hospital and unit characteristics, communication method, and patient characteristics. These items were selected based on the literature review. Following questions were asked to in the survey to capture contextual factors: (a) VAP is a *priority* at my hospital, (b) I had adequate *education* on VAP prevention, (c) role *of infection control department* had been important in VAP prevention, (d) I know *who to ask* if I have VAP related questions, (e) *pre-printed orders* help me do VAP prevention in the right way, (f) *designated documentation* makes me more conscious of VAP prevention, and (g) knowing that I'll be *audited* makes me do VAP prevention as recommended.

Reliability and Validity of "P-VAP Survey"

The surveys items were mostly rated with a four-point Likert-scale. Response options for questions about possible predictors were "true" to "not true," and response options regarding the guideline adherence were "never" to "always." One of the most unique qualities of the "P-VAP Survey" is that knowledge, attitudes, and adherence is measured against the respondents' institutional guideline (policy or protocol) instead of professional guidelines.

Face and content validity were established through expert reviews including Dr. Cabana (content expert), Dr. Stewart (survey expert), and dissertation committee members (Dr. M. Blegen, Dr. E. Froelicher, and Dr. J. Mullan). In addition, eight graduate critical care nurses reviewed the survey. Based on the feedback, wording was modified, and some questions were deleted, resulting in 106 item survey (Appendix 1). The survey was revised again after examining the responses of Hospital 1. The final "P-VAP Survey" consisted of 93 items (Appendix 2).

The survey was first administered at the Hospital 1. Preliminary analyses were conducted with RN data to test survey reliability and validity, and to further improve the survey. One hundred twenty-two ICU nurses had participated from the Hospital 1 (43.5% response rate). Cronbach's coefficient alpha was calculated to provide estimates of internal consistency of the test (Nunnaly, 1994). Cronbach's alpha was calculated for the attitude scale for each VAP intervention. As this was an exploratory study, reliability coefficient of 0.50-0.80 was targeted (Switzer, Wisniewski, Belle, Dew, & Schultz, 1999). Furthermore, test-retest reliability was tested by Spearman's correlation statistic for the attitude scale for each of the VAP interventions. Twenty retest responses were obtained from RNs from Hospital 1. The attitude scale was compared between the original responses and the retest responses using Spearman's Rho correlations. The correlations were all significant: OH .843 ($p \leq .01$), HOB .489 ($p \leq .05$), SBT .684 ($p \leq .01$), and HH.582 ($p \leq .01$).

Exploratory factor analysis was conducted to identify the factor structure and nature of the latent factors (Kline, 1994) and to test for the construct validity. Guideline user attitudes for each of the VAP prevention strategies were entered into

the model to identify the structure of the measures. Exploratory factor analysis was conducted with principal axis extraction method and Promax with Kaiser Normalization. The number of factors was selected by Eigan values above 1 or by specifying the number of factors. Results of multiple analyses ended with no consistent factor matrix. However, the EFA lead to reorganization of the survey items so that it was easier for respondents to follow.

Based on the reliability and validity analyses and an examination of missing responses, the draft survey was revised. Now, the survey consists of fewer questions (93 items) and each VAP intervention section was separated into two parts (Appendix 2). The first part was about the intervention itself and the second part was about the specific guideline. This change was made because not all of the units were likely to have all the guidelines that were included in the survey. Also, questions were deleted or combined to lessen the responders' burden and to increase the response rate (Appendix 6). Questions were deleted when responses did not vary (i.e., patient load, work load, and duration of interventions). A question about motivation was eliminated due to low factor loading with other attitude questions in the exploratory factor analysis. Questions were combined to a single question with modified response categories when appropriate (i.e., my responsibility vs. shared responsibility, supply availability).

There were some changes in the questions about nurses' professional characteristics to obtain more accurate information (i.e, "*nursing* degree" rather than a "degree"). A question about liability was reworded to "accountability." Respondent's adherence to the specific guideline changed from "I provided ___ exactly per

policy/guideline?" to "I ___ per policy/guideline." The word "exactly" was excluded to decrease missing responses. A question about adherence of respondents' colleagues was reworded to be comparable with self-reported adherence. A single new item in addressed colleagues' level of priority to capture unit cultural norm.

Most questions remained from the original survey. When questions were modified, responses from the original survey were recoded to be comparable with responses from the revised survey. Thus Hospital 1 responses were included in the final analyses. Final analyses that do not include Hospital 1 data are noted.

At Hospital 1, physicians and respiratory therapists were also enrolled into the study. However, due to challenges associated with access and recruitment of non-nursing professions, they were excluded from data collection and thus will not be discussed in this dissertation.

Infection Control and Critical Care Unit Interviews

Interviews with infection control and critical care unit staff were conducted to obtain unit specific VAP guidelines, VAP rates, and capture VAP prevention activities (Appendix 3 and 4). The author conducted all the interviews to ensure consistent content and delivery of the interview questions.

VAP guidelines were defined as any type of written statement that is distributed to ICU RN staff to provide recommendations for VAP prevention. Interviewees were asked to provide written statements of policy and procedure, standard of care, MD orders, etc. that assist bedside nurses in practicing OH, HOB, SBT, and HH. Unofficial memo and daily goal sheets were also included as part of VAP guideline.

VAP rates were collected from the infection control interview. VAP was defined by CDC's criteria. This was consistent with all the participating hospitals as each reports VAP rates to the State of California through the CHART (California Hospital Assessment and Reporting Taskforce) program. The number of VAP cases and number of ventilator days for the most recent 12 months was obtained for each unit.

Data Analysis

Data analyses were conducted for each of the specific aims. Survey data were entered into the Excel spreadsheet by the author and the research assistant. Every other data entry was double checked to assure accuracy. Based on the data entry manual that was created, ambiguous responses and missing data were consistently and appropriately handled. Excel spreadsheet was then imported into PASW version 15 (formally known as SPSS) (Chicago, Illinois). Scores were assigned as following; higher score indicate positive attitude or facilitators of guideline adherence. Negatively worded questions were reversed before the scores were assigned. After the data were cleaned, descriptive analyses were conducted to evaluate distributional properties and identify logical inconsistencies. The level of significance was set high at $p \leq 0.05$ to broadly examine possible associations to reflect the exploratory nature of the study. PASW was used for most of the analyses. STATA version 10 (StataCorp., 2007) was used for multi-level analyses.

Analytical Strategies for Specific Aim 1

The first aim of the analyses was to describe the possible factors associated with guideline adherence for each of the VAP interventions. Descriptive statistics were

utilized to identify mean and frequency as well as distributions from survey responses. Analyses were conducted to identify frequency and scores for guideline adherence, user attitudes, quality of the VAP prevention guidelines, and perceptions of contextual factors. To allow for comparison across units and interventions, frequencies were calculated for the whole sample, as well for each unit.

A total of three scales and indices were created to represent each study domain. An *attitude scale* was created to represent guideline user attitudes. It was calculated as a mean of four Likert-scale questions: (a) agreement with the guideline content, (b) self-efficacy, (c) outcome expectancy, and (d) plan to use the guideline. The *guideline quality index* was created for each of the four VAP interventions (OH, HOB, SBT and HH) and was calculated as a mean of the following Likert-scale questions: (a) guideline is easy to understand, (b) guideline is practical, and (c) there are no conflicting guidelines. Lastly, *VAP context index* evaluated VAP prevention practice environment and was calculated as a mean of seven Likert-scale items: (a) VAP is a priority at my hospital, (b) I had adequate education on VAP prevention, (c) role of infection control department had been important in VAP prevention, (d) I know who to ask if I have VAP related questions, (e) pre-printed orders help me do VAP prevention in the right way, (f) designated documentation makes me more conscious of VAP prevention, and (g) knowing that I'll be audited makes me do VAP prevention as recommended. Cronbach alpha was calculated to examine the internal consistency of the attitude scale.

Analytical Strategies for Specific Aim 2

There were six hypotheses that explored the relationships between individual guideline adherence and guideline user, quality, and contextual factors. Possible predictors of guideline adherence were first identified by bi-variate analyses. Because of non-normal distribution of the adherence scores and predictor variables, correlations were calculated using Spearman's correlations.

After significant predictors were identified, inter-class correlations (ICC) were tested to examine the potential clustering of the individual nurses' response by unit. Multi-level regression analyses were performed when a clustering effect was identified, as determined by an ICC greater than 0.1 (Scariano, 1987). In selecting the prediction models, the following limitations were considered. First, the primary outcome of self-reported adherence had negatively skewed distribution as most of the respondents responded always or almost always adhere. Second, there were limitations in the statistical techniques for multi-level regression with continuous or ordinal data with skewed distribution with a cluster size of 10-30. Thus, dichotomization of the adherence outcome was considered. A benefit of dichotomized adherence would be that it will allow for comparison with published reports of guideline adherence. Also, clinicians are more familiar with odds ratios than regression coefficients. Generalized Estimating Equations and Poisson Regressions were also considered; however, these methods would require larger numbers of participants per sample clusters, and was therefore less appropriate for the current data (Bruce Cooper, Senior Biostatistician, Office of Research, UCSF School of Nursing, personal communication, May 2nd, 2011).

Multi-level logistic regressions were chosen for this study. This technique would incorporate the clustering effect of units if existent. STATA was used to conduct the multi-level logistic regression analyses instead of SPSS for more accurate estimation processes. Multi-level logistic regression models were created for each of the VAP interventions studied. Six predictors were included in the regression models: Attitude scale, awareness of the guideline, level of prioritization, guideline quality index, time availability, and VAP context index. Regression models were tested for the best fitting model by following procedures. First, models with all of the possible predictors were tested. Second, a variable with high p-value were excluded from the model to examine the difference in the model fit and odds ratios. P-values were used for this selection process to accommodate for continuous, ordinal, and dichotomous data. The goal was to achieve a model in which all the p-values were below .1. The significance level of $\leq .1$ was chosen for this exploratory analysis as significance level of <.05 may be too stringent and potentially exclude important variables (Hosmer & Lemeshow, 2000).

Analytical Strategies for Specific Aim 3

In order to address specific aim 3, individual data were aggregated to the unit level and correlated with unit VAP data. Multiple non-parametric correlations were tested to explore the relationship between unit mean guideline adherence scores and VAP rates. This is appropriate for analyzing 17 ICUs with extremely low VAP rates (0-3.2 incidences per 1,000 ventilator days). Based on Hosmer and Lemeshow (2000), significance level was set at .1 so as not to exclude potential relationships as this analysis was based on a small sample size.

CHAPTER 4

Results

The purpose of this dissertation research was to identify factors that affect how clinical guidelines are used for VAP prevention. The aims of this study were: (1) To describe guideline user factors, guideline qualities, and contextual factors associated with guideline adherence; (2) To test the relationships among these factors and guideline adherence rates; and (3) To explore the relationships between adherence rates and VAP occurrence.

This chapter will first describe the findings related to study participants, various types of VAP prevention guidelines, and prevalence of correct knowledge about these guidelines. The results for specific aim 1 focused on frequencies and distributions. For specific aim 2, the results of Spearman's correlations and multi-level logistic regression modeling will be presented. The correlations were used again for specific aim 3 to test the relationship between the guideline adherence and VAP rates at the unit level. Lastly, six hypotheses of this study will be evaluated in conjunction with the study findings.

Sample

Survey participants. Eight hospitals were enrolled into the study. Hospitals included four public, three private non-profit, and one academic hospital. Licensed bed sizes ranged from 271 to 574 beds. Of the 18 ICUs, nine were medical/surgical, three cardiac, two trauma, one medical/cardiology, one neurologic, one burn, and one surgical units. The size of the ICUs varied from 8 to 24 beds. In terms of the roles of the intensivists or ICU team, there were eleven "open ICUs," meaning an attending

MD with ICU admitting privileges can be the physician of record and provide direct ICU care (Treggiari et al., 2007), four "closed ICUs" (intensivist service has primary patient care responsibilities), and three "mixed ICUs" where the role of intensivists were dictated by the type of service that the patient was on (Table 4.1.).

Table 4.1. *Survey Participants*

Hospital	Unit	Unit Type	ICU Type	Number of Beds[a]	Total RNs	Responses	Response (%)
Hospital1	A	Neurology	Open[b]	16	125	34	(27.2)
	B	Medical/Surgical	Open[b]	16	132	52	(39.4)
	C	Cardiac	Open[b]	8	88	36	(40.9)
Hospital2	D	Trauma	Closed	16	73	35	(47.9)
	E	Medical/Surgical	Open	14	57	33	(57.9)
Hospital 3	F	Cardiac	Open	24	73	38	(52.1)
	G	Medical/Surgical[c]	Open	8	27	16	(59.3)
Hospital 4	H	Trauma	Open	8	42	24	(57.1)
	I	Surgical	Open	8	40	19	(47.5)
	J	Medical/Cardiac	Closed	8	78	37	(47.4)
	K	Burn	Open	8	40	21	(52.5)
Hospital 5	L	Medical/Surgcal[c]	Mixed[d]	20	87	28	(32.2)
Hospital 6	M	Cardiac[c]	Mixed[d]	14	46	25	(54.3)
	N	MedicalSurgical[c]	Mixed[d]	21	86	42	(48.8)
	O	MedicalSurgical[c]	Open	8	49	21	(42.9)
	P	MedicalSurgical[c]	Closed	10	30	18	(60.0)
Hospital 7	Q	MedicalSurgical[c]	Closed	30	90	33	(36.7)
Hospital 8	R	MedicalSurgical[c]	Open	30	128	64	(50.0)
Total					**1291**	**576**	**(44.6)**

Note.
[a]Currently active beds. [b]The ICU team (intensivists) is privileged to write orders for ventilated patients.
[c]Combination of various medical and surgical services. [d]ICU team consult depends on the medical service.

Data from 576 ICU nurses were included in this study (44.6% response rate of 1,291 potential participants). The data were collected between June 16th 2010 and April 12th 2011. It is suspected that some per-diem nurses who work minimal hours at the unit did not participate because of lack of exposure to the study. Also, during the

study visit, couple of nurses told the researcher that they opted out from the survey because of lack of experience, as well as a nurse who refused to be in the survey because she thought the guidelines were nuisance.

The respondents were well-educated: 72.2% with a bachelor's or graduate degree and 39.2% with nursing specialty certification. The majority of these nurses held a Critical Care Registered Nurse certification granted by the American Association of Critical Care Nurses. Approximately 70% of nurses had more than 5 years of ICU experience; 69.3% of the nurses worked between 24 and 36 hours a week. Over 30% of nurses had worked in their current position for more than five years and took care of three or more mechanically ventilated patients in the last two weeks. Nurses' characteristics varied across units. For example, experience of taking care of mechanically ventilated patients varied by the unit: 19% of nurses from unit K (burn unit) reported not taking care of mechanically ventilated patients in the last two weeks, where as 50% of nurses from unit H from the same hospital reported taking care of more than six mechanically ventilated patients (Table 4.2).

Interview participants. A total of 15 interviews were conducted. Six directors of infection control met with the author to provide VAP rates of the participating hospitals. One hospital declined to participate in the infection control interview component, and one infection control department oversaw two hospitals under the same management. Nine critical care nurse educators, nurse managers, and charge nurses participated in critical care unit interviews. All of the interviews were conducted face to face. The average time for the interviews

was one hour. Through these interviews, VAP guidelines were obtained as well as information on how guidelines were implemented. Only two out of eight hospitals had readily available detailed records on VAP cases such as age and primary diagnosis. However, the number of VAP cases and total annual duration of mechanical ventilation was obtained from 17 units.

Table 4.2. *ICU Nurses' Education, Training, and Clinical Experience*

	N	Percentage (%)	Percentage Range by Unit[a] (n=18)(%)
Education (n=568)			
Associate or Diploma Degree	152	26.4	11.7-45.8
Bachelor's Degree	362	62.8	46.7-73.5
Graduate Degree	54	9.4	0-20
Specialty Certification (n=549)			
Critical Care Registered Nurse certification	186	32.3	12.5-56.5
Other specialty certification[b]	40	6.9	0-21.7
Hours Worked in a Week (n=570)			
Working less than 12 hours	13	2.3	0-7.9
Working 12≤24 hours	80	13.9	2.6-23.8
Working 24≤36 hours	399	69.3	29.7-82.4
Working more than 36 hours	78	13.5	0-43.2
ICU Experience (n=570)			
Working ≤1 year	21	3.7	0-15.2
Working 1 ≤ 5 years	149	25.9	6.3-41.7
Working 5 ≤ 10 years	150	26.1	10.7-37.5
Working 10 ≤ 20 years	129	22.4	12.5-43.8
Working more than 20 years	121	21.0	4.8-39.3
ICU Experience at This Unit (n=567)			
Working ≤1 year	45	7.9	0-14.3
Working 1 ≤ 5 years	225	39.3	21.1-66.7
Working 5 ≤ 10 years	126	22.0	5.6-44.4
Working 10 ≤ 20 years	100	17.5	0-35.7
Working > 20 years	71	12.4	0-33.3
Number of Mechanically Ventilated Patients Cared for in the Last 2 weeks (n=569)			
None	34	6.0	0-19
1-2 patients	163	28.6	8.8-64.7
3-5 patients	268	47.1	14.3-63.3
≥6 patients	104	18.3	0-50

Note.

[a] n=18 units [b] Specialty certifications includes 11 TNCC (Trauma Nursing Course Certified) , 7 CNS (Clinical Nurse Specialist), 8 ACLS (Advanced Cardiac Life Support) , and 12 other certifications. Many of these RNs had CCRN certifications as well.

Types of Institutional VAP Prevention Guidelines

All types of written documents used for VAP prevention were obtained through the interviews. Guidelines were defined for this study as "any type of written statement that is distributed to ICU RN staff to provide recommendations for VAP preventions" for this study. Table 4.3. lists various types of VAP prevention guidelines. Hospitals utilized "Standard of Care," "Unit Policy," "Protocol," "Manual," "MD Orders," and informal memos as VAP prevention guidelines. No hospital had a single guideline including all of the recommendations for oral hygiene (OH), head of bed elevated patient positioning (HOB), spontaneous breathing trial (SBT), and hand hygiene (HH). Thus, a guideline was considered a "VAP (Prevention) Guideline" (indicated by "V" in Table 4.3) for this study when at least two of four VAP interventions were included in the guideline.

Hospitals 1, 3, 6 and 7 had the most comprehensive nursing guidelines for VAP prevention. The length of these guidelines ranged from one to eight pages. The guideline from Hospital 3 was the most comprehensive with the following items included: Expected outcomes, inclusion and exclusion criteria, assessment points, methodology (e.g., supplies and frequencies), rationale, and references. Hospital 5 was unique in that the closest thing to a VAP guideline was the "Attending Progress Notes/Daily Goal Sheet," which was completed daily and signed by MD. This sheet included a check box for "Vent Bundle followed." The actual component of the bundle was on the back of this note and recommended HOB and OH.

Table 4.3. *Overview of Institution Specific VAP Prevention Guidelines*

	Hosptal 1		Hospital 2		Hospital 3		Hospital 4		Hospital 5		Hospital 6			Hospital 7		Hospital 8	
Guideline Name	Ventilator-Associated Pneumonia (VAP) Prevention	SBT Protocol	VAP Prevention	SBT Protocol Orders	Management of Adult Patients Requiring Continuous Mechanical Ventilation	Management of the adult patient undergoing weaning from ventilator	Ventilator Management Protocol	Oral Care for Intubated, Trached, or Altered Mental Status Patient	Attending Progress Note/Daily Goals	Oral Care	Management of Ventilated (Mechanically) Patient-Adult	Oral Cre for Critically Ill Patients	Respiratory Driven Weaning Protocol	Practices of Care for the Mechanically Ventilated Patients	(Admission order)	Ventilator Bundle	SBT MD order
VAP Guideline Type	Nursing standard of care (V)	ICU protocol	Unofficial memo (V)	MD order	Nursing protocol (V)	Nursing protocol	MD order (V)	Nursing procedure manual	Daily goal sheet (signed by MD)(V)	Unofficial memo (flier)	Nursing protocol (V)	Nursing protocol	RT protocol	Unit policy (V)	MD order	MD order (V)	MD order
Components	**HOB, OH & HH**	**SBT**	**HOB, OH, HH & SBT**	**SBT**	**HOB & OH**	**SBT**	**HOB & SBT**	**OH**	**HOB & OH**	**OH**	**HOB, OH & HH**	**OH**	**SBT**	**HOB & OH**	**OH**	**HOB & OH**	**SBT**
Head of Bed Elevation	**Yes** (30 degrees)	n/c	**Yes** (30 degrees)	n/c	**Yes** (30 degrees)	n/c	**Yes** (30-45 degrees)	n/c	**Yes**	n/a	**Yes** (30-45 degrees)	No	n/c	**Yes** (at least 30)	**Yes** (30 degress)	**Yes** (30-45 degrees)	n/c
Oral hygiene	**Yes**	n/c	**Yes**	n/c	**Yes**	n/c	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	n/c	**Yes**	**Yes**	**Yes**	n/c
Oral swab/toothett frequency	q4-6hrs ((1400, 1800, (0200), 0600))	n/c	n/c	n/c	Yes ("oral care" q 4hrs)	n/c	No	q 4hrs (0100, 0500, 1300, 1700)	No	q 4hrs	q 2hrs & prn	q 2hrs & pm*	n/c	q 4hrs	q 4hrs with 1.5% hydrogen peroxide	No	n/c
Toothbrush frequency	q 12 (1000 & 2200)	n/c	Twice a shift	n/c	No	n/c	No	0900 & 2100	No	q 12hrs	am & pm	am & pm	n/c	am & hs	am & pm with toothpaste	q 4hrs	n/c
CHG frequency. (concentration)	No. (Uses 1.5% hydrogen peroxide)	n/c	No. (Uses 1.5% hydrogen peroxide)	n/c	Yes (0.12%). with swab q 12 hrs. Included in 24 hr kit.	n/c	No	No. (however, CHG is being used in practice)	No	Yes (0.12%). Need MD order. q 12 hrs with	No	No. (Uses 1.5% hydrogen peroxide)	n/c	Yes (0.12%). No frequency indicated. With toothbrush.	Yes (0.12%). No frequency indicated.	Yes (0.12%), Use 5ml q 12 hrs.	n/c
Spontaneous breathing trial	No	**Yes** (Used by both RN and RT)	No	**Yes** (Used by both RN and RT)	No	**Yes** (Used by RNs. Introduces various types of weaning processes. Refers to MD orders for specifications.)	No. Need separate orders.	No	No. "ICU Weaning Protocol" is being trialed	n/a	No	n/a	**Yes** (RT initiated protocol order. Treated as provider orders. Used by RNs & RTs)	No. RT dept. has "Weaning Guidelines." No MD\NP signature required. Not readily available for RNs to view.	No	No	**Yes** (Used by both RNs & RTs)
Hand hygiene	**Yes**	No	**Yes**	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No

NOTES:

V: VAP prevention guideline, OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, and HH: Hand hygiene.

CHG: Chlorhexidine

RN: Registered Nurse, RT: Respiratory Therapists, q:every, n/c: Not Commented

Three hospitals used MD orders to implement the VAP prevention recommendations. MD order at Hospital 4, called "Ventilator Management Protocol," just included recommendations for HOB and referred to the weaning protocol used by RTs. Oral care recommendations were not listed but were included in the nursing policy. On the other hand, Hospital 7 and 8 had a very comprehensive MD order set including not only HOB but also specifications for OH. This is significant for OH, as these MD orders were readily available to bedside nurses in the charts whereas nursing policies were usually online or separately located. Of note, Hospital 7 had both the comprehensive nursing policy for VAP as well as MD order.

Accessibility of Institutional VAP Prevention Guidelines

Guidelines were accessible to staff nurses in a variety of ways. Two hospitals were entirely paper based: paper charting and policies in the binder. Conversely, another two hospitals used electronic charting and clinical guidelines. The rest of the hospitals used some combination of paper and electronic documentation.

Contents of Institutional VAP Prevention Guidelines

Oral hygiene recommendations. OH was most commonly included as part of nursing standard of care. Two hospitals had a policy just on oral care of ICU patients. Recommended OH procedures varied greatly among hospitals. All of the hospitals had recommended frequency of oral hygiene, but the specifications differed from indicating specific times (e.g., 14:00, 18:00, 02:00, and 06:00), to times of day (e.g., "morning and night"). Use of tooth swab (sponge) and toothbrush were commonly recommended but the frequencies differed from using the swab every two hours

(Hospital 6) to twice a shift or every four to six hours. Toothbrush frequency was indicated in all hospitals except Hospital 3.

Use of chlorhexidine rinse varied across sites. Five hospitals incorporated chlorhexidine rinse as part of their standard care and three of the hospitals made the change to use chlorhexidine during late 2010. Hospital 8 was the only hospital that had been using chlorhexidine for more than 5 years. All five hospitals using chlorhexidine rinse used a "24 hour oral hygiene kit" which includes three to four toothswabs or toothbrushes, a suctioning kit, and bottles of 0.12 % chlorhexidine solution.

Head of bed elevation patient positioning recommendations. HOB was the only VAP intervention item that was consistently included in the VAP prevention guidelines. This may be due to the mandatory reporting of HOB to the State of California through CHART (California Hospital Assessment and Reporting Taskforce)(CHART, 2010). Four hospitals recommended 30 degrees while other recommended 30-45 degrees or 35 degrees.

Spontaneous breathing trial recommendations. Usually, SBT existed as a stand-alone guideline. Only five hospitals had SBT guidelines: two hospitals had SBT Protocol (pre-printed MD orders) (Hospital 2 and 8), one hospital had RT\RN shared SBT Policy (Hospital 1), one hospital had a nursing weaning policy which introduced various types of weaning processes (Hospital 3), and one hospital had "RT Driven Weaning Protocol" which included SBT and were processed as MD orders (Hospital 6). Thus, only survey responses from these five hospitals were used for analysis related to SBT in the later sections. Hospitals that did not have SBT protocol included Hospital 4 which had a pre-printed ventilator order that defined patients appropriate

for weaning but did not list specifications of the weaning process and MD orders were needed for SBT to occur. At Hospital 5, SBT protocol was still being developed and was not consistently implemented. At Hospital 7, RTs had department specific weaning guideline that included SBT components and lead SBT. RNs did not have access to this guideline unless requested.

Hand hygiene recommendations. HH was rarely mentioned as part of institutional VAP prevention guidelines. However, all of the hospitals had a separate HH guideline created by the infection control department. Access to these guidelines and education surrounding appropriate hand hygiene varied.

Summary. Institutional VAP prevention guidelines existed in many forms ranging from unit policy to MD orders. Also, the content of the guideline varied across hospitals. Head of bed elevation was the most consistent component of the VAP prevention guideline. Oral hygiene was also frequently included as a part of nursing standard of care but the recommended specific procedures differed across sites. Spontaneous breathing trial and hand hygiene recommendations were often not included as part of VAP prevention guideline.

Correct Knowledge of Institutional VAP Prevention Guidelines

The correct knowledge of the guideline varied across the interventions (Table 4.4). The recommended frequency of toothbrushing was every 12 hours for six hospitals (including "AM and PM," and "twice a day" recommendations). Hospital 3 did not have a specific frequency recommendation for toothbrushing and Hospital 8 recommended toothbrushing every 4 hours. Nurses indicated they provided toothbrushing consistent with their hospital guideline only 31% of the time. But

interestingly, 484 nurses (84% of the participants) who responded to the question actually brushed patients' teeth more frequently than recommended. However, 92 nurses did not answer this question and there was a discrepancy between what is recommended in the guideline and knowledge of recommended frequency.

For HOB, almost all of the respondents were aware of the correct intervention and there were only subtle variations among units for ≥30 degree patient head positioning practices (Table 4.4.). For HH, most of respondents knew to use water and soap for *Clostridium Difficile* precaution. The missing responses were minimal for HOB and HH knowledge questions. Nurses' knowledge of the guideline recommendations for SBT ventilator setting was not examined since only Hospital 1 had a nursing accessible guideline that included this information.

Table 4.4. *Correct Knowledge of Institutional VAP Prevention Guidelines*

VAP Intervention	Guideline Recommendations	N	Percentage Correct (%)	Range of Percentage Correct Across ICUs (%)
OH	Frequency of tooth brushing (every 4 or 12 hours depending on a hospital)[a]	484	31.1	5.4-47.8
HOB	Degree of head elevation ≥30 degrees	534	100	100
HH	Water and soap for *Clostridium Difficile* precaution[b]	411	99.8	96-100

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, and HH: Hand hygiene.
SBT was excluded since 7 hospitals did not have standardized ventilator setting for SBT.
a Hospital 3 did not have any tooth brushing frequency recommendations, thus excluded from the analysis. b Hospital 1 did not get this question. Thus not included. * p≤.05, **p≤.01

Results of Specific Aim 1

The following sections will first examine the self-reported guideline adherence for each VAP interventions studied: OH, HOB, SBT, and HH. Then, the possible predictors of guideline adherence categorized by the theoretical framework will be evaluated. The variables will be assessed in the following order: Guideline user characteristics, guideline qualities, and contextual factors.

Self-Reported Adherence

Adherence was measured by the question "I practiced ____ per guideline." Four-point Likert scale (4: Always, 3: Most of the time, 2: Sometimes, 1: Never) was used. Figure 4.1. illustrates the distribution of how nurses rated their guideline adherence behaviors. The distribution is skewed toward "Always" and "Most of the time" except for SBT. Because of this skewed distribution, adherence was dichotomized. When dichotomized, "Adherence" was specified as "4: Always" and "3: Most of the time" adhering. "Non-adherence" was specified as "2: Sometimes" and "1: Never" adhering.

Figure 4.1. *Percentage of Adherence by the VAP Intervention*

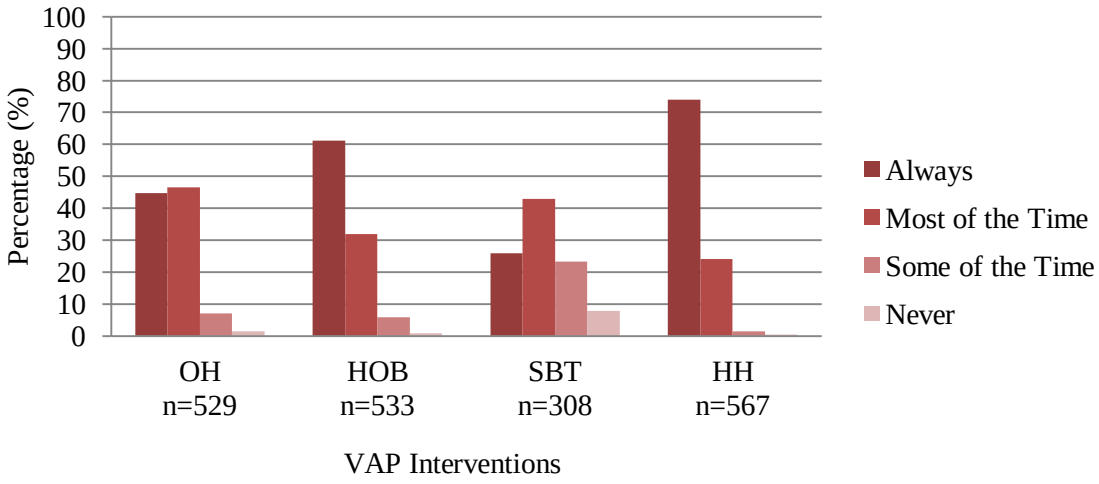


Table 4.3. represents the percentage of adherence when the scores were dichotomized. The highest adherence was for HH at 98.1%, followed by HOB at 93.1%, OH at 91.3%, and finally SBT at 68.8%. The percentage for the SBT was calculated using respondents from the only five hospitals with SBT guidelines. Also, compared to other interventions for which some of the units reported 100% adherence to such as OH or HOB, the highest adherence percentage for SBT was 85.7% within studied units. The widest variations across the units were for HOB and SBT (57.1-100.0% and 44.4-85.7%, respectively). OH and HOB were more consistently practiced according to the guideline across the units. Missing data for OH and HOB were close to 30 responses.

Table 4.5. *Percent Adherence by VAP Interventions*

VAP Intervention	N	Percentage of Adherence (%)	Range of Percentage Adherence Across ICUs (%)
OH	529	91.3	68.6-100.0
HOB	539	93.1	57.1-100.0
SBT[a]	308	68.8	44.4 - 85.7
HH	567	98.1	90.4-100.0
Overall VAP Adherence[b]	561	99.1	94.2-100.0

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, and HH: Hand hygiene. Adherence is when the responses is "4: Always adhering" and, "3: Most of the time adhering," on a 1-4 point response scale. [a]Only 5 hospitals (Hospitals 1,2,3,6, and 8) which had nursing SBT guidelines or MD SBT standard orders were included in the analyses. [b]For Hospitals 1,2,3,6, and 8, Overall VAP Adherence were calculated as a mean of HH, HOB, SBT, and HH guideline adherence scores. For Hospitals 4,5, and 7, because they did not have SBT guidelines to adhere to, Overall VAP Adherence were calculated with just OH, HOB, and HH guideline adherence scores.

Guideline User Characteristics

There were nine items that measured guideline user characteristics for each of the VAP intervention. These items were categorized to represent guideline user attitude scale, guideline awareness, level of prioritization, and sense of responsibility.

Attitude scale. A scale was created to represent guideline users' attitude toward a specific VAP intervention guideline. This scale was created by calculating the mean score from the following survey items: (a) agreement with the guideline content, (b) confidence in conducting the intervention, (c) outcome expectancy of the intervention, and (d) planned use of the guideline. These items all had Likert scale responses (4: True, 3: Somewhat true, 2: Slightly true, 1: Not true). Agreement with the statement (4: True) represented the most favorable attitude. Scores were dichotomized by grouping "4: True" and "3: Somewhat true" as "agreement" and "2: Slightly true" and "1: Not true" as "disagreement." The attitude scales were also

calculated as continuous variable using the mean of the four items for later analyses. The attitude scale was created for each of the VAP interventions studied. This scale was created only when there were at least two valid responses. Table 4.6. lists characteristics of components included in the attitude scale. Guideline users' attitudes were generally positive. Compared to range of percent agreement for adherence, there was less variability within units in regards to attitudes toward the guidelines.

Table. 4.6. *Percent Agreement for Attitude Scale Components*

VAP Intervention	Attitudes	N	Percent Agreement (%)	Range of Percent Agreement Across ICUs (%)
OH	Agreement with the guideline content	507	96.8	86.7-100.0
	Self-efficacy	536	98.5	94.1-100.0
	Plan to use the guideline	532	95.1	80.0-100.0
	Outcome expectancy	522	96.2	86.7-100.0
HOB	Agreement with the guideline content	529	99.8	97.1-100.0
	Self-efficacy	536	97.6	95.0-100.0
	Plan to use the guideline	532	99.4	95.2-100.0
	Outcome expectancy	525	99.2	94.1-100.0
SBT[a]	Agreement with the guideline content	306	97.4	85.7-100.0
	Self-efficacy	328	94.5	84.4-100.0
	Plan to use the guideline	336	95.8	90.0-100.0
	Outcome expectancy	321	95.0	86.7-100.0
HH	Agreement with the guideline content	564	99.5	95.8-100.0
	Self-efficacy	567	98.9	94.2-100.0
	Plan to use the guideline	565	98.4	87.5-100.0
	Outcome expectancy	550	97.3	89.5-100.0

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, and HH: Hand hygiene.
[a]Only 5 hospitals which had nursing SBT guidelines or MD SBT standard orders were included in the analyses.

The attitude scales, calculated as means of the items, also indicated that in general, most of the respondents had positive attitudes toward their VAP prevention guidelines (Table 4.7.). Out of a maximum score of four, HH was rated the highest at 3.91, followed by HOB at 3.90, then OH at 3.79, and lastly SBT at 3.69.

The internal consistency of the continuous scale was measured by calculating Cronbach alpha. Cronbach alphas for OH, HOB, and SBT were .61, .61, and .74 respectively, indicating acceptable reliability. Items in the HH attitude scale did not strongly correlate resulting in a Cronbach alpha of .28.

Table 4.7. *Cronbach Alphas and Mean Scores for Attitude Scales*

VAP Intervention	N	Cronbach Alpha	Mean Score	Range of Scores Across ICUs
OH Attitude Scale	389	.61	3.77	3.62-3.93
HOB Attitude Scale	391	.61	3.89	3.84-3.96
SBT Attitude Scale[a]	337	.74	3.69	3.54-3.78
HH Attitude Scale	407	.28	3.90	3.84-3.99
General Attitude Scale [b]	405	.63	3.82	3.76-3.89

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, and HH: Hand hygiene. The following items are included in the each of the attitude scale: (1) Agreement with the guideline content, (2) Self-efficacy, (3) Plan to use the guideline, and (4) Outcome expectancy. [a]Only 5 hospitals which had nursing SBT guidelines or MD SBT standard orders were included in the analyses. [b]General attitude scale was calculated as a mean of HH, HOB, SBT, and HH Attitude scale.

Guideline awareness. The awareness of the guideline was determined by the item "How much have you read the guideline?" (Table 4.8.). The corresponding response scale was: 4 all sections multiple times, 3 all sections at least once, 2 some sections, and 1 not at all. Responses were grouped as "aware" for "reading all sections of the guideline at least once or multiple times (4 and 3)," and "not aware" for "reading some sections or none of the guideline (2 and 1)." Of all the respondents,

51.1-78.5% reported reading all sections of the guidelines at least once for OH, HOB, SBT, and HH. Thus, depending on the intervention, close to half of the respondents have only read part of the guideline.

Table 4.8. *Percent Agreement for Guideline Awareness*

VAP Intervention	Guideline Awareness	N	Percentage Agreement (%)	Range of Percentage Agreement Across ICUs (%)
OH	Read all sections of the guideline at least once	521	64.5	40.0-82.4
HOB	Read all sections of the guideline at least once	521	55.1	35.5-80.6
SBT[a]	Read all sections of the guideline at least once	305	51.1	14.6-100
HH	Read all sections of the guideline at least once	563	78.5	54.5-93.5

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, and HH: Hand hygiene. a Only Hospitals 1,2,3, 6, and 8 which had nursing SBT guidelines or MD SBT standard orders were included in the analyses. b This question was added after the preliminary analysis of Hospital 1 data. Thus, Hospital 1 is excluded from this sample. * $p \leq .05$, ** $p \leq .01$

The level of prioritization. The priority level of the intervention was measured by two items: (a) "How do you rate priority level of ___ ?" and (b) "How do other nurses' rate the priority level of ___?" The response choices were: 4 highest, 3 high, 2 moderate, and 1 low. Responses were grouped as "high priority" for "highest and high priority (4 and 3)" and "low priority" for "moderate and low priority (2 and 1)." HH and HOB were frequently rated (93.5-90.1%, respectively) as high or highest priority (Table 4.9.). On the contrary, only 79.7% considered OH and SBT as high or highest priority. The perspective of colleagues' practice was addressed in order to identify the practice norm of the unit. Respondents tended to rate their priority levels higher than their colleagues. This difference was most significant for OH: Close to 80%

considered OH as their high or highest priority but responded that only half of their colleagues rate the OH priority level as high as they did. Also, less than 80% of respondents answered this question about prioritization of their colleagues. Thus, a decision was made to use priority levels of respondents rather than their colleagues' in the bi-variate analysis.

Table 4.9. *Percent Agreement for Level of Prioritization*

VAP Intervention	Guideline User Characteristic	N	Percentage Agreement (%)	Range of Percentage Agreement Across ICUs (%)
OH	High or highest priority	521	79.7	63.9-94.4
	High or highest priority for my colleagues [b]	411	46.7	21.1-66.7
HOB	High or highest priority	568	90.1	84.8-96.4
	High or highest priority for my colleagues [b]	422	77.3	60.0-96.4
SBT[a]	High or highest priority	305	79.7	55.9-87.5
	High or highest priority for my colleagues	207	66.7	43.5-77.8
HH	High or highest priority	561	99.5	95.7-100.0
	High or highest priority for my colleagues [b]	445	93.5	84.8-96.4

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, and HH: Hand hygiene. a Only Hospitals 1,2,3, 6, and 8 which had nursing SBT guidelines or MD SBT standard orders were included in the analyses. b This question was added after the preliminary analysis of Hospital 1 data. Thus, Hospital 1 is excluded from this sample. * $p \leq .05$, ** $p \leq .01$

Role expectations. There were two questions aimed at measuring sense of role expectations: (a) I am accountable to practice ___, and (b) ___ is RN responsibility (Table 4.10.). The accountability question had Likert scale responses (4: True, 3: Somewhat true, 2: Slightly true, 1: Not true). Scores were dichotomized by grouping "4: True" and "3: Somewhat true" as "agreement" and "2: Slightly true" and "1: Not true" as "disagreement." The responsibility question had two possible responses: "RN

responsibility" or "RN and RT responsibility." Originally, there was a question about "liability," however due to the high missing responses; it was changed to "accountability" starting with Hospital 2 data collection. It was assumed that accountability would be a more appropriate term for nurses. With this change, there were fewer missing responses.

The percent agreement for the sense of accountability was higher than sense of nursing responsibility (82.4-99.5% vs. 9.1-66%). Of note, there is a policy at Hospital 7 which specifies that OH is shared between RN and RT. Thus, OH is provided alternatively every four hours by each of the professions. Alternatively, at Hospital 8, there is no policy related to the profession in charge of OH, but 100% nurses responded that OH is a shared responsibility. The largest gap existed for SBT (81% for accountability and 9% for responsibility).

Table 4.10. *Percentage Agreement for Role Expectations*

VAP Intervention	Guideline User Characteristics	N	Percentage Agreement (%)	Range of Agreement Across ICUs (%)
OH	Accountable to practice[b]	404	99.3	93.8-100.0
	RN responsibility[c]	523	66.0	0-100.0[d]
HOB	Accountable to practice[b]	416	99.5	94.4-100.0
	RN responsibility[c]	413	72.6	59.5-94.7
SBT[a]	Accountable to practice[b]	270	81.1	58.8-81.3
	RN responsibility[c]	286	9.1	0-25.0
HH	Accountable to practice[b]	436	99.5	94.4-100
	RN responsibility[c]	n/a	n/a	n/a

Note.

OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, HH: Hand hygiene. a Only 5 hospitals had SBT guidelines. bThis question is only provided for Hospital 2-8. c RN responsibility question was worded differently for Hospital 1, thus not included in the sample. [d] RN responsibility was omitted from HH is part of routine practice. [C]The response scale had two options: 1) RN responsibility 2) shared responsibility between RN and RT. * $p \leq .05$, ** $p \leq .01$

Guideline Quality

Guideline quality index. The guideline quality indices were created for the specific guideline and for the overall VAP guideline. Three questions addressed individual guideline quality: (a) Guideline is easy to understand (worded as "difficult to understand" in the survey and then reverse coded), (b) Guideline is practical to use, and (c) There are no conflicting guidelines (worded as "there are conflicting guidelines" and then reverse coded). All of the responses were reported in 4 point Likert scale (4: True, 3: Somewhat true, 2: Slightly true, 1: Not true). Both dichotomous agreement scores (agree=4 and 3, disagree=2 and 1) are reported. Table 4. 11. lists percent respondents' agreement with guideline quality index components.

Table 4.11. *Percent Agreement for Guideline Quality Index Components*

VAP Intervention	Guideline Characteristics	N	Percent Agreement (%)	Range of Percent Agreement Across ICUs (%)
OH	Easy to understand	491	86.6	72.2-100.0
	Practical to use	516	95.7	87.1-100.0
	No conflicting guidelines	421	84.8	71.4-100.0
HOB	Easy to understand	489	88.3	73.3-100.0
	Practical to use	516	97.7	91.4-100.0
	No conflicting guidelines	492	48.2	18.8 - 65.6
SBT[a]	Easy to understand	299	77.9	55.6 - 92.9
	Practical to use	301	93.4	71.4-100.0
	No conflicting guidelines	262	58.4	28.6-100.0
HH	Easy to understand	553	90.8	81.0-100.0
	Practical to use	561	97.7	84.3-100.0

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, and HH: Hand hygiene. [a]Only 5 hospitals which had nursing SBT guidelines or MD SBT standard orders were included in the analyses.

Individual guideline quality index scores, calculated as mean of the three items as a continuous score, were calculated only when there were at least 2 items to represent the index. The index scores were high except for SBT at 3.30 (Table 4.12.). Respondents indicated that OH, HOB, and HH guidelines were easy to understand, practical to use, and there were no conflicting guidelines.

Table 4.12. *Mean Guideline Quality Index Scores Across VAP Interventions*

Guideline Quality Characteristics	N	Mean Score	Range of Scores Across Units
OH Guideline Quality Index[a]	537	3.79	3.43-3.90
HOB Guideline Quality Index[a]	537	3.90	3.11-3.72
SBT Guideline Quality Index [ab]	302	3.30	2.76-3.63
HH Guideline Quality Index[a]	567	3.91	3.56-4.00

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, HH: Hand hygiene.[a] Possible scores range 1-4 (4=facilitating quality). [a] Guideline quality index includes 1) Practical, 2) Easy to understand, 3) No conflicting guidelines.[b]Only 5 hospitals which had SBT guidelines or were included in the analyses. * $p \leq .05$, ** $p \leq .01$

Attitudes toward overall VAP guideline. In addition to guideline quality index, attitudes toward overall VAP guideline were measured. The following questions were asked: "VAP Prevention Policy/Guideline" (a) does not interfere with my professional autonomy (reverse coded), (b) helpful in practice, and (c) decrease variations of care? These three questions were asked only once in regards to their overall VAP prevention policy/guideline. All of these questions had 4-point Likert scale response choices (4: True, 3: Somewhat true, 2: Slightly true, 1: Not true). Responses were dichotomized to obtain percent agreement (agree=4 and 3, disagree=2 and 1).

Attitudes toward overall VAP guideline were positive and many considered VAP guidelines to be helpful (97%) and decrease inappropriate variation in care

(91%). However, only 83% of nurses agreed that guidelines do not interfere with professional autonomy.

Table 4.13. *Percent Agreement for Attitudes toward Overall VAP Guideline*

Attitudes Toward Overall VAP Guideline	N	Percent Agreement (%)	Range of Agreement Across ICUs (%)
VAP Guideline does not interfere with my professional autonomy	575	82.8	50.0- 95.2
VAP Guideline is helpful in my practice	539	96.8	88.5-100.0
VAP Guideline will decrease inappropriate variation of care	541	90.8	81.0-100.0

Contextual Factors

Context for individual interventions. Contextual factors were specified for the individual VAP interventions and also for overall VAP prevention. Contextual questions addressing the individual VAP interventions included: (a) Having enough time to practice, (b) Supplies are readily available at bedside, (c) Patient condition or preference does not contradict the guideline.

Less than half of the nurses responded that they had enough time to do oral care (Table 4.14.). This was much lower than the percentage of people who reported feeling short of time for HH, HOB, or SBT. Only 70% of nurses felt that supplies were readily available for OH.

Nurses were asked to estimate how much patient preference or conditions affected their VAP prevention practices. Unfortunately 23-35% of survey participants

did not answer this question. Depending on the VAP intervention studied, 51% responded that patient factors affected the SBT practice. The patient influences were slightly different for OH and HOB as the majority of respondents reported not being influenced by patient condition or preference (34-37% reported being influenced). The patient condition and preference factor item was excluded from further analyses due to high missing data.

Table. 4.14. *Percent Agreement for Contexts of Individual VAP Preventions*

Contextual Factor	N	Percentage Agreement (%)	Range of Agreement Across ICUs (%)
OH			
Have time	526	42.2	15.9- 65.6
Toothbrush, toothswab, flashlight, and toothpaste are at bedside	519	69.6	45.2- 88.9
Patient preference or conditions do not contradict[b]	433	63.5	29.4- 88.9
HOB			
Have time	531	83.2	92.9-100.0
Patient preference or conditions do not contradict[b]	442	65.4	44.4- 84.2
SBT[a]			
Have time	286	71.0	50.0- 85.7
Patient preference or conditions do not contradict[b]	269	49.4	35.0- 62.5
HH			
Have time	564	80.1	63.6- 93.8
Sink, soap, and alcohol gel are readily available	531	97.7	86.3-100.0

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, HH: Hand hygiene.
[a]Only 5 hospitals which had SBT guidelines were included in the analyses. [b]The patient condition question was reworded after the preliminary analysis of Hospital 1. Thus, Hospital 1 was excluded from the sample.
* $p \leq .05$, ** $p \leq .01$

VAP Context Index

In addition to the contextual factors for each of the individual VAP interventions, overall VAP context index was calculated to capture the hospital-wide influence on VAP prevention (Table 4.15.). The VAP context index was calculated as a mean of the following seven questions with a 4-point Likert scale. The calculations were made when there were ≥4 items to represent the index. Included in the calculations were: (a) VAP is a priority at my hospital, (b) I had adequate education on VAP prevention, (c) The role of the infection control department has been important in VAP prevention, (d) I know who to ask if I have VAP related questions, (e) pre-printed orders help me do VAP prevention in the right way, (f) designated documentation makes me more conscious of VAP prevention, and (g) knowing that I'll be audited makes me do VAP prevention as recommended. The mean VAP context index was 3.48 (± .52). These seven questions were considered to be more sensitive to capturing hospital and unit contextual characteristics rather than the context surrounding certain intervention.

Scores on each items were also dichotomized to indicate agree (4: True and 3: Somewhat true) and disagree (2: Slightly true and 1: Not true). Only 73 % of nurses agreed that practice audits change their guideline adherence behavior and 77% responded that pre-printed order sets helped them do the VAP prevention in the right way. The role of infection control department and opportunity for VAP education were perceived to adequate and almost all the nurses responded that VAP prevention is a priority in their hospitals.

The question about role models, termed as "I know who to ask when I have questions about VAP prevention practices," only 80% of respondents agreed with this statement. Also, the range across the units was wide (45.0-100.0%). A question about pre-printed order sets yielded least number of responses (n=511) because some of the units did not utilize pre-printed order sets. This also affected the range of agreement across units (45.0-100.0%).

Table 4.15. *Percentage Agreement for VAP Context Index Components*

Contextual Factor	N	Percent Agreement (%)	Range of Agreement Across ICUs (%)
VAP prevention is a priority in my hospital	575	99.1	96.9-100.0
I have had adequate education on VAP prevention	573	93.9	76.2-100.0
Role of Infection Control Dept. has been important in VAP prevention	530	88.3	74.1-100.0
I know who to ask when I have questions about VAP prevention practices	526	80.0	45.0-100.0
Preprinted order sets help me do VAP prevention in the right way	511	76.7	37.0-100.0
Designated documentation makes me more conscious of VAP prevention	558	91.6	84.2-100.0
Knowing that I may be audited makes me do VAP prevention practices as recommended	563	72.8	50.0- 90.5

Results of Specific Aim 2

This section describes the relationship between VAP guideline adherence and various possible predictors. First, the direction and strength of the bi-variate relationships between guideline adherence and the predictors were evaluated. Second, because of the possible clustering of individual nurses' responses at the unit level, inter-class correlations were tested for adherence to each VAP interventions. Last,

variables that were significant in bi-variate analyses were entered into appropriate regression models.

Nurses' Professional Characteristics and Guideline Adherence

Nurses' level of education, specialty certification, experience, and work hours.

First, relationships within nurses' professional characteristics were evaluated. Higher education (bachelor and graduate degrees) were negatively correlated with years of ICU experience (r = -.12). Specialty certification such as Critical Care Registered Nurse certification were positively correlated with ICU experience (r = .22) and hours worked in a week (r = .09).

Some of nurses' professional characteristics influenced the attitude toward and the adherence of guidelines; although the correlations were weak. In examining the relationships between nurses' professional characteristics and guideline adherence, findings were limited (Table. 4. 16). Level of education was negatively correlated with HH adherence (r = -. 09), specialty certifications or recent ventilation care experience were not correlated with any of the guideline adherence behavior, ICU experience was correlated with SBT adherence (r = .12), and hour worked in a week was correlated with OH adherence (r = .10). However, correlations among adherence to different VAP interventions were all significant indicating that nurses who adhere to certain interventions were associated with adhering to other VAP guidelines.

Table 4.16. *Correlation Matrix: Nurses' Professional Characteristics and Guideline Adherence*

	1	2	3	4	5	6	7	8	9
Nurses' Professional Characteristics									
1. Education[a]	1.00								
2. Specialty Certification[b]	.02	1.00							
3. Recent Ventilation Care Experience[c]	.04	.00	1.00						
4. Hours worked[d]	-.12*	.27**	-.06	1.00					
5. ICU experience[e]	.04	.09*	.05	.02	1.00				
Guideline Adherence									
6. OH adherence	.00	.06	.04	.04	.10*	1.00			
7. HOB adherence	-.04	-.02	.00	-.07	.01	.31**	1.00		
8. SBT adherence[f]	.10	.10	-.01	.12*	.03	.17**	.14**	1.00	
9. HH adherence	-.09*	-.01	-.01	.02	-.02	.29**	.31**	.15**	1.00

Note.
Spearman's correlations. OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, HH: Hand hygiene. [a] Education was dichotomized to "associate or diploma degrees" and "bachelor and graduate degrees." [b] Specialty certification was dichotomized to those with or without specialty certification. [c] Number of mechanically ventilated patients taken care for in the last 2 weeks. [d] Hours worked in a week. [e] Years of ICU exprience. [f] Only Hospitals 1,2,3, 6, and 8 which had nursing SBT guidelines or MD SBT standard orders were included in the analyses. Sample size 361-570. * $p \leq .05$, ** $p \leq .01$

VAP Context Index, Nurses' Professional Characteristics, Guideline Quality, and Adherence

The conceptual model suggested that contextual variables would be correlated with both guideline user characteristics and guideline quality. Thus, Table 4.17. focused on how VAP context index correlated with selected nurses' professional characteristics, guideline adherence, attitude scale, and guideline quality index. Overall VAP guideline adherence was calculated as mean of OH, HOB, SBT, and HH adherence. There were two measures of guideline qualities. Individual guideline quality index was calculated as a mean of three questions that addressed guideline characteristics (simplicity, compatibility, and existence of conflicting guidelines). Overall VAP guideline quality

index was a mean of three questions: “Guideline does not interfere with my professional practice,” “Guideline is helpful,” and “Guideline will decrease inappropriate variation in care.” VAP context index was calculated as a mean of seven questions that address hospital-level VAP prevention context such as prioritization of VAP prevention, role of infection control department, and education as discussed previously (see Table. 4.15.)

VAP context was correlated with ICU experience but not hours worked. VAP context index was significantly correlated with OH, HOB, SBT, and HH guideline adherence ($p \leq .01$) but not overall VAP guideline adherence. VAP context index was also significantly associated with all of attitude scales and guideline quality indices of the individual VAP intervention and overall scale/index.

Table 4. 17. also illustrates how overall VAP adherence correlates with overall VAP attitude scale ($r = .07$) , overall VAP guideline quality ($r = .10$), and VAP context index ($r = .05$). Compared to how individual VAP interventions correlated between adherence and attitude scale ($.31 < r < .36$) ($p \leq .01$) and guideline quality ($.12 < r < .29$) ($p \leq .01$), overall scores presented less significant correlations. Thus, further analyses focus on adherence to individual VAP interventions.

Table 4.17. *Correlation Matrix: Nurses' Professional Characteristics, Guideline Adherence, Attitude Scales, and Guideline Quality Indices*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. VAP context index	1.00																	
Nurses' professional characteristics																		
2. ICU experience	.11**	1.00																
3. Hours Worked	.04	.02	1.00															
Guideline adherence																		
4. OH adherence	.27**	.04	.10*	1.00														
5. HOB adherence	.18**	-.07	.01	.31**	1.00													
6. SBT adherence[a]	.15**	.12*	.03	.17**	.14**	1.00												
7. HH adherence	.24**	.02	-.02	.29**	.31**	.15**	1.00											
8. Overall VAP adherence[b]	.05	.03	-.09*	.10*	.19**	.13**	.20**	1.00										
Attitudes scales																		
9. OH attitude	.24**	.09*	.01	.32**	.14**	.14**	.16**	.04	1.00									
10. HOB attitude	.18**	-.03	-.01	.19**	.31**	.15**	.22**	.11*	.37**	1.00								
11. SBT attitude[a]	.14**	.00	-.06	.08	.20**	.36**	.16**	.07	.26**	.40**	1.00							
12. HH attitude	.11*	-.02	-.08	.15**	.14**	.04	.31**	.05	.32**	.29**	.17**	1.00						
13. Overall VAP attitude[b]	.21**	.01	-.04	.25**	.26**	.28**	.25**	.07	.71**	.60**	.18**	.50**	1.00					
Guideline quality indeces																		
14. OH guideline quality	.12**	.05	.02	.12**	.03	.03	.03	-.04	.35**	.23**	.18**	.09*	.31**	1.00				
15. HOB guideline quality	.11*	-.02	-.01	.12**	.29**	.1	.16**	.08	.20**	.27**	.16**	.13**	.26**	.36**	1.00			
16. SBT guideline quality[a]	.12*	.09	.03	.04	.13*	.25**	.10	.01	.13*	.15**	.38**	.07	.32**	.41**	.36**	1.00		
17. HH guideline quality	.11*	.02	-.01	.12**	.12**	.03	.24**	.04	.15**	.13**	.11*	.21**	.20**	.19**	.18**	.25**	1.00	
18. Overall VAP guideline quality[c]	.24**	.07	-.01	.14**	.16**	.18**	.18**	.10*	.25**	.20**	.26**	.15**	.29**	.24**	.19**	.27**	.20**	1.00

Note.

Spearman's correlations. OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, HH: Hand hygiene. Sample size 329-575. aOnly Hospitals 1,2,3, 6, and 8 which had nursing SBT guidelines or MD SBT standard orders were included in the analyses. bMean of OH, HOB, SBT, and HH scores. [c]Mean of 3 items: "guideline does not interfere with my professional practice," "guideline is helpful," and "guideline will decrease inappropriate variation of care." * p≤.05, **p≤.01

Guideline User Attitudes, Guideline Quality, and Contextual Factors

Oral hygiene. For oral hygiene, guideline adherence was significantly correlated with guideline awareness, attitude scale, level of prioritization, guideline quality index, VAP context index, time and supply availability (Table 4. 18.). Neither of the responsibility questions (sense of responsibility or accountability) did correlate with OH adherence. The most significant correlations were for the attitude scale, VAP context index, and having time.

Table 4.18. *Correlation Matrix: Oral Hygiene Guideline Adherence*

	1	2	3	4	5	6	7	8	9	10
1. Guideline adherence	1.00									
2. Guideline awareness	.17**	1.00								
3. Attitude scale	.32**	.11*	1.00							
4. Prioritization	.26**	.24*	.20**	1.00						
5. Responsibility	.01	.09*	-.04	.	1.00					
6. Accountability	-.03	-.03	-.01	.03	.06	1.00				
7. Guideline quality index	.12**	.17**	.34**	.08	.12**	.05	1.00			
8. VAP context index	.27**	.11**	.24**	.17**	.05	.04	.12**	1.00		
9. Time availability	.41**	.05	.24**	.33**	.07	.02	.24**	.17**	1.00	
10. Supply availability	.09*	.15**	.11**	.12**	-.01	.01	.05	.07	.09*	1.00

Note.
Sample size 386-568. * $p \leq .05$, ** $p \leq .01$

Head of bed elevated patient positioning. Correlations for HOB adherence were very similar to that of OH (Table 4.19.). The strongest correlations were for attitude scale, level of prioritization, guideline quality index, and time availability.

Table 4.19. *Correlation Matrix: Head of Bed Elevated Patient Positioning Guideline Adherence*

	1	2	3	4	5	6	7	8	9	10
1. Guideline adherence	1.00									
2. Guideline awareness	.09*	1.00								
3. Attitude scale	.31**	.12**	1.00							
4. Prioritization	.23**	.20**	.17**	1.00						
5. Responsibility	.03	-.01	.05	-.01	1.00					
6. Accountability	.03	.08	.04	.07	.01	1.00				
7. Guideline quality index	.29**	.10*	.27**	.12**	.02	.06	1.00			
8. VAP context index	.18**	.26**	.18**	.12**	-.08	.04	.11*	1.00		
9. Time availability	.23**	.09	.16**	.11*	.05	.02	.25**	.00	1.00	

Note.

Sample size 392-567.* p≤.05, **p≤.01

Spontaneous breathing trial. Correlations for SBT guideline adherence were significantly correlated with awareness, attitude scale, level of prioritization, accountability, guideline quality index, VAP context index, and time availability (Table 4.20.). Unlike OH and HOB, SBT guideline adherence was correlated with accountability.

Table 4.20. *Correlation Matrix: Spontaneous Breathing Trial Guideline Adherence*

	1	2	3	4	5	6	7	8	9
1. Guideline adherence	1.00								
2. Guideline awareness	.31**	1.00							
3. Attitude scale	.36**	.22**	1.00						
4. Prioritization	.33**	.17**	.39**	1.00					
5. Responsibility	.10	.06	.08	.11*	1.00				
6. Accountability	.14*	.07	.25**	.25**	.14**	1.00			
7. Guideline quality index	.25**	.20**	.38**	.22**	-.01	.09	1.00		
8. VAP context index	.15**	.07	.14**	.20**	.07	.08	.12*	1.00	
9. Time availability	.14**	.1	.10*	.12*	-.06	.11	.27**	.01	1.00

Note.

Sample size 254-513.* $p \leq .05$, ** $p \leq .01$

Hand hygiene. For HH, correlations between guideline adherence and possible predictors were similar with OH, HOB, and SBT guideline adherence (Table 4.21.). The most significant correlations were found for guideline quality index, VAP context index, and time availability. Supply availability which measures availability of sinks, soaps, and alcohol gels may not have significantly correlated with guideline adherence due to limited variability in the responses (93% reported supplies being readily available).

Table 4.21. *Correlation Matrix: Hand Hygiene Guideline Adherence*

	1	2	3	4	5	6	7	8	9
1. Guideline adherence	1.00								
2. Guideline awareness	.12**	1.00							
3. Attitude scale	.22**	.05	1.00						
4. Prioritization	.20**	.16**	.09*	1.00					
5. Accountability	.05	.09	-.03	.13**	1.00				
6. Guideline quality index	.24**	.06	.13**	.13**	-.03	1.00			
7. VAP context index	.24**	.18**	.18**	.14**	.00	.11*	1.00		
8. Time availability	.43**	.10*	.17**	.17**	.11*	.24**	.15**	1.00	
9. Supply availability	-.08	-.04	-.11*	-.10*	.01	-.16**	-.05	-.14**	1.00

Note.

Sample size 410-572. * p≤.05, **p≤.01

Variable Selection for the Regression Analyses

Variables with statistical significant relationships with guideline adherence in bi-variate analyses were further tested with regression analyses. The following six items were selected to be entered into the regression models to predict guideline adherence for each of the VAP interventions: Guideline awareness, attitude scale, prioritization, guideline quality index, VAP context index, and time availability. The education level of nurses, ICU experience, or hours worked per week were not included in the model because their correlations were often not significant.

Clustering at the unit level. Prior to choosing the appropriate regression model to understand the relationships between guideline adherence and guideline user, guideline quality, and contextual factors, possible inter-class correlations (ICC) must be evaluated. Because respondents are nested within their work units, it was expected

that there would be some clustering effect. ICCs were calculated for adherence scores to determine whether the clustering of responses occurred at the unit level and if it was large enough to impact the relationships of interest. Any ICC value of 0.1 or higher leads to a significantly increased type II error if inter-dependence of responses are not taken into account (Scariano, 1987). ICC statistics were as follows: OH .09, HOB .18, SBT .02, and HH .10 (For SBT, analyses were conducted only for hospitals that have the SBT guideline. Refer to Table 4.1.). Thus, significant clustering effects were present. And, a regression modeling that takes into account a multi-level sample was chosen. The outcome (guideline adherence) was dichotomized between "always and mostly adhere" and "sometimes and never adhere." With a dichotomous outcome and clustering, multi-level logistic regression models were determined to be appropriate for this testing (Glantz & Bryan, 2001; Raudenbush & Bryk, 2002). This statistical technique would incorporate clustering of individual nurses' responses at the unit level.

Multi-Level Logistic Regression Analyses

The following six factors were entered into the regression models: The attitude subscale, guideline awareness, prioritization of the intervention for self, guideline quality index for the individual interventions, availability of time, and general context index. Multiple models were tested in order to achieve the most parsimonious model with the best model fit. First, a full model with five predictors was tested. Second, the predictor with the largest p-value was eliminated for the next model. P-value instead of odds ratios were used due to scaling differences among the predictors (some were continuous and others ordinal). Third, the process continued until all of the predictors

were statistically significant. The significance level of ≤.1 was chosen for this exploratory analysis as significance level of <.05 may be too stringent and exclude important variables (Hosmer & Lemeshow, 2000). Fourth, log likelihood and Wald chi-squares were used to identify the best fitting model. Fifth, the significance level was set at <.05 to evaluate difference in the model fit.

Oral hygiene. Guideline user attitude scale (OR 3.89), time availability (OR 1.54), and VAP context index (OR 1.81) provided the most parsimonious model without jeopardizing the model fit (p≤ .1)(Table 4.22.). Thus, for OH, nurses with higher attitude scores were five times more likely odds to adhere to the guideline, close to twice more odds when they perceived to have more time and VAP context was adequate.

Table 4.22. *Model Testing for Factors associated with Oral Hygiene Guideline Adherence (n=448)*

	Full Model	Model 1	Model 2	Model 3	Model 4
Attitude scale					
OR (p value) (95% CI)	3.47 (p=.01) (1.39-8.63)	3.48 (p=.01) (1.40-8.66)	3.70 (p=.00) (1.53-8.91)	3.89 (p=.00) (1.64-9.21)	5.00 (p=.00) (2.20-11.30)
Guideline awarenss					
OR (p value) (95% CI)	1.30 (p=.34) (.75-2.26)	1.32 (p=.30) (.78-2.25)	1.35 (p=.26) (.80-2.28)		
Prioritization					
OR (p value) (95% CI)	1.07 (p=.85) (.56-2.05)				
Guideline quality index					
OR (p value) (95% CI)	1.20 (p=.61) (.60-2.39)	1.19 (p=62) (.60-2.38)			
Time availability					
OR (p value) (95% CI)	1.49 (p=.07) (.96-2.31)	1.52 (p=.05) (1.00-2.29)	1.54 (p=.04) (1.02-2.32)	1.54 (p=.04) (1.03-2.31)	1.58 (p=.03) (105-2.37)
VAP context index					
OR (p value) (95% CI)	1.77 (p=.12) (.86-3.65)	1.77 (p=.12) (.86-3.66)	1.78 (=.12) (.87-3.68)	1.81 (p=.10) (.89-3.71)	
Log likelihood	-98.88	-98.90	-99.02	-99.02	-100.91
Wald statistic	25.11	25.06	24.93	24.93	22.24

Log likehihood ratio .04-4.07 (p>.11)

Head of bed elevated patient position. The attitude scale (OR 4.75) and guideline quality index (OR 2.13) provided the most parsimonious model without jeopardizing the model fit (p≤.1)(Table 4.23.). Thus, for HOB, nurses who have

positive attitude and perceive to have good quality clinical guidelines had a higher odds of adhering to the guideline.

Table 4.23. *Model Testing for Factors Associated with Head of Bed Elevated Patient Positioning Guideline Adherence (n=482)*

	Full Model	Model 1	Model 2	Model 3	Model 4
Attitude scale					
OR (p value) (95% CI)	3.44 (p=.12) (.74-16.05)	3.43 (p=.12) (.74-16.02)	3.54 (p=.11) (.77-16.33)	3.97 (p=. 08) (.87-18.10)	4.75 (p=.04) (1.10-20.37)
Guideline awarenss					
OR (p value) (95% CI)	.88 (p=.61) (.54-1.44)	.88 (p=.61) (.54-1.44)			
Prioritization					
OR (p value) (95% CI)	1.76 (p=.20) (.74-4.22)	1.75 (p=.20) (.75-4.11)	1.71 (p=.21) (.73-3.99)	1.76 (p=.19) (.76-4.10)	
Guideline quality index					
OR (p value) (95% CI)	1.93 (p=.14) (.81-4.61)	1.91 (p=.13) (.82-4.46)	1.87 (p=.14) (.81-4.33)	1.97 (p=.11) (.86-4.55)	2.13 (p=.07) (.94-4.81)
Time availability					
OR (p value) (95% CI)	.98 (p=.94) (.61-1.57)				
VAP context index					
OR (p value) (95% CI)	1.68 (p=.20) (.77-3.68)	1.68 (p=.19) (.77-3.68)	1.62 (p=.22) (.75-3.51)		
Log likelihood	-91.59	-91.59	-91.72	-92.46	-93.35
Wald chi	12.82	12.82	12.75	11.46	10.12

Log likehihood ratio .01-3.52 (p>.18)

Spontaneous breathing trial. The attitude scale (OR 4.10) and the level of prioritit̀zation (OR 1.56) provided the most parsimonious model without jeopardizing the model fit ($p \leq .1$)(Table 4.24.). Thus, nurses who had better attitudes were four times higher odds of adhering to the guideline, and those who prioritize SBT are slightly more likely to adhere to the SBT guideline.

Table 4.24.
Model Testing for Factors Associated with Spontaneous Breathing Trial Guideline Adherence (n=317)

	Full Model	Model 1	Model 2	Model 3	Model 4
Attitude scale					
OR (p value) (95% CI)	4.14 (p=.00) (2.01-8.52)	4.21 (p=.00) (2.07-8.54)	4.20 (p=.00) (2.07-8.53)	4.01 (p=.00) (2.07-7.78)	4.10 (p=.00) (2.12=7.92)
Guideline awarenss					
OR (p value) (95% CI)	1.04 (p=.82) (.72-1.51)				
Prioritization					
OR (p value) (95% CI)	1.53 (p=.07) (.97-2.41)	1.53 (p=.06) (.98-2.42)	1.54 (p=.06) (.98-2.42)	1.54 (p=.06) (.98-2.41)	1.56 (p=.05) (.99-2.44)
Guideline quality index					
OR (p value) (95% CI)	.90 (p=.68) (.56-.1.46)	.91 (p=.69) (.56-1.47)	91 (p=.71) (.57-1.47)		
Time availability					
OR (p value) (95% CI)	1.03 (p=.82) (.79-1.36)	1.04 (p=.80) (.79-1.36)			
VAP context index					
OR (p value) (95% CI)	1.18 (p=.55) (.68-2.06)	1.18 (p=.55) (.68-2.06)	1.18 (p=.55) (.68-2.06)	1.17 (p=.57) (.68-2.03)	
Log likelihood	-167.33	-167.36	-167.39	-167.46	-167.62
Wald statistic	30.15	30.18	30.15	30.12	29.93

Log likelihood ratio .05-.57 (p>.56)

Hand hygiene. The attitude scale (OR 19.68), guideline awareness (OR .43) and having enough time (OR 2.11) provided the most parsimonious model without jeopardizing the model fit ($p \leq .1$)(Table 4.25.). Thus, nurses with positive attitudes

about the guideline are at 16 times higher odds to adhere to the HH guideline and those who perceived to have more time were twice as likely to adhere. However, when nurses were aware of the guideline content, they were less likely to report adherence to the guideline.

Table 4.25.
Model Testing for Factors associated with Hand Hygiene Guideline Adherence (n=540)

	Full Model	Model 1	Model 2	Model 3	Model 4
Attitude scale					
OR	15.65	19.68	19.68	28.45	16.41
(p value)	(p=.01)	(p=.01)	(p=.01)	(p=.00)	(p=.00)
(95% CI)	(1.76-138.99)	(2.28-170.18)	(2.28-170.17)	(3.52-230.14)	(2.46-109.39)
Guideline awarenss					
OR	.39	.39	.43		
(p value)	(p=.07)	(p=.07)	(p=.08)		
(95% CI)	(.14-1.06)	(.14-1.06)	(.16-1.11)		
Prioritization					
OR	1.95				
(p value)	(p=.37)				
(95% CI)	(.46-9.26)				
Guideline quality index					
OR	2.24	2.24			
(p value)	(p=.17)	(p=.17)			
(95% CI)	(.71-7.03)	(.71-7.03)			
Time availability					
OR	2.33	2.33	2.30	2.37	2.11
(p value)	(p=.01)	(p=.01)	(p=.01)	(p=.01)	(p=.02)
(95% CI)	(1.20-4.50)	(1.20-4.50)	(1.20-4.42)	(1.25-4.48)	(1.12-3.96)
VAP context index					
OR	3.36	3.36	3.57	3.52	
(p value)	(p=.05)	(p=.05)	(p=.03)	(p=.04)	
(95% CI)	(1.02-11.01)	(1.02-11.1)	(1.11-11.45)	(1.09-11.36)	
Log likelihood	-32.58	-32.97	-33.87	-35.63	-37.22
Wald chi	23.44	22.71	22.05	22.41	19.31

Log likelihood ratio .78-9.30 (p>.05)

Summary

The relationships between guideline adherence and predictors were different across the VAP interventions studied (Table 4.26.).

OH adherence scores were best predicted by the attitude scale, time availability, and VAP context index. The attitude scale was a mean score of four items: Agreement with the guideline content, self-efficacy, outcome expectancy, and decision to use the guideline. Time availability was a single item "sometimes I don't have time to provide ____ as recommended by the guideline" (reverse coded). VAP context index is a mean score of seven items about organizational priority, education, role of infection control department, designated charting, pre-printed order sets, audit, and role models. The odds of adherence increased close to four 4 times with higher attitude scale, and the odds of adherence increased close to 1.5 times when respondents perceived that they had adequate time for the oral care, or contexts surrounding VAP prevention was adequate.

HOB adherence scores were best predicted by the attitude scale and HOB guideline quality index. The guideline quality index is a mean score of degree of agreement on three items: guideline is easy to understand, practical to use, and there are no conflicting guidelines. The odds of adherence increased 2.13-4.75 times for higher attitude scale and guideline quality index.

SBT adherence scores were best predicted by the attitude scale and the level of prioritization. The level of prioritization was measured by a single item "How do you rate priority level of ___ ?" The odds of adherence increased 4.1 times with higher attitude scale score and increased by 1.5 times with higher priority level.

For HH, adherence scores were best predicted by the attitude scale, guideline awareness, availability of time, and VAP context. The guideline awareness was measured by a single item "How much have you read the guideline?" The availability

of time was measured by nurses' perception of having enough time to practice. VAP context is a mean score of seven items addressing organizational characteristics such as role of education and prioritization of the organization. The odds of adherence increased more than 19 times with higher attitude scale score, and the odds of adherence increased more than 2-3 times when respondents perceived to have enough time or VAP context index was adequate for HH. Awareness of the HH guideline did not increase the adherence but instead decreases the odds of adherence.

In conclusion, the attitude scale was the consistent predictor for four VAP interventions studied. Time availability and VAP context index were the second consistent predictor. The guideline quality increased the odds of adherence only for HOB, and the level of prioritization increased the odds only for SBT. Lastly, guideline awareness decreased the odds for HH adherence.

Table 4.26. *Selected Odds Ratios for OH, HOB, SBT, and HH Adherence*

	OH	HOB	SBT	HH
Attitude scale				
OR (p value)	3.89 (p=.00)	4.75 (p=.04)	4.10 (p=.00)	19.68 (p=.01)
Guideline awarenss				
OR (p value)				.43 (p=.08)
Prioritization				
OR (p value)			1.56 (p=.05)	
Guideline quality index				
OR (p value)		2.13 (p=.07)		
Time availability				
OR (p value)	1.54 (p=.04)			2.30 (p=.01)
VAP context index				
OR (p value)	1.81 (p=.10)			3.57 (p=.03)

The Results of Specific Aim 3

The aim of this section is to present patient care unit level analyses. First, the relationship between guideline adherence rates and VAP rates are analyzed. Second, the relationship between types of guidelines, adherence rates, and VAP rates are analyzed. A total of 18 patient care units are included in these analyses. Since the sample size is small, significance level is set liberally at $p \leq .1$ so as not to exclude any possible relationships.

Adherence Rates and VAP Occurrence

VAP incident rates were collected from 17 ICUs (Table 4.27.). One hospital declined to provide the data. For the most recent data collection year, the number of cases ranged from 0-6 and ventilator days ranged from 230-6,830. VAP rates ranged from 0-3.2 per 1,000 ventilator days. Eight of the units did not have a single case of

VAP in the last year. The number of ventilator days did not correlate with VAP incidence.

Table 4.27. *VAP Rates Across Units*

Unit	Unit Type	Patient Beds*	VAP Incidence (year)	Ventilator Days (year)	VAP Rates (Per 1000 ventilator days)
A	Neurology	16	6	2317	2.6
B	Medical/Surgical	16	6	3378	1.8
C	Cardiac	8	2	1839	1.1
D	Trauma	16	5	2434	2.1
E	Medical/Surgical	14	5	1549	3.2
F	Cardiac	24	1	1678	0.6
G	Medical/Surgical	8	0	366	0.0
H	Trauma	8	1	1602	0.6
I	Surgical	8	0	1076	0.0
J	Medical/Cardiac	8	0	2982	0.0
K	Burn	8	0	410	0.0
L	Medical/Surgical	20	n/a*	n/a*	n/a*
M	Cardiac	14	0	1230	0.0
N	Medical/Surgical	21	0	2059	0.0
O	Medical/Surgical	8	0	1091	0.0
P	Medical/Surgical	10	0	828	0.0
Q	Medical/Surgical	30	3	1991	1.5
R	Medical/Surgical	30	2	6830	0.3
Total			**25**	**31343**	

Notes.
** unable to obtain data*

Types of Guidelines and Adherence Rates

This study found that various types of guidelines were utilized as VAP prevention guidelines in the critical care units. Mainly, nursing policy (standards of care) and standard physician orders were used, depending on the VAP prevention studied (Table 4.3.). The correlations between types of guidelines and unit average guideline adherence and attitude scale were tested for OH, HOB, and SBT. HH policy was excluded in the analysis since only two of the hospitals mentioned hand hygiene as part of their VAP guideline. However, no significant correlations were found.

Possible Predictors of VAP Rates

Table 4.28. presents the correlations between VAP rates and possible predictors. Individual level predictors such as self-reported adherence and attitude scales were aggregated to the unit level by calculating the mean of individual nurses from that unit. Thus, findings were limited with a sample size of 17, but the following analyses provided some indication of possible factors affecting occurrence of VAP. The significance level was set at $p \leq .05$. The significance level of $p \leq .1$ was also identified to be inclusive of any possible relationships as this is an exploratory study using non-random sampling.

The correlation between VAP rates and guideline adherence for HOB was $r = -.52$ ($p \leq .05$). VAP rates were also significantly correlated with awareness of the SBT guideline (.75, $p \leq .01$) and quality of the OH guideline (.52, $p \leq .05$). When attitude scales were aggregated to the unit level, attitudes did not correlate with VAP rates. This finding was contrary to individual level analyses. Level of prioritization, guideline type, and time availability were excluded from this table because no significant relationships were identified.

Table. 4. 28. *Correlation Matrix: Unit VAP Rates, Guideline Adherence, Attitude Awareness, Attitude Scales, Guideline Quality Indices, and VAP Context Index*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. VAP rates	1.00																	
2. OH adherence	-.05	1.00																
3. HOB adherence	-.52*	.54*	1.00															
4. SBT adherence[a]	.15	.45	.15	1.00														
5. HH adherence	-.37	.54*	.64**	-.07	1.00													
6. OH awareness	.18	.15	.06	-.18	-.20	1.00												
7. HOB awareness	.05	.49*	.24	-.13	.18	.77**	1.00											
8. SBT awareness[a]	.75**	.18	-.39	.08	-.18	.20	.34	1.00										
9. HH awareness	.01	.15	.22	-.48	.13	.56*	.54*	.23	1.00.									
10. OH attitude scale	.04	.48*	.28	.16	.26	-.31	-.05	.23	-.01	1.00								
11. HOB attitude scale	.04	.39	.53*	-.15	.62**	-.04	.20	.03	.06	.41†	1.00							
12.HH attitude scale	-.10	.51*	.32	-.32	.44†	-.31	.06	.26	.11	.50*	.19	1.00						
13. SBT attitude scale[a]	.28	-.55†	-.39	-.15	-.15	-.15	-.32	.25	.27	.13	-.01	.08	1.00					
14. OH guideline quality	.52*	.32	.11	.11	-.11	.39	.34	.83**	.25	.26	.12	.14	.18	1.00				
15. HOB guideline quality	.23	.42†	.06	.35	.09	.25	.26	.23	-.11	-.08	.28	-.03	-.52†	.37	1.00			
16. SBT guideline quality[a]	.37	.41	.05	.28	-.04	.39	.52†	.78**	.08	-.20	.05	.12	-.20	.77**	.50†	1.00		
17. HH guideline quality	-.03	.42†	.43†	.22	.46†	-.01	.33	.10	.14	.12	.43†	.37	-.54†	.09	.49*	.43†	1.00	
18. VAP context index	-.17	.50*	.28	.14	.49*	.08	.43	-.13	-.07	.03	.18	.13	-.52†	-.21	.05	.27	.37	1.00

Note.
Spearman's correlations. OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, HH: Hand hygiene. Sample size 16-18. aOnly Hospitals 1,2,3, 6, and 8 which had nursing SBT guidelines or MD SBT standard orders were included in the analyses. †p≤.1, * p≤.05, **p≤.01

Evaluation of Hypotheses

The following six hypotheses were tested in this study. For the individual level analyses: A) OH adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher (higher score indicates presence of facilitators); B) HOB adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher; C) SBT adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher; D) HH adherence score will be higher when guideline user, guideline quality, and contextual factor scores are higher; E) Overall VAP prevention guideline adherence rates will be higher when guideline user, guideline quality, and contextual factor scores are higher.

For the unit level analyses: F) Unit VAP rates will be lower when the mean adherence score of the unit is higher.

For the individual level analyses (Hypotheses A-D), the relationships were tested using multi-level logistic regression. Adherence responses were dichotomized to adherence (adhere always or most of time) and non-adherence (adhere sometimes or never). Guideline user characteristics were measured by the attitude scale, guideline awareness, and the level of prioritization. Guideline quality was measured by the guideline quality index. The contextual factors were measured by availability of time and VAP context index. Possible scores for all the items are one through four with four representing the most facilitating factor.

Hypothesis (A). OH adherence scores will be higher when guideline user, guideline quality, and contextual factor scores are higher (higher score indicates presence of facilitators).

OH adherence score were best predicted by the guideline user attitude scale, availability of time, and VAP context index. The odds of adherence increased close to 4 times with higher attitude score, and the odds of adherence increased more than 1.5 times when respondents perceived that they had enough time for the oral care and had facilitating context. Thus, Hypothesis (A) was supported for guideline user and contextual factor but not for the guideline quality.

Hypothesis (B). HOB adherence scores will be higher when guideline user, guideline quality, and contextual factor scores are higher.

HOB adherence scores were best predicted by the attitude scale and the guideline quality. The odds of adherence increased 4.75 times for higher attitude score and doubled for higher quality of the guideline. Thus, Hypothesis (B) was supported for guideline user and guideline quality but not for the contextual factors.

Hypothesis (C). SBT adherence scores will be higher when guideline user, guideline quality, and contextual factor scores are higher.

SBT adherence scores were best predicted by the guideline user attitude scale and the level of prioritization. The odds of adherence increased 4.1 times with higher attitude scale score and the odds of adherence increased more than 1.5 times for higher

priority level perceived by the respondent. Thus, Hypothesis (C) was supported only for guideline user but not for guideline quality or contextual factors.

Hypothesis (D). HH adherence scores will be higher when guideline user, guideline quality, and contextual factor scores are higher.

HH adherence scores were best predicted by the guideline user attitude scale, availability of time, and general context. The odds of adherence increased more than 19 times with higher attitude scale score and the odds of adherence more than doubled when respondents perceived to have enough time for HH and when the perception of the surrounding context was positive. Interestingly, guideline awareness was associated with .43 decreased the odds of guideline adherence. Thus, Hypothesis (D) was partly supported for guideline user and general context but not for the guideline quality.

Hypothesis (E). Overall VAP prevention guideline adherence rates will be higher when guideline user, guideline quality, and contextual factor scores are higher.

In the bi-variate analyses, overall VAP adherence scores did not significantly correlate with the overall VAP attitude scale, overall VAP guideline quality, or VAP context index ($.05 \leq r \leq .1$). Thus, Hypothesis (E) was not tested further.

The relationships between guideline adherence and predictors were different across the VAP interventions studied. The attitude scale was the most consistent predictor for the four VAP interventions studied. The contextual factors such as time availability and VAP context index was second most consistent. The level of prioritization and guideline quality was important for HOB and SBT adherence, and guideline awareness were associated with the decreased odds of adherence for HH.

Hypothesis (F). Unit VAP rates will be lower when the mean adherence score of the unit is higher.

For the unit level analyses, the relationships were tested using correlations. VAP rates are defined as incidents of VAP per 1,000 ventilator days and this information was provided to the author from the infection control department of 7 participating hospitals.

Unit VAP rates were significantly inversely correlated with HOB adherence scores (-.52, $p \leq .05$). However, VAP rates were not significantly correlated with other adherence scores. Thus, Hypothesis (F) was supported only for the relationship between HOB adherence and VAP rates.

Summary

This study was conducted at eight hospitals in the Northern California. The "P-VAP Survey" involved 576 nurses from 18 critical care units. There were fifteen face-to-face interviews with critical care unit nurse educators, CNSs, nurse managers, and infection control personnel in order to obtain VAP guidelines and detailed information on their implementation. Variables were selected for the regression models based on results of bi-variate analyses. Clustering of nurses' responses with the units was taken into account by conducting multi-level logistic regression. The final predictors

included the attitude scale, the guideline awareness, the level of prioritization of the intervention, the guideline quality index, availability of time, and general context index. The multi-level analyses tested the Hypotheses (A-D). The relationships between guideline adherence and predictors were different across the VAP interventions studied. Overall VAP adherence did not correlate with aggregated overall guideline user and guideline quality indicators. Thus, it was not further tested (Hypothesis E). Hypothesis (F) was tested using correlations of aggregated unit mean adherence with only 17 eligible units. Unit VAP rates were significantly correlated with HOB adherence scores (-.52, $p \leq .05$) but not others.

CHAPTER 5

Discussions

The aim of this cross-sectional survey study was to identify factors that influence adherence to VAP prevention guidelines with focus on OH, HOB, SBT, and HH. Because no tool exists to comprehensively measure factors associated with clinical guideline adherence, the P-VAP Survey was developed based on a conceptual framework. The three specific aims of the study were:

1) To describe guideline user factors, guideline qualities, and contextual factors associated with guideline adherence;
2) To test the relationships among these factors and guideline adherence rates; and
3) To explore the relationships between adherence rates and VAP occurrence.

The study achieved all three study aims. The P-VAP Survey captured perceptions regarding various VAP guidelines for the specific aim 1. In general, nurses had positive attitudes toward VAP prevention interventions and guidelines. Multiple multi-level logistic regressions were used to test the relationship between adherence and possible predictors for specific aim 2. Nurses' attitudes toward the guideline were the strongest predictor of adherence to all four interventions with increased odds of 3.89-19.68 ($.00 \leq p \leq .04$). Other significant positive predictors were the level of prioritization, guideline quality index, time availability, and the VAP context index that measured hospital prioritization, education, infection control, documents, and procedures that encourage adherence. On the contrary, guideline awareness significantly decreased the odds of adherence for HH. In regards to the relationship with VAP incidence, findings for the specific aim 3 were limited because only 17 units were available for unit-level analyses. However, there was a significant inverse

correlation between higher HOB guideline adherence among nurses on a unit and VAP rates ($p \leq .05$). Although not significant, adherence to OH and HH guidelines also had inverse relationship with VAP rates.

Guideline Adherence and Factors Associated with Adherence

In this section, each VAP prevention intervention is discussed separately. Then comparison across the four interventions will identify consistent themes to arise across the interventions studied.

Oral Hygiene

All of the hospitals had a policy/guideline for the OH practices. There were two hospitals where OH recommendations were promulgated via informal memos or fliers. Compared to the study by Cason et al. (2007) that found that only 56% of the respondents had an oral care protocol at their hospital, hospitals in this study had more formal structure to provide consistent oral care practices.

Guideline adherence. Respondents indicated high guideline adherence for OH. However, upon examining the unit averages, only 69% of the nurses in one unit adhered to the guideline, whereas at the other units, the adherence rate was 100%. Of the respondents, 84 % of nurses brushed intubated patient's teeth more frequently than every 12 hours. In comparison, Bingham et al. (2010) and Cason (2007) which found only 17-34% of respondents practiced toothbrushing every 8-12 hours as recommended in the institutional policy. Nurses who participated in this survey brushed intubated patients' teeth more frequently. One of the attributing factors for this may be the growing recognition of OH as a vital infection control measure.

Factors associated with adherence. In general, nurses had positive attitudes toward the intervention with a mean score 3.8 out of a maximum of 4 and perceived OH guideline to be of high quality (mean score of 3.79). Almost all of the nurses reported that they were accountable for OH practices. Despite the fact that all hospitals had some kind of OH guidelines, only 65% of respondents had read the OH guideline, 66% thought they were responsible for it, and 80% regarded OH as a high or highest priority. In order to evaluate the results of sense of responsibility, it must be taken into account that OH was alternatively provided by both RTs and RNs at some hospitals. Thus, some nurses responded that it was a shared responsibility between RTs and RNs, but even then, nurses considered OH to be part of their accountability.

OH guideline was generally thought to be easy to understand, practical to use, and conflicting guidelines did not exist. In terms of having enough time or supplies for the intervention, only 42% of nurses responded that they had enough time to provide the care as recommended and that 70% reported that supplies were not readily available. From the logistic regression, the odds of OH guideline adherence increased moderately with increased availability of time and quality of the context surrounding VAP prevention. This is consistent with findings by Ricart and colleagues (2002).

In summary, nurses considered themselves to be accountable for oral hygiene and had positive attitudes about it. Thus, the intervention was done as recommend most of the time. However, nurses were not well supported in this practice in regards to having enough time or necessary supplies. Increasing the accessibility of the supplies may increase the adherence rates of oral hygiene at units with low adherence rates.

Head of Bed Elevated Patient Positioning

All of the hospitals had a policy/guideline for HOB elevation and nurses practiced this recommendation 93% of the time. This was more frequent than 86 % adherence found by Cason and colleagues' (2007) and the 70% adherence that Bingham et al. (2010) found. This is likely due to the state mandate for California hospitals to submit surveillance reports for HOB elevation on quarterly basis (California Healthcare Foundation, 2009).

Guideline adherence. This study found high guideline adherence (93%) for HOB elevation. This is higher adherence compared to previous findings of 35-86% HOB adherence (Bird et al., 2010; Cason et al., 2007; DuBose et al., 2008; Kaynar et al., 2007; Ricart et al., 2003). Similar to OH, there was variations across the units with some unit average adherence rate as low as 57%.

Factors associated with adherence. In general, nurses had very positive attitudes toward the intervention (mean score 3.9 out of a maximum of 4) and perceived HOB guidelines to be of high quality (mean score of 3.9). Despite the fact all hospitals had HOB guidelines, only 55% reported that they had read all the sections of the guideline. A plausible reason may be that HOB elevation recommendation is a brief statement. For example, at some units HOB guideline would simply state that patient's head must be elevated unless there are contraindicated. Because of its brevity, some respondents might not have perceived that they had read the full guideline. Approximately 90% of the respondents regarded HOB as a high or highest priority and close to 100% considered that they were accountable for the practice.

The HOB Guidelines were generally considered to be easy to understand and practical to follow. However, more than half of the respondents indicated that there were conflicting guidelines for HOB that could hinder guideline adherence. In regards to having enough time for the intervention, 83% of nurses responded that they had enough time to position patients appropriately. It was expected that many nurses will indicate concerns for patient comfort related to HOB positioning (Ricart et al., 2003). However, nurses' responses regarding possible contraindication to the intervention due to patient's condition were similar between HOB and OH. More than half of the respondents responded that patient condition or preference affected their practices. Logistic regressions revealed that the odds of HOB guideline adherence increased by close to five times with one unit increase in attitude scale and doubled by increased guideline quality.

In summary, patient condition or preference must be taken into account to evaluate feasibility of HOB guideline adherence. Furthermore, guideline adherence could be improved by resolving conflicting guidelines such as pressure ulcer prevention guidelines. However, nurses reported consistent HOB guideline adherence and the author observed that HOB elevation was a norm at participating ICUs. One plausible reason for high adherence rates, despite the challenges, may be the mandatory reporting of HOB data in California.

Spontaneous Breathing Trial

Only five hospitals had SBT policies or guidelines that nurses can refer to. This is congruent with the findings by Tanios et al (2009) that a great heterogeneity exists for the use of sedation protocol and daily sedation interruption practices that

usually are conducted along with SBT. SBT was the most challenging intervention to study in this research project. The study found that SBT is still a new concept for some organizations and there was great variation in terminologies, role responsibilities, and implementation practices.

Guideline adherence. From the five hospitals that had SBT guidelines, 69% of nurses adhered to this protocol. This finding falls within previously reported frequencies of weaning trial practices of 29-98% (Bird et al., 2010; Christenson et al., 2006; Crunden et al., 2005; DuBose et al., 2008). Again, variation across units was noted; only 44% of the nurses report adhering to the guideline in one of the units while 86 % reported adhering to the SBT guideline in an another unit.

Factors associated with adherence. Even with a low adherence rate, nurses still had fairly positive attitudes toward SBT interventions with a mean score of 3.69 (on a scale of 1-4), but this was the lowest score for all the interventions studied. The guideline quality index was 3.3 (out of 1-4 possible score). At the five hospitals that had SBT guidelines, only 51% of respondents had read the guideline. About 80% of nurses regarded SBT as a high or highest priority and considered themselves as accountable for SBT. On the contrary, less than 10 % of the respondents thought they were responsible. This disparity, even at the five hospitals with SBT guides, may be due to variant role expectations of RTs and RNs at these hospitals. It was evident during site visits that depending on the institutions, RTs took more initiative than others.

Nurses generally considered SBT to be practical to use but not necessarily easy to understand. Also, only 60% of nurses responded that there are no conflicting

guidelines and this could be hindering the use of SBT guidelines. Only 71% of nurses reported that they had enough time for SBT. In addition, the effects of patient condition or preference were more prevalent compared to other interventions studied with half of the respondent citing the decisions related to patient specific situation such as hemodynamic instability for not being able to follow through with the guideline.

From the logistic regression analyses, guideline user characteristics affected the SBT guideline adherence. The attitude scale increased the odds of SBT guideline adherence by four times and prioritization increased the odds by 1.6.

In summary, SBT guidelines and practices varied across hospitals. Even by limiting the analyses to five hospitals with SBT guidelines, fewer nurses had read and adhered to the guidelines. They also had less positive attitudes about SBT intervention. In order to increase SBT guideline adherence, for example, structurally encouraging nursing involvement by having guidelines that specify roles of RNs, RTs, and MDs could lead to more consistent practices of SBT.

Hand Hygiene

HH was different from other VAP interventions in that it was not a prevention strategy unique to VAP. All of the hospitals had HH protocol/guidelines. Only two hospitals included HH as part of VAP prevention.

Adherence. Almost all (98%) of the nurses reported that they adhered to the hand hygiene protocol. There was less variation among the units (90-100%) compared to other interventions studied. This adherence rate is at the higher end of previously reported HH adherence rates of 82-98% in VAP prevention studies (Bird et al., 2010; Cason et al., 2007; Kaynar et al., 2007). There are always biases in self-reported

responses as one tends to overestimate professionally expected behavior. It is likely that HH responses were biased towards adherence as HH is such a basic measure of infection control and there is a high expectation for guideline adherence. Also, HH adherence is unique because there are countless opportunities for HH in any given day which makes it difficult to remember when HH was missed. However, inclusion of HH practice in this survey provided the insight as to how the guideline user attitudes, contextual environment, and time availability contributed to increased guideline adherence.

Factors associated with adherence. Nurses almost had a perfect score (3.9) on the attitudes scale and guideline quality index for HH. Among the attitude indicators measured, the outcome expectancy of HH was least agreed upon. Approximately 80% of the nurses had read the guideline and close to 100% of the respondents regarded hand hygiene as a high or highest priority and accountable to the practice. The priority and accountability levels were much higher compared to other interventions. The guidelines were considered practical to use (97%) but fewer considered them to be easy to understand (90%). Respondents reported that supplies were readily available but comparatively fewer nurses reported that they had enough time for HH. From the logistic regressions, the odds of HH guideline adherence increased twenty fold with one unit increase in the attitude scale and doubled with one unit increase in time for the intervention. The extreme increase of odds for the attitude scale may be attributed to lack of variability among the reported HH adherence behavior. Interestingly, guideline awareness decreased the odds of HH adherence, but it may be due to the fact

that nurses are more aware of specific indications of HH and realize that they may not be adhering to the guideline at all times.

In summary, respondents reported high rates of HH guideline adherence and no major issues were identified for factors associated with adherence. However, some areas of improvement may be to increase the awareness of outcome expectancy for HH and crafting more user-friendly guidelines.

Overall VAP Prevention

All of the hospitals had some form of VAP prevention guidelines. The content and the format of the guidelines varied widely. To the best of the author's knowledge, this is the first study to compare various institutional VAP prevention guidelines. The difficulty in studying overall VAP prevention was that recommendations included in the VAP prevention guidelines were not consistent.

Guideline adherence. VAP prevention guideline adherence score was calculated as a mean adherence of all four interventions. Unit variations were minimal for this overall VAP guideline adherence (94-100%). Almost all of the respondents reported that they adhered to the VAP prevention guidelines. However, there may be a sampling bias because nurses who did not typically use the guidelines may not be interested in participating in a guideline adherence survey in the first place.

Factors associated with adherence. Nurses had positive attitudes toward overall VAP prevention (mean score of 3.82). Attitudes toward overall VAP guidelines were positive. Many considered VAP guidelines to be helpful (97%) while decreasing inappropriate variation in care (91%). However, only 83% of nurses agreed that guidelines did not interfere with professional autonomy. Among the nurses that the

author interacted with, there were nurses who indicated the frustrations regarding clinical guidelines especially oral hygiene guidelines. They wanted oral hygiene to be less standardized to allow for more autonomous and individualized nursing practice.

In general, nurses perceived they had a supportive environment for VAP prevention in terms of VAP being the priority of the hospital, involvement of infection control department, and educational opportunities. Interestingly practice audits and pre-printed order sets had little impact upon nurses to change behavior.

Correlations were not significant between overall VAP guideline adherence and overall guideline quality and contextual factors (Table 4. 17). However, correlations were significant between VAP context index and scores for adherence, attitude scale, and guideline quality for OH, HOB, SBT and HH. Thus, compared to the overall VAP adherence score, individual scores were more sensitive to capture the relationships. Capturing data for individual interventions increased the number of questions in the survey but it was beneficial.

Summary

VAP prevention guidelines were structured in many different ways. However, attitudes were generally positive for the VAP interventions and for the guideline qualities studied. Unit mean guideline adherence to OH, HOB, and HH guidelines were high except for SBT. However, there were notable unit level differences in adherence for each of the intervention.

This study was able to evaluate four VAP interventions. This resulted in close to 100 questions but there were two notable benefits to its length. First, prominent differences were identified between HH and SBT. Respondents reported the highest adherence, attitude scale score, awareness of the guidelines, level of priority, and

guideline quality for HH. On the contrary, SBT were rated the lowest for these indicators. Second, analysis of individual intervention resulted in identifying consistently significant correlations between adherence and guideline user characteristics, guideline quality, and contextual factors regardless of the intervention studied. The overall indicators of adherence, quality, and context did not present significant correlations with other overall indicators for attitudes and guideline quality. Thus, this study provided benefits studying four VAP interventions separately.

Evaluation of the Conceptual Framework

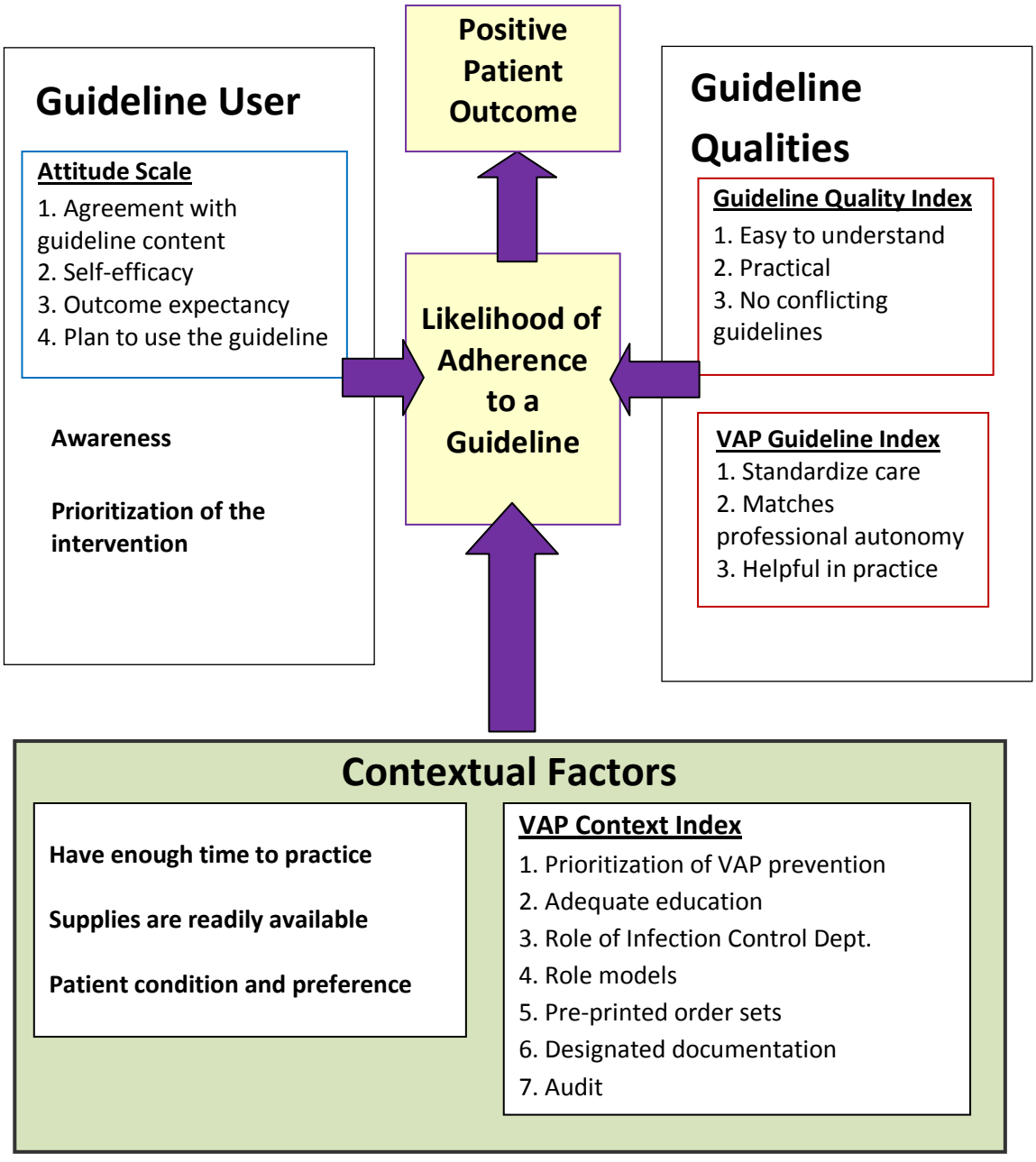
A conceptual framework was created to guide variables used in this research and to create the P-VAP Survey. Using the results of the descriptive analyses and correlational analyses, the proposed conceptual framework model was modified (Figure 5.1.).

This updated framework incorporated and categorized variables associated with guideline adherence. Guideline use is now comprised of awareness, attitudes, and level of priority toward the guidelines. The characteristics of guidelines and contexts are now identified as “specific to the intervention” or “relevant to all of VAP interventions.” This distinction has not been made previously.

The results of this study support the basic structure of the model that better attitudes or facilitating factors increase guideline adherence. There were consistent positive relationships with guideline adherence and attitude scale, awareness and priority, guideline quality index, time availability, and VAP context. Furthermore, this study found a positive relationship between increased HOB guideline adherence and

decreased VAP rates at the patient care unit level. Thus this model was successful in guiding this study and has potential to advance guideline adherence research.

Figure 5.1. *Revised Relationships among Guideline-User, Guideline Qualities, and Contextual Factors*



Study Limitations

Although this study provided many valuable insights into the relationships among guideline adherence and guideline users, guideline qualities, and contextual factors, there some limitations in design, sampling, and analysis.

Design Limitations

First, cross-sectional survey was conducted thus no causal conclusions can be made. While survey methodology is best suited to study both guideline adherence rates and factors affecting adherence from large number of participants, self-selection bias is inevitable. A negative side of the self-administered survey is the difficulty in randomly selecting participants with diverse experiences and behavior. As the author learned during site visits, there were nurses who opted out of the study because they felt that they didn't have enough experience with patients on mechanical ventilation. Thus, the sample is more representative of nurses who were experienced at taking care of mechanically ventilated patients. Also, there were some nurses checking with the guideline to find the "right" answer before completing the survey, which may have affected responses for some questions about their knowledge about the guidelines.

Second, adherence is only measured by self-report. The anonymous survey was intended to seek nurses' honest opinions. However, adherence may be over reported due to professional expectations. Also, for an intervention like hand hygiene where there are many opportunities to clean the hands in a work day, one may not remember how many times they actually adhered to the guideline recommendations.

Third, VAP rates were retrospectively collected. In order to minimize the seasonal influences on VAP rates, the VAP rates for the most recent twelve months

were collected. Thus, the VAP data did not match the time that the survey was conducted. However, the data collected are adequate to examine the relationship between predictors of adherence behavior, adherence behavior itself, and VAP rates.

Sampling Limitations

All the hospitals were members of a local patient safety network, thus this group was representative of hospitals that are invested in improving patient outcomes. Thus, compared to the national adult benchmark VAP rates of 2.9 (Edwards et al., 2009), most units included in this study had lower rates. Furthermore, all the hospitals were from California where there is ICU nurse staffing ratio law in ICU since 1999 which specify that a nurse could only be assigned to less than two patients or less (American Nurses Association, 2010).

This study included full-time, part-time, and per-diem nurses. It was difficult to ensure that all ICU nurses received the survey. Although data collection at each of the sites was conducted over a period of one to two months, depending on the work schedule, some nurses may only have worked a couple of days during this period. Thus, these nurses had less opportunity to participate. Also, depending on the preference of the managers, surveys were placed in employee mailboxes but some employees did not have mailboxes or rarely accessed them. Surveys were also emailed to ICU nurses but some nurses rarely accessed emails. Lastly, surveys were typically placed in the nurses' break rooms per request by the nurse manager. However, break rooms were often cluttered and had no suitable space for the surveys to be noticed. And, depending on the unit, not all the ICU nurses used the break room. In the end, approximately 1,000 surveys were distributed and 576 were returned.

The response rate was 44.6%. A higher response rate would have been optimal; however, considering that it was a 96 item survey which took an average of 15 minutes, it was acceptable. The author visited all the study sites weekly to encourage participation and to answer any questions. At one hospital, a bedside ICU nurse became the liaison for this study and distributed/collected all the surveys at this unit. Despite the on-site help, the response rates were 49% and 54% at two ICUs of this hospital. Thus, unless the format drastically changes for this survey, it will be difficult to obtain higher response rates. Lastly, there were abrupt changes in nursing leadership at four of the units which could have potentially affected participation in the study.

Analysis Limitations

This study was challenged by the data. Because of highly skewed responses for adherence and the nested nature of the responses, analysis techniques were limited. In addition, there was a skill limitation for a beginning researcher to conduct a very complicated analysis. However, even with multi-level logistic regression and correlation tests, there were some significant findings meaningful to future studies.

Study Strengths

Despite the limitations, this study identified factors that facilitate or hinder guideline adherence. This study was especially unique due to six novel approaches.

First, this study measured nurses' adherence to specific institutional policies and guidelines rather than adherence to professional VAP guidelines. This study is one of the first to report on the various types and contents of institutional VAP guidelines and explored implementation of VAP prevention at the unit level.

Second, "sense of responsibility and accountability" questions were added to the survey based on Gurses and colleagues' (2008) theory that various ambiguities including role responsibility contributes to suboptimal guideline adherence. This is one of the first to address perceptions regarding the professional roles.

Third, guideline qualities were addressed in the study. Grol and colleagues (1998) suggested that guideline's quality highly affects its use, however, this aspect is rarely examined in guideline adherence studies. This study not only examined user's perceptions of the guideline using the P-VAP Survey but also obtained objective information on guideline characteristics through the interviews.

Fourth, this study addressed specific contextual factors surrounding VAP prevention. There have been limited studies indicating how contextual factors are associated with guideline adherence (de Vos et al., 2010; Francke et al., 2008a; Wyszewianski & Green, 2000). The P-VAP Survey included questions about time and supply availability for the specific VAP intervention, as well as contextual factors such as adequate education, role of infection control department, having a role model, and effects of designated charting space and audit.

Fifth, this study used a conceptual framework to organize guideline user characteristics, guideline qualities, and contextual factors. And relationships that were hypothesized in the model were supported by the study findings.

Lastly, this study has incorporated nested nature of nurses' responses within the unit in the regression analyses. Unlike physicians who are transient across units, nurses usually have an assigned home unit that they typically work in, thus there is a stronger inter-class correlations of nurses' responses in general. Multi-level logistic

regression modeling was an appropriate analysis for this type of data and is recommended when evaluating an outcome that is affected by clustering effect of nurses in a unit.

Study Implications

This study provided many insights into what influences nurses' guideline adherence. The survey and the conceptual framework are intended to be applied to other areas of patient safety initiatives which involve the use of clinical guidelines in aims of improving patient outcomes. Parts of the survey, such as the attitude scale or guideline quality index, could be used to evaluate guideline implementations, or they could be used as a guide for creating local guidelines and policies.

Also, this study may have captured how a policy impacted providers' HOB behavior as well as patient outcome with California's mandate to report HOB audit results to state authorities. Although it is controversial to increase the number of mandatory quality indicators, this study could be used as a reference if hospitals in other states that are still struggling with inconsistent implementation of HOB elevation practices in the ICUs.

This study can be helpful in future implementation science research projects in understanding the use of clinical guidelines. First, the survey may be shortened in the hope of increasing the response rates. Also, the use of this survey outside of California with different ICU nurse to patient ratios and hospitals not belonging to a patient safety network may yield some interesting comparative results with the current data.

Second, P-VAP Survey can be used in conjunction with objective measure of adherence to re-examine the relationship between adherence and specific factors

associated with OH, HOB elevation, SBT, and HH adherence. The use of technology such as surveillance cameras at ICUs may be one way to conduct observations with little Hawthorn effect.

Third, in order for SBTs to be conducted regularly for appropriate patients in a timely manner, obtaining RTs point of view on SBT using a similar survey would be valuable. Because it is such a prime example of collaborative practice, interdisciplinary perspectives will be critical. Encouragingly, there were many RTs that the author encountered during the study visits who were eager to participate.

Conclusions

This study explored the relationships among the guideline user attributes and characteristics, guideline qualities, and contextual factors with adherence to the local VAP prevention guidelines. There were five major findings:

1. Nurses generally had positive attitudes and high adherence to commonly implemented VAP interventions: OH, HOB, and HH. However, there were significant variations among the aggregated adherence rates on units ranging 50 to 100%.
2. SBT guidelines were not consistently used by hospitals. Even when they were in place, SBT practice varied and adherence to SBT guidelines and attitudes were lower compared to other interventions.
3. Predictors of guideline adherence differed by the intervention. However, attitude scale was the strongest predictor of guideline adherence for all the interventions studied.

4. There was a significant inverse correlation between HOB guideline adherence and unit VAP rates.

5. The conceptual model supported the hypotheses and provided useful framework to comprehensively understand the relationship between guideline adherence and barriers and facilitators related to adherence.

Considerable effort has been put into place to incorporate VAP prevention as part of routine care in ICUs. Low rates of VAP at participating hospitals were likely the results of many coordinated efforts. However, the process of how the evidence-based guidelines were translated into day-to-day practices differed by sites. And there were units that succeeded and those that were slower to change. In order to facilitate evidence-based practice with the aim of achieving better patient outcome, identifying and embracing the factors that facilitate the guideline use is critical. As this study found, nurse's attitudes are the most consistent predictor of the guideline adherence. The attitude scale which includes nurse's agreement with the guideline content, self-efficacy, outcome expectancy, and plan to use the guideline influences the guideline use cross multiple VAP interventions. In addition, guideline user's level of prioritization, guideline quality, time availability, and contextual factors surrounding VAP prevention will also impact the guideline adherence. Thus, future guideline implementation strategies should aim to first facilitate guideline user's positive attitudes and then focus on creating high quality guidelines and providing supportive environment to facilitate evidence-based practice.

( ) ICU Retake Survey Code (_ _ _ _ & _ _ _ _)
(Last 4 letters of last name & 4 digits of phone)

Preventing VAP: Facilitators and Barriers of Clinical Guideline Use
(P-VAP Survey)

Dear Nurse Colleague,

We are conducting a study to learn about the realities of VAP prevention. You are being asked to take part in this pilot study because you work in a critical care unit at the UCSF Medical Center.

As you may have heard, ventilator-associated pneumonia (VAP) occurs in 9-27% of mechanically ventilated patients and some researchers estimate that 30% of patients who acquire VAP do not survive. Various practice guidelines have been developed to prevent this. However, the local guidelines (institutional policy and procedures, standard of care, manuals, etc.) vary by site and VAP prevention practices differ widely.

This survey will be one of the first to assess a wide range of factors that may explain whether guidelines are used or not used in providing oral hygiene, semi-recumbent patient positioning, daily assessment to wean, and hand hygiene. About 150 clinicians will take part in this study. This study is partly funded by Agency for Healthcare Research and Quality.

This is an anonymous survey, meaning your survey responses will never be linked to your name and all of the results will be reported as group averages or totals. Information will be kept private with utmost care. You will be asked to complete a survey about your experiences with VAP prevention. It should take about 15 minutes to complete this survey. You may choose to further assist in this research project by retaking the survey once more in a 2-4 week period. Your participation is voluntary, and you can stop at anytime without consequence for you. Your choice to participate or not will not affect your employment. Receipt of your completed survey tells us that you agree to participate. Should you have any questions, problems, or concerns about the study, please contact the investigators listed below. You may also contact the Office of the Committee on Human Research at 415-476-1814.

Upon completion of the survey, you'll receive $3 gift coupon for your time.
Thank you very much for your time and for sharing your views.

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Instructions:

① There are 8 sections including questions about oral hygiene, semi-recumbent patient positioning, daily assessment to wean, and hand hygiene. Please select answer choices that best match your opinion.

② Please write in any feedback that you may have. This is a pilot survey.

1. Please tell us about yourself		
1	How long have you worked in intensive care units (ICU)?	_____ Years
2	How long have you worked in this ICU?	**Check one:** ☐ <1 year ☐ 1-4 years ☐ 5-9 years ☐ ≥10 years
3	On average, how many hours a week do you work in the ICU?	_____ Hours
4	What is usual patient load per work day?	_____ Patients
5	On average, is your workload manageable?	**Check one:** ☐ Yes ☐ No ☐ Don't know
6	How many mechanically ventilated patients have you taken care of in last 2 weeks.	_____ Patients
7	What is your highest degree earned?	**Check one:** ☐ Diploma/ ☐ Associate ☐ Baccalaureate ☐ Graduate
8	What is your current certification status?	**Check ALL that apply：** ☐ CCRN ☐ CNS ☐None ☐Other (_____)

2. Oral Hygiene Policy/Guideline		
9	Which oral hygiene policy/guideline do you have on your unit to take care of intubated and mechanically ventilated patients?	**Check *All* that apply:** ***"Oral hygiene for…"*** ☐ Critically ill ☐ Intubated patients ☐ Ventilated patients ☐ Orally intubated patients
10	How much have you read this oral hygiene prevention policy/guideline?	**Check one:** ☐ Never ☐ All sections at least once ☐ Some sections ☐ All sections multiple time ☐ We don't have this
11	Please rate the priority level of oral care for mechanically ventilated patients?	**Check one:** ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
12	Do you use a standardized oral *assessment* tool to assess the oral cavity?	**Check one:** ☐ Yes ☐ No

13	Do other nurses practice oral hygiene the same way that you do?	**Check one:** ☐ Yes ☐ No

How true are these statements to you?

	Check one →	True	Somewhat True	Slightly True	Not true	N/A
14	I agree with the oral hygiene recommendations	☐	☐	☐	☐	○
15	Oral care is a shared responsibility between respiratory therapists and nurses	☐	☐	☐	☐	○
16	It is my responsibility to make sure that oral care is done	☐	☐	☐	☐	○
17	I may be liable if I don't use this policy/guideline	☐	☐	☐	☐	○
18	I would prefer to continue my oral hygiene routines and habits rather than to change based on policies/guidelines	☐	☐	☐	☐	○
19	I plan to use the oral hygiene guideline/policy whenever I can	☐	☐	☐	☐	○
20	Using oral hygiene guideline/policy will reduce VAP	☐	☐	☐	☐	○
21	Oral hygiene recommendations are difficult to understand	☐	☐	☐	☐	○
22	Oral hygiene policy/guideline is practical to use	☐	☐	☐	☐	○
23	There are other policies/guidelines that conflict with oral hygiene guideline	☐	☐	☐	☐	○
24	Following supplies are readily available for me to use (i.e., at bedside)					
	Toothbrush	☐	☐	☐	☐	○
	Oral swab	☐	☐	☐	☐	○
	Oral-cleansing agent (i.e, tooth paste, oral rinse)	☐	☐	☐	☐	○
	Flashlight	☐	☐	☐	☐	○
25	Sometimes I don't have time to provide oral hygiene	☐	☐	☐	☐	○
26	Sometimes patients (or family) prefers to NOT have the intervention	☐	☐	☐	☐	○

27. *What is the typical duration of oral hygiene for you?* Please check only ONE duration.

	< 30 seconds	31-60 seconds	1-2 minutes	≥2 minutes	Don't know	Don't practice
Example: Oral assessment	☐	☐	✔	☐	○	○
Oral assessment	☐	☐	☐	☐	○	○
Foam swabs/Foam toothettes	☐	☐	☐	☐	○	○
Manual Toothbrush	☐	☐	☐	☐	○	○
Electric toothbrush	☐	☐	☐	☐	○	○

28. *What is the typical oral care for intubated and mechanically ventilated patient for you?*
For each intervention, please check only ONE frequency.

Frequency / Oral Care Intervention	Q 2 hours	Q 4 hours	Twice a shift	Once a shift	Less than once a shift	When specified by MD or family	Don't practice
Example: Foam swabs	☐	☐	☐	✔	☐	○	○
Oral assessment	☐	☐	☐	☐	☐	○	○
Foam swabs/ Foam toothettes	☐	☐	☐	☐	☐	○	○
Toothbrushing	☐	☐	☐	☐	☐	○	○
Toothpaste	☐	☐	☐	☐	☐	○	○
Oral rinses (e.g. Peridex/ Chlorhexidine)	☐	☐	☐	☐	☐	○	○
Paste/gel (e.g. anti-microbial)	☐	☐	☐	☐	☐	○	○

How often do these statements apply to you?
For intubated, mechanically ventilated patients, and medically appropriate patients…

	Check one →	Always	Most of the Time	Some of the time	Never	N/A
29	I had a hard time providing oral hygiene per policy/guideline with last 4 patients that I took care of…	☐	☐	☐	☐	○
30	I provided oral hygiene exactly per policy/guideline with last 4 patients that I took care of…	☐	☐	☐	☐	○

3. Semi-Recumbent Patient Positioning Policy/Guideline		
31	How much have you read about semi-recumbent patient positioning policy/guideline of your unit?	**Check one:** ☐ Never ☐ All sections multiple time ☐ Some sections ☐ We don't have this ☐ All sections at least once
32	Please rate the priority level of placing patients in semi-recumbent position for mechanically ventilated patients?	**Check one:** ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
33	Do other nurses practice patient positioning the same way that you do?	**Check one:** ☐ Yes ☐ No

How true are these statements to you?

	Check one →	True	Somewhat True	Slightly True	Not true	N/A
34	I agree with the semi-recumbent patient positioning policy/guideline	☐	☐	☐	☐	○
35	Placing patients on semi-recumbent patient positioning is a shared responsibility	☐	☐	☐	☐	○
36	It is my responsibility to make sure that patients are placed in semi-recumbent position	☐	☐	☐	☐	○
37	I may be liable if I don't place my patients in semi-recumbent position without documented reason	☐	☐	☐	☐	○
38	I would prefer to continue my routines and habits rather than to change based on policies/guidelines	☐	☐	☐	☐	○
39	I plan to use this guideline whenever I can	☐	☐	☐	☐	○
40	Semi-recumbent patient positioning will reduce VAP	☐	☐	☐	☐	○
41	Semi-recumbent patient positioning policy/guideline is difficult to understand	☐	☐	☐	☐	○
42	Semi-recumbent patient position policy/guideline is practical to use	☐	☐	☐	☐	○
43	There are other policies/guidelines that conflict with semi-recumbent patient positioning guideline (i.e. pressure ulcer prevention)	☐	☐	☐	☐	○
44	Sometimes I don't have time to place patients in semi-recumbent position	☐	☐	☐	☐	○
45	Sometimes patients condition contradicts with policy/guideline indications (i.e., risk for pressure ulcer, hemodynamic instability)	☐	☐	☐	☐	○
46	Sometimes patients (or family) prefers patients to NOT have the intervention due to preference or discomfort	☐	☐	☐	☐	○

***How often* do these statements apply to you?**
For intubated, mechanically ventilated patients, and medically appropriate patients…

	Check one →	Always	Most of the Time	Some of the time	Never	N/A
47	I had a hard time placing patients in semi-recumbent position per policy/guideline with last 4 patients that I took care of…	☐	☐	☐	☐	○
48	I placed patients in semi-recumbent position exactly per policy/guideline with last 4 patients that I took care of…	☐	☐	☐	☐	○

6. Daily Assessment for Readiness to Wean Practice Policy/Guideline		
49	How much have you read about daily assessment of readiness to wean policy/guideline of your unit?	**Check one:** ☐ Never ☐ All sections multiple times ☐ Some sections ☐ We don't have this ☐ All sections at least once
50	Please rate the priority level of assessing readiness to wean for mechanically ventilated patients?	**Check one:** ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
51	Do other nurses assess patients' readiness to wean the same way that you do?	**Check one:** ☐ Yes ☐ No

How true are these statements to you?

	Check one →	True	Somewhat True	Slightly True	Not true	N/A
52	I agree with the daily assessment to wean policy/guideline	☐	☐	☐	☐	○
53	Assessing patients for their readiness to wean is a shared responsibility	☐	☐	☐	☐	○
54	It is my responsibility to make sure that patients are assessed for readiness to wean when appropriate	☐	☐	☐	☐	○
55	I may be liable if I don't assess my patients for their readiness to wean when medically appropriate without a documented reason	☐	☐	☐	☐	○
56	I would prefer to continue my routines and habits rather than to change based on policies/guidelines	☐	☐	☐	☐	○
57	I plan use the policy/guideline to assess patient's readiness to wean whenever I can	☐	☐	☐	☐	○

	Check one →	True	Somewhat True	Slightly True	Not true	N/A
58	Daily assessment to wean will reduce VAP	☐	☐	☐	☐	○
59	Daily assessment to wean recommendations are difficult to understand	☐	☐	☐	☐	○
60	Weaning assessment policy/guideline is practical to use	☐	☐	☐	☐	○
61	There are other policies/guidelines that conflict with daily assessment to wean	☐	☐	☐	☐	○
62	Sometimes I don't have time to assess patient's readiness to wean even when it is medically appropriate	☐	☐	☐	☐	○
63	Sometimes patient (or family) preference prohibits me from assessing patient's readiness to wean	☐	☐	☐	☐	○
64	Sometimes patients condition contradicts with policy/guideline indications (i.e., DNR, hemodynamic instability)	☐	☐	☐	☐	○

***How often* do these statements apply to you?**
For intubated, mechanically ventilated patients, and medically appropriate patients…

	Check one →	Always	Most of the Time	Some of the time	Never	N/A
65	I had a hard time assessing patient's readiness to wean per policy/guideline with last 4 patients that I took care of…	☐	☐	☐	☐	○
66	I assessed patient's readiness to wean exactly per policy/guideline with last 4 patients that I took care of…	☐	☐	☐	☐	○

5. Hand Hygiene Policy/Guideline

67	How much have you read about hand hygiene policy/guideline of your unit/hospital?	**Check one:** ☐ Never ☐ Some sections ☐ All sections at least once ☐ All sections multiple times ☐ We don't have this
68	Given competing priorities for a critically ill patient, please rate the priority level of washing your hands?	**Check one:** ☐ Low priority ☐ Moderate priority ☐ High priority ☐ Highest priority

How true are these statements to you?

	Check one →	True	Somewhat True	Slightly True	Not true	N/A
69	I agree with the hand hygiene policy/guideline	☐	☐	☐	☐	○
70	Ensuring hand hygiene is a shared responsibility	☐	☐	☐	☐	○

71	It is my responsibility that I maintain my hand hygiene as stated in the policy/guideline	☐	☐	☐	☐	○
	Check one →	True	Somewhat True	Slightly True	Not true	N/A
72	I would prefer to continue my hand hygiene routines and habits rather than to change based on policies/guidelines	☐	☐	☐	☐	○
73	I plan to use hand hygiene policy/guideline whenever I can	☐	☐	☐	☐	○
74	Hand hygiene practices will reduce hospital-acquired infection rates	☐	☐	☐	☐	○
75	If I follow the hand hygiene policy/guideline, it is likely that my hands will be in worse shape (e.g., drier skin)	☐	☐	☐	☐	○
76	Hand hygiene policy/guideline is difficult to understand	☐	☐	☐	☐	○
78	Hand hygiene policy/guideline is practical to use	☐	☐	☐	☐	○
79	Following supplies were readily available for me to use (i.e., at bedside)					
	Sink	☐	☐	☐	☐	○
	Soap	☐	☐	☐	☐	○
	Antiseptic gel/spray	☐	☐	☐	☐	○
	Disposable gloves	☐	☐	☐	☐	○
80	Sometimes I don't have time to do hand hygiene as recommended in the policy/guideline	☐	☐	☐	☐	○

How often do these statements apply to you?

	Check one →	Always	Most of the Time	Some of the time	Never	N/A
81	I had a hard time practicing hand hygiene per policy/guideline in last 4 weeks…	☐	☐	☐	☐	○
82	I practiced hand hygiene exactly per policy/guideline in last 2 weeks…	☐	☐	☐	☐	○

6. Tell us about your experience with VAP prevention

	Check one →	True	Somewhat True	Slightly True	Not true	N/A
83	I know that VAP prevention is a priority in my hospital	☐	☐	☐	☐	○
84	I think the role of the Infection Control Department has been important in prevention of VAP	☐	☐	☐	☐	○
85	I have had adequate education on VAP prevention	☐	☐	☐	☐	○

86	I have someone on my unit that is a "role model" or "champion" in VAP prevention	☐	☐	☐	☐	○
	Check one →	**True**	**Somewhat True**	**Slightly True**	**Not true**	**N/A**
87	Preprinted order sets help me do VAP prevention in the right way	☐	☐	☐	☐	○
88	A designated place to document VAP prevention measures (i.e., oral hygiene, patient position) makes me more conscious about VAP prevention.	☐	☐	☐	☐	○
89	Knowing that I may be audited (through chart review) makes me do VAP prevention as recommended in the policy/guideline	☐	☐	☐	☐	○

Let's call a written document with recommendation for VAP (Ventilator-Associated Pneumonia) prevention (VAP Bundle, Policy & Procedure, Manual, Standard of Care) at your unit *"VAP Prevention Policy/Guideline."*

7. Tell us about "Ventilator-Associated Pneumonia (VAP) Prevention Policy/Guideline" on your unit		
90	How much have you read this VAP Prevention Guideline?	**Check one:** ☐ Never ☐ Some sections ☐ All sections at least once ☐ All sections multiple times ☐ We don't have this
91	Which components are included in this guideline?	**Check *all* that apply:** ☐ Oral hygiene ☐ Semi-recumbent positioning (Head of bed elevation>30) ☐ Daily assessment for readiness to wean ☐ Daily sedation interruption ☐ Spontaneous breathing trial ☐ Hand hygiene ☐ Other ( )
92	"VAP Prevention Policy/Guideline" is helpful in my practice	**Check one:** ☐ True ☐ Mostly true ☐ Somewhat true ☐ Not true
93	"VAP Prevention Policy/Guideline" interferes with my professional autonomy	**Check one:** ☐ True Mostly true ☐ Somewhat true Not true
94	It is impossible to keep up with this guideline	**Check one:** ☐ True Mostly true ☐ Somewhat true No true
95	This guideline will decrease inappropriate variation of care	**Check one:** ☐ True Mostly true ☐ Somewhat true No true

8. Do you know the VAP rate of your unit?			
96	Most recent VAP rate on my unit was _____ (per 1,000 ventilator days)	Check one: ☐ <1 incidences ☐ 2-4 incidences	☐ 4-6 incidences ☐ >7 incidences ☐ I don't know
97	How do you know this?	Check *All* that apply: ☐ Posters/Fliers ☐ Email ☐ In-services ☐ Staff meetings	☐ I know where to get this information ☐ Other ( )

"It's more of a guideline than a regulation."

Turn the page for further instructions.

Please detach this page from rest of the survey

****

In order to receive the gift coupon, please print

Name: ( )  **Work Mailbox #: ( )**

And if you are able to take this survey again ☐,

remember your survey code (ex. KIYO1234) on the cover page.

You will be eligible for another gift coupon for your time!
A survey will be delivered to you in 2-4 weeks and questions will be exactly the same.

****

OPTIONAL: The following information will help us improve the survey.

- How long did this survey take? _____ minutes
- Please share an episode of VAP (prevention) that you was memorable to you

Any event that changed how you practice VAP prevention differently… a severe VAP case you experienced, personal experience with hospital-acquired infections…

Please check this box →☐ *IF* it is OK for the research team to contact you to learn more about your experience

- Please use this space for other comments

Anything unclear or confusing? Anything you liked?

****

Please return the survey in the designated box.

Information on this page will NOT be linked to your survey responses.

Thank you for completing the survey!

My home unit is ( ) ICU
(Please fill in)

Preventing VAP: Facilitators and Barriers of Clinical Guideline Use
(P–VAP Survey)

Dear Critical Care Nurse Colleague,

We are conducting a study to learn about the realities of ventilator-associated pneumonia (VAP) prevention. This survey will be one of the first to assess a wide range of factors that may explain why guidelines are used or not used in providing mechanically ventilated patients' oral hygiene, semi-recumbent patient positioning, spontaneous breathing trials, and hand hygiene. You are being asked to take part in this study because you are a **bedside critical care nurse**.

As you may know, VAP occurs in 9-27% of mechanically ventilated patients, and some researchers estimate that 30% of patients who acquire VAP do not survive. Various practice guidelines have been developed to prevent this. However, the local guidelines (institutional policy and procedures, standard of care, protocol, manuals, etc.) vary by site, and VAP prevention practices differ widely.

This is an anonymous survey, meaning your survey responses will never be linked to your name and all of the results will be reported as group averages or totals. Information will be kept private with utmost care. You will be asked about your experiences with VAP prevention and it should take about 15 minutes to complete.

Your participation is voluntary, and you can stop at anytime without consequence to you. Your choice to participate or not will not affect your employment. About 200 nurses from SCVMC will be asked to take part in this study. 700 total nurses are expected to participate among all study sites. Receipt of your completed survey tells us that you agree to participate. Should you have any questions, problems, or concerns about the study, please contact the investigators listed below. You may also contact the Santa Clara Valley Research and Human Subjects Review Committee at 408-885-3115. This study is partly funded by the Agency for Healthcare Research and Quality.

*Upon completion of the survey, you'll receive a **$5 gift coupon**.*

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Instructions:
The followings questions ask about mechanically ventilated patients' oral hygiene, semi-recumbent patient positioning, spontaneous breathing trials, and hand hygiene. For each item please select the answer choice(s) that best matches your opinion.

1. Please tell us about yourself

1	How long have you worked in the intensive care unit (ICU) setting?	_____ Years
2	How long have you worked in this ICU?	_____ Years
3	On average, how many hours a week do you work in the ICU?	_____ Hours
4	How many mechanically ventilated patients have you taken care of in the last 2 weeks?	Check one: ☐ None ☐ 1−2 patients ☐ 3-5 patients ☐ ≥6 patients
5	What is your highest degree earned in nursing?	Check one: ☐ Diploma ☐ Associate ☐ Bachelor ☐ Graduate degree
6	What is your current nursing specialty certification status?	Check ALL that apply： ☐None ☐Critical Care Registered Nurse ☐ Other (specify:)

2-A. Oral Hygiene for Mechanically Ventilated Patients

7	How do you rate the priority level of oral hygiene for mechanically ventilated patients?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
8	How do other nurses rate the priority level of oral hygiene for mechanically ventilated patients?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
9	Who is responsible for making sure that patients receive appropriate oral hygiene?	Check one: ☐ Shared responsibility between respiratory therapists and nurses ☐ Nurses' responsibility ☐ Don't know
10	I am accountable for providing appropriate oral hygiene for patients.	Check one: ☐ Yes ☐ No ☐ Don't know
11	How often is oral hygiene practice affected by the patient's condition or patient's (or their family's) preference?	Check one: ☐ Always ☐ Some of the time ☐ Most of the time ☐ Never ☐ Don't know
12	Do you use a standardized oral assessment tool to assess the oral cavity?	Check one: ☐ Yes (specify:) ☐ No

13	The following supplies are readily available (i.e., at bedside):	Check *ALL* that apply： ☐ Tooth swab ☐ Flashlight ☐ Tooth brush ☐ Tooth paste

14. In general, how often do you provide oral hygiene care for mechanically ventilated patients? For each intervention, please check only ONE frequency.

Frequency / Oral Hygiene Intervention	Q2 hours	Q4 hours	Q6 hours	Q8 hours	Q12 hours	Less than once a shift
Oral assessment	□	□	□	□	□	○
Foam swabs/ foam toothettes	□	□	□	□	□	○
Tooth brush	□	□	□	□	□	○
Tooth paste	□	□	□	□	□	○
Oral rinses (e.g., Peridex/chlorhexidine)	□	□	□	□	□	○
Oral paste/gel (e.g., anti-microbial paste)	□	□	□	□	□	○

2-B. Oral Hygiene Policy/Guideline for Mechanically Ventilated Patients

If there is NO oral hygiene policy/guideline for ventilated patients at your unit, skip to Section 3-A (#28)

15	How much have you read the oral hygiene policy/guideline for your unit?	Check one: ☐ Not at all ☐ All sections at least once ☐ Some sections ☐ All sections multiple times
16	What is the recommended frequency of tooth brushing?	Every _____ hours ☐ Don't know

How true are these statements for you?

	Check one →	True	Somewhat True	Slightly True	Not true	Don't know
17	I agree with the oral hygiene policy/guideline.	□	□	□	□	○
18	The oral hygiene policy/guideline is practical to use.	□	□	□	□	○
19	The oral hygiene policy/guideline is difficult to understand.	□	□	□	□	○
20	Using the oral hygiene guideline/policy will reduce VAP.	□	□	□	□	○

21	I plan to use the oral hygiene guideline/policy whenever I can.	☐	☐	☐	☐	○
22	I am confident that I can perform oral hygiene as recommended in the policy/guideline.	☐	☐	☐	☐	○
	Check one →	True	Somewhat True	Slightly True	Not true	Don't know
23	Sometimes I don't have time to provide oral hygiene as recommended in the policy/guideline.	☐	☐	☐	☐	○
24	There are other policies that conflict with the oral hygiene policy/guideline.	☐	☐	☐	☐	○
25	I had a hard time practicing oral hygiene per policy/guideline with the last 4 ventilated patients I cared for.	☐	☐	☐	☐	○

How often do these statements apply to you?

	Check one →	Always	Most of the Time	Some of the time	Never	N/A
26	I practiced oral hygiene per policy/guideline with the last 4 ventilated patients that I cared for.	☐	☐	☐	☐	○
27	In general, my nurse colleagues practice oral hygiene per policy/guideline.	☐	☐	☐	☐	○

3-A. Semi-Recumbent Position (or Head of Bed Elevation) for Mechanically Ventilated Patients

28	How do you rate the priority level of placing mechanically ventilated patients in semi-recumbent position?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
29	How do the other nurses rate the priority level of placing mechanically ventilated patients in semi-recumbent position?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
30	Who is responsible for making sure that patients are in semi-recumbent position when medically appropriate?	Check one: ☐ Shared responsibility between respiratory therapists and nurses ☐ Nurses' responsibility
31	I am accountable for placing patients in semi-recumbent position.	Check one: ☐ Yes ☐ No ☐ Don't know
32	How often is your semi-recumbent patient positioning practice affected by the patient's condition or patient's (or their family's) preference?	Check one: ☐ Always ☐ Some of the time ☐ Most of the time ☐ Never ☐ Don't know

3-B. Semi-Recumbent Position Policy/Guideline for Mechanically Ventilated Patients

If there is NO semi-recumbent patient positioning policy/guideline for ventilated patients at your unit, ***skip to Section 4-A (#46)***

33	How much have you read the ventilated patient positioning policy/guideline for your unit?	Check one: ☐ Not at all ☐ All sections at least once ☐ Some sections ☐ All sections multiple times
34	Patients on mechanical ventilation should be placed at ___ degrees.	_____ degrees ☐ Don't know

How true are these statements for you?

	Check one →	True	Somewhat True	Slightly True	Not true	Don't Know
35	I agree with the semi-recumbent patient positioning policy/guideline.	☐	☐	☐	☐	○
36	The semi-recumbent patient position policy/guideline is practical to use.	☐	☐	☐	☐	○
37	The semi-recumbent patient positioning policy/guideline is difficult to understand.	☐	☐	☐	☐	○
38	Using the semi-recumbent patient positioning policy/guideline will reduce VAP.	☐	☐	☐	☐	○
39	I plan to use the semi-recumbent patient positioning policy/guideline whenever I can.	☐	☐	☐	☐	○
40	I am confident that I can position patients as recommended in the policy/guideline.	☐	☐	☐	☐	○
41	Sometimes I don't have time to place patients in a semi-recumbent position as recommended in the guideline.	☐	☐	☐	☐	○
42	There are other policies/guidelines that conflict with the semi-recumbent patient positioning guideline (e.g., pressure ulcer prevention policy).	☐	☐	☐	☐	○
43	I had a hard time positioning patients per semi-recumbent policy/guideline with the last 4 ventilated patients that I cared for.	☐	☐	☐	☐	○

How often do these statements apply to you?

	Check one →	Always	Most of the Time	Some of the time	Never	N/A
44	I positioned patients in semi-recumbent position per policy/guideline with last the 4 ventilated patients that I cared for.	☐	☐	☐	☐	○
45	In general, my nurse colleagues position patients in semi-recumbent position per policy/guideline.	☐	☐	☐	☐	○

Halfway Done!!

4-A. Spontaneous Breathing Trial (SBT) for Mechanically Ventilated Patients

46	How do <u>you</u> rate the priority level of spontaneous breathing trials for mechanically ventilated patients when medically appropriate?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
47	How do <u>other nurses</u> rate the priority level of spontaneous breathing trials for mechanically ventilated patients when medically appropriate?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
48	Who's responsibility is it to make sure that patients receive spontaneous breathing trials when medically appropriate?	Check one: ☐ Shared responsibility between respiratory therapists and nurses ☐ Nurses' responsibility
49	I am accountable for making sure that spontaneous breathing trials happen.	Check one: ☐ Yes ☐No ☐ Don't know
50	How often is your practice affected by the patient's condition or patient's (or their family's) preference?	Check one: ☐ Always ☐ Some of the time ☐ Most of the time ☐ Never ☐ Don't know
51	Which criteria do you use to identify patients who may be ready to liberate from mechanical ventilation?	Check *All* that apply: ☐ Sedation Wake-up Protocol ☐ Burns Weaning Assessment Program (BWAP) ☐ SBT protocol ☐ mMAAS ☐ Other ( )

4-B. Spontaneous Breathing Trial (SBT) for Ventilated Patients Policy/Guideline

If there is <u>NO</u> <u>spontaneous breathing trial</u> <u>policy/guideline</u> at your unit, skip to <u>Section 5-A (#65)</u>

52	How much have you read about the SBT policy/guideline of your unit?	Check one: ☐ Not at all ☐ All sections at least once ☐ Some sections ☐ All sections multiple times
53	What is the <u>initial</u> ventilator mode for SBT?	Initial ventilator mode: PSV ____ cmH2O FiO2 ___ PEEP ___cm H2O

How true are these statements for you?

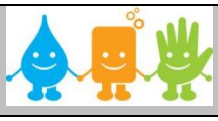
	Check one →	True	Somewhat True	Slightly True	Not true	Don't know
54	I agree with the SBT policy/guideline.	☐	☐	☐	☐	○
55	The SBT policy/guideline is practical to use.	☐	☐	☐	☐	○

56	The SBT policy/guideline is difficult to understand.	☐	☐	☐	☐	○
	Check one →	True	Somewhat True	Slightly True	Not true	Don't know
57	Using the SBT policy/guideline will reduce VAP.	☐	☐	☐	☐	○
58	I plan to use the SBT policy/guideline whenever I can.	☐	☐	☐	☐	○
59	I am confident that I can perform SBTs as recommended in the policy/guideline.	☐	☐	☐	☐	○
60	There are other policies/guidelines that conflict with SBTs.	☐	☐	☐	☐	○
61	Sometimes I don't have time to follow the SBT policy/guideline.	☐	☐	☐	☐	○
62	I had a hard time with the SBT policy/guideline with the last 4 ventilated patients that I took care of.	☐	☐	☐	☐	○

How often do these statements apply to you?

	Check one →	Always	Most of the Time	Some of the time	Never	N/A
63	I practiced SBTs per policy/guideline with the last 4 ventilated patients that I cared for.	☐	☐	☐	☐	○
64	In general, my nurse colleagues conduct SBTs per policy/guideline.	☐	☐	☐	☐	○

5-A. Hand Hygiene



65	How do you rate the priority level of hand hygiene?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
66	How do the other nurses rate priority level of hand hygiene?	Check one: ☐ Low priority ☐ High priority ☐ Moderate priority ☐ Highest priority
67	I am accountable for practicing appropriate hand hygiene.	Check one: ☐ Yes ☐ No ☐ Don't know
68	The following supplies are readily available (i.e., at bedside):	Check *ALL* that apply: ☐ Sink ☐ Soap ☐ Alcohol gel

5-B. Hand Hygiene Policy/Guideline

If there is NO hand hygiene policy/guideline, ***skip to Section 6 (#82)***

69	How much have you read about the hand hygiene policy/guideline of your unit/hospital?	Check one: ☐ Not at all ☐ All sections at least once ☐ Some sections ☐ All sections multiple times

70	After going into the room of a patient who is known to have *C Diff*, how would you clean your hands?	Check one: ☐ Nothing ☐ Water and soap ☐ Alcohol gel ☐ Alcohol gel or water & soap

How true are these statements for you?

	Check one →	True	Somewhat True	Slightly True	Not true	Don't Know
71	I agree with the hand hygiene policy/guideline.	☐	☐	☐	☐	○
72	The hand hygiene policy/guideline is practical to use.	☐	☐	☐	☐	○
73	The hand hygiene policy/guideline is difficult to understand.	☐	☐	☐	☐	○
74	The hand hygiene policy/guideline will reduce VAP.	☐	☐	☐	☐	○
75	If I follow the hand hygiene policy/guideline, it is likely that my hands will be in worse shape (e.g., drier skin).	☐	☐	☐	☐	○
76	I plan to use the hand hygiene policy/guideline whenever I can.	☐	☐	☐	☐	○
77	I am confident that I can perform hand hygiene as recommended in the policy/guideline.	☐	☐	☐	☐	○
78	Sometimes I don't have time for hand hygiene as recommended in the policy/guideline.	☐	☐	☐	☐	○
79	I had a hard time following the hygiene policy/guideline in the last 2 weeks.	☐	☐	☐	☐	○

How often do these statements apply to you?

	Check one →	Always	Most of the Time	Some of the time	Never	N/A
80	I practiced hand hygiene per policy/guideline in the last 2 weeks.	☐	☐	☐	☐	○
81	In general, my nurse colleagues practice hand hygiene per policy/guideline.	☐	☐	☐	☐	○

6. Your experience with VAP prevention

	Check one →	True	Somewhat True	Slightly True	Not True	Don't Know
82	I know that VAP prevention is a priority in my hospital.	☐	☐	☐	☐	○
83	I think the role of the Infection Control Department has been important in VAP prevention.	☐	☐	☐	☐	○
84	I have had adequate education on VAP prevention.	☐	☐	☐	☐	○
85	I know who to ask when I have questions about VAP prevention practices.	☐	☐	☐	☐	○

86	Preprinted order sets help me do VAP prevention in the right way.	□	□	□	□	○

	Check one →	True	Somewhat True	Slightly True	Not True	Don't Know
87	A designated place to document VAP prevention measures (e.g., oral hygiene, patient position) makes me more conscious of VAP prevention.	□	□	□	□	○
88	Knowing that I may be audited (through chart review or observation) makes me do VAP prevention practices as recommended in the policy/guideline.	□	□	□	□	○

89	The most recent VAP rate of my unit was _____ (per 1,000 ventilator days).	Check one: □ ≤1 incidences □ 1≤3 incidences □ 3≤5 incidences □ >5 incidences □ I don't know

7. "VAP Prevention Policy/Guideline" of your hospital
(e.g., VAP Bundle, Policy & Procedure, Manual, Standard of Care)

If there is NO VAP prevention policy/guideline at your unit, ***you're done!***

90	How much have you read this "VAP Prevention Guideline"?	Check one: ☐ Not at all ☐ Some sections ☐ All sections at least once ☐ All sections multiple times
91	The "VAP Prevention Policy/Guideline" is helpful in my practice.	Check one: ☐ True ☐ Somewhat true ☐ Slightly true ☐ Not true
92	This guideline will decrease inappropriate variation of care.	Check one: ☐ True ☐ Somewhat true ☐ Slightly true ☐ Not true
93	The "VAP Prevention Policy/Guideline" interferes with my professional autonomy.	Check one: ☐ True ☐ Somewhat true ☐ Slightly true ☐ Not true

Must fill in & detach to receive your gift

Name: ( ) Unit: ( )

Please return the survey & your name in the designated box. Thank you!

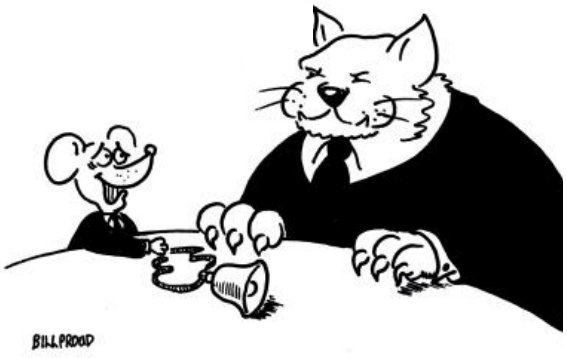
OPTIONAL: The following information will help us improve the survey.

- How long did this survey take? _____ minutes

- Please share a VAP episode that was memorable to you.

Ex. Personal or professional experience that changed how you practice...

- Please use this space for other comments



"It's more of a guideline than a regulation."

Date ( ) Hospital ( ) Unit ( )

Items	Questions	Responses
Staffing	What is the FTEs for infection control professional, analysts, others	1) Infection control professional ( )FTEs 2) Analysts ( )FTEs 3) Director ( )FTEs 4) Others ( )FTEs
Organizational structure	To whom does the Infection Control Director report to?	CHECK: 1) Medical Director 2) Nursing Director 3) Quality Management Director 4) Dept, of Pt Safety and Quality 5) Others ( )
Role of ICD in VAP prevention	What do you do for VAP prevention?	CHECK: 1) Audit and/or surveillance for process measures A) Oral care B) Hand hygiene C) Head of bed elevation D) Daily assessment to wean 2) Offer educational session 3) Create manual, policy and procedure 4) In-depth review of VAP cases (RCA, FEMA)(Y/N)
	How often is audit/surveillance done for oral care	CHECK: 1) More than bi-weekly 2) Monthly 3) Every 2-3months 4) Quarterly
	Hand hygiene	CHECK: 1) More than bi-weekly 2) Monthly 3) Every 2-3months 4) Quarterly
	Head of bed elevation	CHECK: 1) More than bi-weekly 2) Monthly 3) Every 2-3months 4) Quarterly
	Daily assessment to wean	CHECK: 1) More than bi-weekly 2) Monthly 3) Every 2-3months 4) Quarterly

	What things do you like to do more of?	
	What things do you like to do less of?	
	Top 3 things that helped facilitated VAP prevention efforts	1) 2) 3)
	Within the last year, have any major changes occurred that could impact VAP adherence or VAP rates?	

Mechanical ventilation days	Total ventilator days (FY 2010) 1) Hospital 2) ( ) ICU 3) ( ) ICU 4) ( ) ICU	 1) ( ) days 2) ( ) days 3) ( ) days 4) ( ) days
VAP incidence	Monthly data per unit for last 12 months (Obtain)(Unit information as well)	( )

Details of VAP #1	Age	( )
	Primary DX	
	Documented comordidity	Sepsis, DM, MI, CAD, etc Others ( )
	Onset of VAP relative to ventilator days	( )
	Total ventilator days	( )
	Cultured organisms	CHECK: Pseudomonas Aeruginosa Escherichia Coli Klebsiella Pneumoniae Acinetobacter MRSA Others ( )
Details of VAP case #2	Age	( )
	Primary DX	

	Documented comordidity	CHECK: Sepsis, DM, MI, CAD, etc Others( )
	Onset of VAP relative to ventilator days	( )
	Total ventilator days	( )
	Cultured organisms	CHECK: Pseudomonas Aeruginosa Escherichia Coli Klebsiella Pneumoniae Acinetobacter MRSA Others ( )
Details of VAP case #3	Age	( )
	Primary DX	
	Documented comordidity	CHECK: Sepsis, DM, MI, CAD, etc Others ( )
	Onset of VAP relative to ventilator days	( )
	Total ventilator days	( )
	Cultured organisms	CHECK: Pseudomonas Aeruginosa Escherichia Coli Klebsiella Pneumoniae Acinetobacter MRSA Others ( )

Optional: Any memorable VAP (prevention) episode?

Date ( ) Hospital ( ) Unit ( )

Items	Questions	Responses
Hospital Demographics	Hospital affiliation	1) College/University 2) Community (profit) 3) Community (non-profit) 4) County 5) State 6) Federal 7) Public 8) HMO/Managed Care 9) Private Industry 10) Military/Government Other
	Hospital affiliated with a medical school?	Y/N
	If yes, do medical students/fellows rotate through (i.e., involved in patient care) the hospital?	Y/N
	Is your hospital participating in any of the following programs?	1) California Hospital Assessment and Reporting Task Force (CHART) 2) California Healthcare-associated Infection Prevention Initiative (CHAIPI) 3) IHI Five Million Lives Campaign 4) Other

ICU demographics	Clinical area	1) Medical 2) Surgical 3) Mixed Medical-Surgical 4) Cardiac 5) Neurology 6) Burn 7) Other
	Number of beds in this ICU	( )
	Approximate average length of stay	( )
	Approximate % of pt on MV OR	<50%, >50%, >90%
	"Do you have intensivists?"	Y / N
	1) Closed ICU? (intensive care team has pt's primary responsibilities) 2) Semi-closed1? (intensivist consult is mandatory to all ICU patients) 3) Semi-closed 2?(intensivist consults with the admitting team/physician as needed) 4) Open ICU? (Attending MD with ICU admitting privileges can be the physician of record and direct ICU care) (Treggiari, 07, AmJRespirCrirCareMed)	( )
	"Does daily rounding happen? Who participates?" Participants:	Y/N RNs, RTs, MDs, Pharm, Social Worker, Case Worker, Other:
VAP prevention	What interventions are currently in place?	1) Head of bed elevation 2) Oral care 3) Spontaneous wakening trial 4) Spontaneous breathing trial 5) Continuous subglottic suction 6) Lateral rotation 7) other ( )

VAP guideline	"Which national guidelines were used to create the current VAP prevention guideline of this unit/hospital?"	1) IHI 2) AACN 3) ATS/IDSA 4) SHEA 5) APIC 6) Society of Critical Care Medicine 7) Other ( )
VAP prevention tools	"What tools were used to promote VAP prevention?" (Obtain these documents if possible)	1) Posters (Y/N) 2) Newsletters (Y/N) (Monthly? Quarterly?) 3) Audit and/or surveillance check sheet (Y/N)(obtain) 4) Providing process feedback (Y/N) 5) Providing outcome data (VAP rates) a) how often are VAP rates disseminated to the unit staff? (Monthly, Quarterly? Yearly? Never?) b) what is the most recent VAP rate? ( ) 6) Designated section to chart for oral care (Y/N), head of bed elevation (Y/N), spontaneous breathing trial (Y/N) 7) Oral care supply packet at bedside (Y/N) Other ( )
	"What are 3 implementation tools that facilitated VAP prevention efforts?"	1) 2) 3)
	"What are 3 challenges for VAP prevention efforts?"	1) 2) 3)

Access to the guideline (unit protocol or policy)	"How can direct care nurses access guidelines when needed?"	1) Patient chart 2) On-line 3) Resource binder at nurses' station/ unit
History effect	Within the last year, have any major changes occurred that could impact VAP adherence or VAP rates?	1) VAP outbreak 2) Policy change related to VAP prevention 3) Policy change related to oral care 4) Management change 5) Tool/equipment change Other ( )
Perceived role of ICD	"What are some examples of how the ICD contributes to VAP prevention"	1) Conducting audit and surveillance 2) Offering education session 3) Creating manuals/protocols 4) Answering questions 5) Other ( )
	"Are there any departments/personnel/committee that help the ICU perform better on VAP prevention?"	1) Quality Improvement 2) Nursing education 3) Performance Improvement 4) Nurse Practice Council 5) Other ( )
Hiring status	Are you CNS, nurse educator, or nurse manager	1) CNS 2) Nurse Educator 3) Nurse Manager
Employment status	What is your employment status	1) Full time 2) Part time

ICD: Infection Control Department

Optional: Any memorable VAP (prevention) episode? What is VAP prevention to you? (essential, another regulatory thing to do, fits with your values, etc)

Domains/Sub-Domains		Definitions	Questions	Studied Interventions				
A. Guideline User				**VAP**	**OH**	**HOB**	**SBT**	**HH**
Awareness with the guideline		Reading about the specific practice of the unit	"How much have read __ guideline"	1 item	1 item	1 item	1 item	1 item
Attitudes	Agreement with the guideline content	Agreement with the guideline content	"I agree with __ guideline"	0	1 item	1 item	1 item	1 item
	Self-efficacy	Belief that he/she can perform guideline recommendations.	"I am confident that I can perform __ as recommended in the guideline"	0	1 item	1 item	1 item	1 item
	Plan use	The intention to use the guideline when the appropriate opportunity arises	"I plan to use __ guideline whenever I can"	0	1 item	1 item	1 item	1 item
	Outcome Expectancy	Expectation of the outcome	"Using __ guideline will reduce VAP"	0	1 item	1 item	1 item	1 item
	Priority levels	Level of importance for a specific interventions	"How do you rate the priority level of ___"	0	1 item	1 item	1 item	1 item
			"How do other nurses rate the priority level of __"	0	1 item	1 item	1 item	1 item
	Agreement with the role expectations	Sense of responsibility	"Nurses are responsible to ___"	0	1 item	1 item	1 item	0
		Sense of accountability	"I am accountable for providing __ "	0	1 item	1 item	1 item	1 item
B. Guideline Qualities								
<u>Relative advantage:</u> The degree to which a new idea is perceived as superior to the existing practice that it replaces		Standarize care	"Using __ guideline will reduce inappropriate variation iof care"	1 item	0	0	0	0
		Matches professional autonomy	(NEG)"__ guideline interfere with my professional autonomy"	1 item	0	0	0	0
		Guideline is helpful	"__ guideline is helpful"					
			(NEG)" Using hand hygiene guideline will dry my hand"	0	0	0	0	1 item
<u>Complexity:</u> The degree of which the guideline is difficult to understand		Guideline is easy to understand	(NEG)" __ guideline is difficult to understand"	0	1 item	1 item	1 item	1 item

Compatibility: The degree to which an innovation is perceived by an individual as compatible previous experience or to beliefs and values or practicality	Guideline is practical to use	"__ guidelline is practical to use"	0	1 item	1 item	1 item	1 item
	No conflicting information exist	(NEG) "There are conflicting guidelines"	1	1 item	1 item	1 item	1 item
C. Contextual Factors							
Individual VAP Prevention	Have enoutgh time	(NEG) "Sometimes I don't have to time to __"	0	1 item	1 item	1 item	1 item
	Patient's condition does not allow or patient/family refuse	"How often is your __ practice affected by pt's condiction or preference"	0	1 item	1 item	1 item	0
	Access to supplies	"__ are readily available to me"	0	4 items*	0	0	3 items**
Overall VAP Prevention	Prioritization of VAP prevention	"VAP prevention is priority in my hospital"	1 item	0	0	0	0
	Adequate VAP prevention education	"There is adequate educational session"	1 item	0	0	0	0
	Role of the Infection Control Department	"ICP has been important in VAP prevention"	1 item	0	0	0	0
	Role model or "champion"*	"I know who to ask if I have questions about __"	1 item	0	0	0	0
	Pre-printed orders	"Pre-printed order sets help me do _ the right way"	1 item	0	0	0	0
	Designated place to document VAP prevention interventions	"Designated place to document __ prompts me be more conscious about __"	1 item	0	0	0	0
	Audit and surveillance	"Audit and surveillance makes me do __ as recommended"	1 item	0	0	0	0
	Guidelines standarize care	"Guidelines help decrease variation in practice"	1 item	0	0	0	0
D. VAP guideline adherence							
Adherence		"I practiced __ per guideline"	0	1 item	1 item	1 item	1 item

Note.

OH: Oral hygiene HOB: Head of bed elevation (semi-recumbent positioning) SBT: Spontaneous breathing trial HH: Hand hygiene (NEG): Negatively worded *: toothbrush, swab, toothpaste, and flashlight **: sink, soap, and antiseptic gel

Items	Original survey (106 items)	Revised survey (93 items)	Rational
Demographic characteristics			
Years of experience in the current ICU	Response choices were categorical	Respondents are required to fill in a number	For more accurate measurement.
Patient load	"What is your usual patient load"	Deleted	No variation in the responses.
Worklaod	"On average, is your workload managemable?"	Deleted	No variation in the responses.
Education level	"What is your highest degree earned"	"What is your highest degree earned in *nursing*?"	To be more specific.
Certification	"What is your current certification status?"	"What is your current *nursing speciality* certification status?"	To be more specific.
Guideline user characteristics			
Motivation /Inertia for previous practice	"I would prefer to continue my ___ routines and habits rather than to change based on this policy/guideline"	Deleted	To decrease missing responses. Liable may be too strong of a word.
Prioriy	none	"How do the other nurses rate the priority level of ___ "	To measure the unit norm.
Responsibility	"I may be liable if __ "	"I may be accountable"	Did not correlate with other attitude items in EFA. Liability may be too strong of a word.
	"It is my responsibility to make sure ___ "	Combined to a question "Who is responsible for ___" and response choices are 1) Shared responsibility between respiratory theraphists and nurses 2) Nurses' responsibility. Excluded for HH.	To streamline the survey. Questions are for OH, HOB, and SBT. No variation in responses for HH.
	"___ is a shared responsibility"		
	"Who initiates SBT?"	Deleted	No variation in responses.
	"Are SBT conducted for appropriate patients in a timely manner?"	Deleted	No variation in responses.
Other			
Patient factor	"Sometimes patients (or families) prefer to NOT have ___"	Combined to a question "How often is ___ affected by patients' condition or patient's (or their family) preferences?"	To streamline the survey. Questions are for OH, HOB, and SBT.
	"Sometimes patient's condition contradicts with policy/guideline indications"		
Supply availability	Separate answers were required for each of the item	Combined to one question "The following supplies are readily available (i.e., at bedside)"	To streamline the survey.
Duration of intervention	A table with list of intervetions and duration	Deleted	No variation in the responses.
Adherence	"I provided ___ exactly per policy/guideline"	"I ____ per policy/guideline"	To decrease missing responses. The word "exactly" may be too extreme.
	"Do other nurses practice ___ the same way that you do?"	"In general, my nurse colleagues ____ per policy/guideline"	To make the item more comparable to self-reported adherence question.

Note.
OH: Oral hygiene, HOB: Head of bed elevation, SBT: Spontaneous breathing trial, HH: Hand hygiene. Unless noted, changes are for OH, HOB, SBT, and HH questions

UNIVERSITY OF CALIFORNIA, SAN FRANCISCO
CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Study Title:

Ventilator-Associated Pneumonia Prevention: Facilitators and Barriers of Provider Guideline Adherence

This is a research study to learn about realities of ventilator-associated pneumonia (VAP) prevention. This study is lead by Mary Blegen, RN, PhD, FAAN and Hiroko Kiyoshi-Teo, RN, PhD(candidate) from UCSF School of Nursing.

Research studies include only people who choose to take part. Please take your time to make your decision about participating. If you have any questions, you may ask the researchers.

You are being asked to take part in this study because you are a critical care clinical nurse specialist, critical care nurse educator, or infection control professional at San Francisco General Hospital.

Why is this study being done?

The purpose of this pilot study is to learn about the realities of VAP prevention with focus on prevention guidelines. Various practice guidelines have been developed to prevent common and deadly VAP. However, the local guidelines (institutional policy and procedures, standard of care, manuals, etc.) vary by site and VAP prevention practices differ widely.

This study is the first to assess a wide range of factors that may explain whether guidelines are used or not used in providing oral hygiene, semi-recumbent patient positioning, spontaneous breathing trial, and hand hygiene.

This study is partly funded by Agency for Healthcare Research and Quality.

How many people will take part in this study?

About 170 nurses, respiratory therapists, and physicians will take part in the survey arm of this pilot study. About 3 critical care clinical nurse specialists, critical care nurse educator, and infection control professional will be interviewed.

What will happen if I take part in this research study?

If you agree, the following procedures will occur:

- The researcher will interview you for no more than an hour in a private office or location of your choice. The researcher will ask you about VAP prevention practices, your responsibilities related to VAP prevention, hospital and unit characteristics, and information about VAP cases without patient identifiers (infection control department personnel only).

- The researcher will make a sound recording of the conversation with your permission in order to accurately capture your responses. The sound recording will be destroyed upon completion of this study.
- The interview participants will not be asked to participate in the survey arm of the study.

How long will I be in the study?

Participation in the study will require one time 30-60 minute interview.

Can I stop being in the study?

Yes. You can decide to stop at any time. Just tell the study researcher right away if you wish to stop being in the study.

Also, the study researcher may stop you from taking part in this study at any time if he or she believes it is in your best interest, if you do not follow the study rules, or if the study is stopped.

What side effects or risks can I expect from being in the study?

Some interview questions may produce unpleasant feelings, but you are free to decline to answer any questions you do not wish to answer

Are there benefits to taking part in the study?

This is an opportunity to participate in nursing research, obtain performance improvement data, and gain knowledge about VAP prevention.

What other choices do I have if I do not take part in this study?

You are free to choose not to participate in the study. If you decide not to take part in this study, there will be no penalty to you. Your employment will not be affected.

Will information about me be kept private?

We will do our best to make sure that the personal information gathered for this study is kept private. However, we cannot guarantee total privacy. Your personal information may be given out if required by law. If information from this study is published or presented at scientific meetings, your name and other personal information as well as hospital name will not be used.

What are the costs of taking part in this study?

You will not be charged for any of the study treatments or procedures.

Will I be paid for taking part in this study?

You will receive a thank you coupon worth $10 for the interview.

What are my rights if I take part in this study?

Taking part in this study is your choice. You may choose either to take part or not to take part in the study. If you decide to take part in this study, you may stop the interview at any time. No matter what decision you make, there will be no penalty to you in any way. You will not lose any of your regular benefits or your employment.

Who can answer my questions about the study?

You can talk to the researcher(s) about any questions, concerns, or complaints you have about this study. Contact Hiroko Kiyoshi-Teo at hiroko.kiyoshi@ucsfmedctr.org or 415-420-0371, or Mary Blegen at mary.blegen@nursing.ucsf.edu or 415-476-2599.

If you wish to ask questions about the study or your rights as a research participant to someone other than the researchers or if you wish to voice any problems or concerns you may have about the study, please call the Office of the Committee on Human Research at 415-476-1814.

CONSENT

You have been given a copy of this consent form to keep.

PARTICIPATION IN RESEARCH IS VOLUNTARY. You have the right to decline to be in this study, or to withdraw from it at any point without penalty or loss of benefits to which you are otherwise entitled.

If you wish to participate in this study, you should sign below.

_____ _____

Date Participant's Signature for Consent

_____ _____

Date Person Obtaining Consent

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