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Effectiveness of Oral Hygiene and Head-Up 30–45° Bundle for Reducing VAP Risk in ICU

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ABSTRACT

Ventilator-associated pneumonia (VAP) is an illness that develops in patients on a ventilator in an intensive care unit (ICU). VAP is mostly caused by bacterial colonization of the respiratory system, which may increase morbidity, mortality, length of stay and medical expenditures. This research was designed to evaluate the effectiveness of oral hygiene and the 30–45° head-up position as a bundle in lowering VAP risk in mechanically ventilated ICU patients. Methods: This was a quantitative pre-experimental one-group pretest-posttest design research. A purposive sampling method was used to select 25 patients. Measurements were taken before the intervention and 48 hours after the intervention. Data were analyzed using the Wilcoxon test, with a significance threshold of 0.05. After the intervention, the mean CPIS score reduced from 6.84 to 2.96. The Wilcoxon test indicated a significant difference between the CPIS scores before and after the intervention ($p = 0.000$), indicating a reduction in CPIS following the implementation of the bundle. Oral hygiene twice a day with 0.2% chlorhexidine and a 30–45° head-up position may contribute to reducing VAP risk in mechanically ventilated patients in the intensive care unit, although the observed reduction cannot be attributed solely to the bundle because of the study design.

Keywords: head-up, ICU, oral hygiene, VAP

INTRODUCTION

Ventilator-associated pneumonia (VAP) is a frequent nosocomial infection among critically sick patients on mechanical ventilators in the intensive care unit (ICU). VAP usually appears 48–72 hours after ventilator commencement due to bacterial colonization of the respiratory tract, which is made worse by the use of endotracheal tubes that weaken the lung's defense mechanism (Klompas et al., 2022). In Indonesia, 857,483 cases of pneumonia were recorded in 2024 (CNN Indonesia, 2025). At Dr. H. Moch. Ansari Saleh Regional General Hospital, 42 VAP cases were recorded in 2023, 57 cases in 2024, and 32 cases up to November 2025 (RSUD dr. H. Moch. Ansari Saleh, 2025).

VAP has a substantial impact on morbidity, mortality, length of stay, ventilator usage duration, and ICU patient care expenses. This illness is brought on by bacterial colonization that develops into lung infection, interfering with gas exchange, producing hypoxia, and raising the risk of mortality for critically sick patients (Kohbodi et al., 2023). VAP prevention is thus essential to raising treatment standards and guaranteeing patient safety in critical care units.

One method of preventing VAP is to implement a VAP package, which includes oral hygiene habits using 0.2% chlorhexidine and a 30–45° head-up posture. Combining these two therapies has been shown to enhance patient respiration, lower the risk of secretion aspiration, and lessen oral bacterial colonization (Wulandari et al., 2024). The implementation of VAP bundles has also been associated with reduced VAP risk and improved patient outcomes, particularly when preventive measures are applied consistently by ICU nurses (Al-Harthi et al., 2025). However, the use of VAP preventive packages in healthcare facilities is still not at its best because of things like nurse compliance, head-up posture consistency, and the quality of oral hygiene implementation (Andriyani, 2022). Evidence from a literature review also indicates that oral hygiene in mechanically ventilated ICU patients is an important component of infection prevention because it helps reduce oral microbial accumulation and the potential transmission of pathogens to the lower respiratory tract (Astuti et al., 2025).

Numerous earlier studies have shown the value of oral hygiene and VAP packages in lowering the risk of VAP, including those by Rumtily (2025), Wulandari et al. (2024), and Yuniandita & Hudiyawati (2020). Meta-analytic evidence has further demonstrated that different oral care modalities may influence the incidence of VAP among critically ill patients, supporting the importance of structured oral care as part of VAP prevention (Fu et al., 2023). Nevertheless, previous studies have generally examined oral hygiene or VAP prevention bundles with different combinations of interventions. Wulandari et al. (2024), for example, evaluated a VAP prevention bundle consisting of oral hygiene, close suction, and a 30–45° head-up position in an ICU in Bali. Rumtily (2025) examined the use of 0.2% chlorhexidine as oral hygiene for VAP prevention in an ICU in Bandung.

However, the available studies cited in this study have not specifically established the effect of combining 0.2% chlorhexidine oral hygiene and a 30–45° head-up position as a two-component bundle using changes in the Clinical Pulmonary Infection Score (CPIS) in a regional hospital setting. Differences in hospital characteristics, patient populations, implementation of preventive interventions, and clinical care practices may also limit the direct generalization of findings from other settings to regional hospitals. Therefore, this study investigates changes in CPIS following the implementation of 0.2% chlorhexidine oral hygiene combined with a 30–45° head-up position among mechanically ventilated patients in the ICU of Dr. H. Moch. Ansari Saleh Regional Hospital, Banjarmasin.

METHODS

The research method was quantitative using pre-experimental one group pretest–posttest design. The research was performed at the Intensive Care Unit (ICU) of Dr. H. Moch. Ansari Saleh Regional General Hospital, Banjarmasin, Indonesia in May–June 2026.

The research sample included 251 patients who were treated in the ICU over the period January–November 2025. From this group, 25 mechanically ventilated patients were selected using purposive sampling based on predetermined inclusion and exclusion criteria. The sample size was determined pragmatically as approximately 10% of the accessible population of 251 patients, following Arikunto's (2013) population-based approach. This approach was not based on an a priori power calculation and may have limited the ability to detect smaller effects. Eligible patients were admitted to the ICU and received mechanical ventilation throughout the research period, but excluded patients who received mechanical ventilation for less than 48 hours, were moved to another ward or died before completion of the CPIS evaluation. Participant characteristics gathered were sex, age, educational level, duration of stay in the ICU, medical diagnosis, initial mean arterial pressure (MAP) and initial oxygen saturation (SpO_2).

The intervention was a VAP prevention bundle consisting of oral hygiene with 0.2% chlorhexidine and head-up posture of 30–45° according to the established standard operating procedures. Twice daily, ICU nurses performed oral hygiene with a soft toothbrush or an oral swab soaked with 0.2% chlorhexidine gluconate to clean the teeth, tongue, palate, area around the endotracheal tube, and lips, and suctioned oral secretions as needed, while maintaining the position of the endotracheal tube. The head of the bed was lifted to 30–45° with head, neck, and torso in alignment and monitoring of the endotracheal tube position, vital signs, oxygenation, hemodynamic stability and patient tolerance. The posture of head up was maintained according to the clinical status of the patient and was checked throughout nursing care and changes of shift.

The main outcome was evaluated using the Clinical Pulmonary Infection Score (CPIS) which was adapted from Lestari (2024) referring to the CPIS by Pugin. CPIS is an established clinical observational tool based on objective clinical data; however, it was not independently validated or reliability-tested in this study, such as through inter-rater agreement. The CPIS score was based on temperature, leukocyte count, tracheal secretions, PaO2/FiO2 ratio, chest radiograph observations, and tracheal culture (where available). The scores for each component were

added together to create a total CPIS, and a value of ≥6 was defined as VAP and <6 as no VAP. CPIS was assessed before the bundle deployment (pretest) and 48 hours after the intervention (posttest). Clinical information was obtained through direct observation, ICU monitoring records, laboratory examinations, radiographic reports and patient medical records. When chest radiography or tracheal culture was not performed at the precise time of CPIS assessment, the most recent clinically relevant result available in the medical record was used. CPIS is an established clinical observational tool based on objective clinical data; however, it was not independently validated or reliability-tested in this study, such as through inter-rater agreement. In addition, tracheal culture, one of the CPIS components, was not consistently available at the time of assessment; therefore, the most recent clinically relevant result available in the medical record was used when the test was not performed. These measurement limitations should be considered when interpreting the CPIS results. Intervention methods were performed according to pre-existing SOPs derived from prior research.

Data processing included editing, coding, tabulation, data input and cleaning. Descriptive statistics were utilized to present participant characteristics and CPIS pretest and posttest results. The normality was determined by the Shapiro–Wilk test since the sample size was less than 50 participants. Paired data that were normally distributed were analyzed using a paired t-test, while non-normally distributed data were analyzed using the Wilcoxon Signed Rank Test. The level of significance was set at $p < 0.05$.

Ethical clearance was acquired from the Research Ethics Committee of the Institute for Research and Community Service, Universitas Sari Mulia Banjarmasin (Ethical Clearance No. 215/KEP-UNISM/V/2026) and permission was received from dr. H. Moch. Ansari Saleh Regional General Hospital. The patient's family or responsible party gave informed permission, and confidentiality was preserved by not include any personally identifying information in the study data.

RESULTS

Univariate Analysis

Univariate analysis was used to characterize the distribution of CPIS scores pre- and post-VAP preventative bundle intervention and the sociodemographic and clinical characteristics of the respondents.

Table 1. Respondent Characteristics

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	11	44
	Female	14	56
	Total	25	100
Age	18–44 (Adult)	6	24
	45–59 (Pre-elderly)	8	32
	≥60 (Elderly)	11	44
Education Level	Elementary School	6	24
	Junior High School	7	28
	Senior High School	10	40
	Higher Education	2	8
Length of ICU Stay	3 Days	1	4
	4 Days	5	20
	5 Days	9	36
	6 Days	8	32
	7 Days	2	8

Most of the respondents were female (56%), older (44%), high school graduates (40%), and had spent five days in the critical care unit (36%). These characteristics indicate that majority of the responders were elderly patients in need of mechanical ventilation and critical care.

Table 2. Medical Diagnosis Characteristics

Medical Diagnosis Category	Frequency (n)	Percentage (%)
Respiratory disorders	6	24
Neurological disorders	8	32
Cardiovascular disorders	4	16
Other conditions	7	28
Total	25	100

Neurological disorders were the most common diagnostic category, accounting for 10 participants (40%), followed by cardiovascular disorders (20%) and respiratory disorders (24%). Other conditions accounted for 16% of the participants.

Table 3. Respondents' Initial MAP

MAP Category	MAP (mmHg)	Frequency (n)	Percentage (%)
Low	<65	1	4
Normal	65–100	19	76
High	>100	5	20
Total		25	100

The majority of responders (76%) reported Mean Arterial Pressure (MAP) readings within the normal range. This finding indicates that most of the patients were hemodynamically stable before the intervention.

Table 4. Respondents' Oxygen Saturation (SpO_2)

SpO_2 (%)	Frequency (n)	Percentage (%)
98	8	32
99	10	40
100	7	28
Total	25	100

Oxygen saturation in each responder varied from 98 to 100%. However, mechanical ventilation was still necessary, since the prescription was based on the clinical condition of the patient and not just on SpO_2 readings.

Table 5. CPIS Frequency Before and After the Intervention

Category	Frequency (f)	Percentage (%)
Pretest		
VAP	24	96
No VAP	1	4
Total	25	100
Posttest		
VAP	0	0
No VAP	25	100
Total	25	100

Their CPIS score was 96% in the VAP group before the intervention. The data suggest that previous to the introduction of the preventive package, patients on mechanical ventilation in the ICU were at significant risk of developing ventilator-associated pneumonia. After oral hygiene and 30–45° head-up posture, all responders (100%) were in the non-VAP group. The data indicate improvements in the clinical circumstances after the intervention.

Table 6. Descriptive Statistics

	N	Min	Max	Median	Mean	Std. Deviation
Pretest	25	4.00	8.00	7.00	6.8400	.89815
Posttest	25	2.00	4.00	3.00	2.9600	.67577
Valid N	25					

CPIS score was 6.84 before and 2.96 after intervention. After implementation of the VAP bundle, the minimum, maximum, median and mean scores all reduced suggesting improved patient health.

Bivariate Analysis

The Wilcoxon Signed Rank Test was used to compare the CPIS scores before and after the VAP prevention bundle implementation in patients on mechanical ventilation in the bivariate trial.

Table 7. Wilcoxon Signed-Rank Test Results

Ranks	N	Mean Rank	Sum of Ranks
Negative Ranks	25	13.00	325.00
Positive Ranks	0	0.00	0.00
Ties	0	0.00	0.00
Total	25		
Test Statistics			
Z			-4.418
Asymp. Sig. (2-tailed)			0.000

The Wilcoxon Signed-Rank Test showed a significant difference in CPIS scores before and after the intervention ($Z = -4.418$; $p = 0.000$). All 25 participants had negative ranks, while no positive ranks or ties were observed, indicating that CPIS scores decreased in all participants following the implementation of the VAP prevention bundle. These findings suggest that the combination of 0.2% chlorhexidine oral hygiene and a 30–45° head-up position was associated with a reduction in CPIS among mechanically ventilated patients.

DISCUSSION

VAP Incidence Before Intervention

The research findings showed that majority of the patients had clinical symptoms of ventilator-associated pneumonia (VAP) according to the Clinical Pulmonary Infection Score (CPIS) before applying oral hygiene and head-up posture of 30-45°. This means that respiratory tract infections are a substantial threat to patients on mechanical ventilators. Ventilation with a ventilator predisposes to bacterial colonization of the oral cavity and oropharynx and impairs the body's natural defensive systems in the airways, such as the cough reflex and mucociliary clearance. Such colonized secretions may then be aspirated into the lower respiratory tract resulting in VAP. This is in excellent accord with Akhter et al. (2025), who suggested that aspiration of colonized oropharyngeal secretions is a key cause of VAP. Howroyd et al. (2024) shown that endotracheal tubes may impair airway defenses and increase the likelihood of microbial colonization in patients receiving mechanical ventilation.

Patients in the critical care unit are also at greater risk for VAP. According to responders' characteristics, patients with different medical problems need to be monitored and ventilator-supported throughout the therapy course. Due to their advanced age and prolonged intensive care unit stays, certain patients were at greater risk of infection risk factors. Risk factors for VAP include extended mechanical ventilation, severe clinical symptoms, restricted mobility and buildup of secretions. Li et al. (2024) reported that longer length of stay in the intensive care unit and duration of mechanical ventilation were associated with a greater incidence of VAP.

VAP Incidence After Intervention

The CPIS assessment showed that the clinical condition of the patient improved following the initiation of oral hygiene with 0.2% chlorhexidine and 30–45° head-up positioning. The results of these changes indicate that the continuous use of both techniques may assist to reduce the risk factors for VAP in patients on mechanical ventilators. The head-up position helps reduce the risk of aspiration of stomach contents and oropharyngeal secretions into the lower respiratory tract, although oral hygiene plays a role in maintaining oral hygiene and limiting microbial colonization in the oropharynx. According to Mohammad et al. (2024) oral hygiene and posture are both important factors in VAP prevention, and they act via separate routes. These findings are corroborated by Abbasi et al. (2025) who revealed the benefits of chlorhexidine-based oral care to reduce the risk of VAP in patients on mechanical ventilators.

The continual use of the intervention according to the standard operating procedures (SOPs) was one of the factors contributing to the improvement of the patient's condition throughout the experiment. Routine oral hygiene may help reduce bacterial colonization and keeping the head up reduces the chances of aspiration when the patient is on a ventilator. These results are in line with the results of Yamakita et al. (2024), who indicated the importance of excellent oral hygiene in critically sick patients, and Lian et al. (2024), who emphasized the significance of a 30–45° head-up position in decreasing aspiration and hence the risk of pneumonia. The administration of a VAP prevention bundle, such as tight suction, oral hygiene, and a 30–45° head-up posture, can help protect patients from the risk of VAP (Wulandari et al., 2024). Hence, the improved condition after the intervention implies that frequent implementation of fundamental nurse interventions may be an essential component of VAP prevention strategies in the critical care unit.

Effectiveness of Oral Hygiene and the 30–45° Head-Up Position as a VAP Prevention Bundle

The use of oral hygiene and the 30–45° head-up position as a single intervention achieved better patients' circumstances, as per the assessment of CPIS, and the research verified this. The effectiveness of both therapies is attributable to their complementary modes of action. The head-up posture of 30–45° reduces the danger of aspirating secretions and stomach contents into the lungs, and oral hygiene with 0.2% chlorhexidine reduces the colonization of bacteria in the oral cavity and oropharynx that may cause lower respiratory tract infections. Oral hygiene and posture are important interventions to prevent VAP since they may control aspiration and bacterial colonization, 2 main risk factors, as stated by Mohammad et al. (2024). These results are in line with previous findings showing that routine oral care may decrease the incidence of VAP in critically ill patients on mechanical ventilation (Abbasi et al., 2025; Darbanian et al., 2024; Yamakita et al., 2024).

A head-up position of 30 to 45 degrees also helps to prevent VAP by decreasing the risk of aspiration. Martinez-Reviejo et al. (2023) believe that semi-recumbent position is crucial in the reduction of pneumonia incidence in patients on ventilators, whereas Klompas et al. (2022) recommend head-of-bed elevation as an essential aspect of the VAP preventative strategies. This position should be altered according to the clinical and physiological characteristics of the patient to ensure patient safety throughout the treatment. Head elevation might be used to preserve hemodynamic stability in critically ill patients while monitoring their condition. The benefits of head-up elevation in this study, therefore, are linked to patient positioning and reduction in aspiration while providing safe care for ventilator-dependent patients.

The effectiveness of the bundle in this research is also shown by other studies on the use of various VAP prevention strategies. Wulandari et al. (2024) found that a bundle of tight suction, oral cleanliness, and 30–45° head-up posture may help preserve patients' conditions from the threat of VAP. Furthermore, good oral hygiene, particularly with chlorhexidine, was shown to decrease the likelihood of infection and bacterial colonization in patients on ventilators (Pitriani et al., 2023; Syarif et al., 2024; Yunus et al., 2025). In contrast, Pozuelo-Carrascosa et al. (2022) and Sutrisno et al. (2025) suggest semi-recumbent or head-up positions as part of VAP prevention. These findings support the notion that the success of an intervention is a function.

CONCLUSION

The combination of 0.2% chlorhexidine oral hygiene and 30–45° head-up posture may have effective reduction of the incidence of ventilator-associated pneumonia (VAP) in patients on mechanical ventilation in the intensive care unit (ICU). This combination may be implemented as part of nursing care to enhance patient safety and promote VAP prevention. Nursing schools may utilize the results as a reference for evidence-based nursing practice. Hospitals and nurses working in critical care units are urged to apply these treatments routinely as per the established standard operating procedures. Additional VAP preventive bundle components and higher sample numbers are recommended for future testing to provide more thorough conclusions.

LIMITATION

The limitations of the current investigation should be considered when interpreting the findings. Because the study was performed using one-group pretest–posttest design, with no control group, it is impossible to verify whether the oral hygiene and 30-45° head-up bundle intervention alone was responsible for the observed improvements in CPIS. Furthermore, the findings may not be as generalizable owing to the use of purposive sampling, a small sample size of 25 patients on mechanical breathing, and one critical care unit. There was no specific examination of other clinical factors that may influence the likelihood of VAP, such as patients' underlying medical conditions, duration of mechanical ventilation, suction procedures, antimicrobial treatment and ventilator management. Moreover, CPIS assessment was based on the clinical and supporting examination data accessible according to the standard ICU practice. Tracheal culture, one of the CPIS components, was not investigated, since it is not regularly performed for all ICU patients and may need additional costs. The combined application of the bundle as a single intervention also prevented the independent evaluation of the impact of head-up posture and oral hygiene, and the 48-h follow-up period reduced the possibility of determining if the observed gains in CPIS were maintained over a longer length of time. Future studies should include controlled study design, larger sample sizes, longer follow-up duration, and more extensive assessment of potential confounding factors to provide stronger evidence for effectiveness of 30–45° head-up bundling and oral hygiene in reducing VAP risk.

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