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EFFECT OF CONVENTIONAL AND STRUCTURED ORAL CARE ON CLINICAL PULMONARY INFECTION SCORES AMONG MECHANICALLY VENTILATED PATIENTS: A REPEATED MEASURES ANALYSIS

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Abstract

Background: Ventilator associated pneumonia (VAP) is a common and serious healthcare-associated infection among mechanically ventilated patients, contributing to increased morbidity, mortality, and healthcare costs. Oral microbial colonization plays a critical role in the pathogenesis of VAP, making oral hygiene care an essential component of preventive strategies. Medicated mouthwash-based oral care has been widely recommended; however, evidence regarding its effectiveness remains inconsistent, particularly in resource-limited settings.Objective: To evaluate the effectiveness of structured medicated mouthwash oral hygiene care on Clinical Pulmonary Infection Scores (CPIS) for the prevention of ventilator-associated pneumonia among mechanically ventilated patients.Methodology: A quasi-experimental repeated measures study was conducted in the intensive care unit of a tertiary care hospital in Bahawalpur. A total of 22 mechanically ventilated patients were selected through consecutive sampling and allocated into two groups: control group (routine oral care, n=11) and intervention group (structured medicated mouthwash oral care, n=11). CPIS scores were recorded at three time points (Day 1, Day 3, and Day 6). Data were analyzed using mixed-design repeated measures ANOVA to assess within-group, between-group, and interaction effects over time.Results: At baseline, CPIS scores were comparable between groups. Over time, CPIS scores increased in the control group (Day 1: 3.73 ± 0.47; Day 6: 6.09 ± 2.26) and decreased in the intervention group (Day 1: 3.55 ± 0.52; Day 6: 3.36 ± 1.80). Repeated measures ANOVA revealed a significant effect of time ($p = 0.008$), group ($p = 0.002$), and a significant time × group interaction ($p = 0.005$), indicating greater improvement in the intervention group.Conclusion: Structured medicated mouthwash oral hygiene care significantly reduces CPIS scores and is effective in the prevention of ventilator-associated pneumonia among mechanically ventilated

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patients. The findings support the implementation of standardized oral care protocols in intensive care settings to improve patient outcomes.

Introduction

Ventilator-associated pneumonia (VAP) is still one of the most dangerous healthcare-associated infections for critically ill patients on mechanical ventilation. It usually starts after 48 hours of intubation and adds a lot to the costs of healthcare, morbidity, and mortality. The reported incidence of VAP varies significantly, from about 9% to 40%, and the death rate can be as high as 70% in severe cases. This makes it one of the most common causes of death in intensive care units (ICUs). (1). VAP not only lengthens the time spent on mechanical ventilation and in the hospital, but it also puts a strain on healthcare systems' budgets, especially in places like Pakistan where resources are limited (2). The pathogenesis of VAP is closely linked to the colonization of pathogenic microorganisms in the oral cavity, which may be aspirated into the lower respiratory tract, underscoring the vital significance of oral hygiene in ventilated patients. (3).

Oral hygiene care has become a crucial preventive measure in ICU environments, focusing on decreasing oral bacterial load to lower the risk of pulmonary infection. Medicated mouthwash gluconate has become very popular as an oral care product because it has a wide range of antimicrobial effects and can stop plaque from forming and microbes from growing (4). Numerous systematic reviews and meta-analyses have shown that using medicated mouthwash for oral care can greatly lower the number of mechanically ventilated patients who get VAP. For example, research shows that using medicated mouthwash for oral care may cut the number of VAP cases by about 30–40% compared to normal care or a placebo (5). Moderate-certainty evidence suggests that medicated mouthwash, as a component of oral hygiene, decreases the incidence of VAP from 26% to approximately 18% in critically ill patients (6). Moreover, the combination of medicated mouthwash with mechanical oral hygiene methods, such as tooth brushing, has been demonstrated to improve its efficacy in preventing VAP (7).

Even though these results are promising, the evidence we have now is still not clear and sometimes even controversial. Recent studies and meta-analyses have indicated no significant advantage of medicated mouthwash in decreasing the incidence of VAP, mortality, or duration of ICU stay, prompting concerns regarding its routine application in all critically ill populations. There is no clear agreement on the best way to keep your mouth clean to avoid VAP, so more research is needed in this area (8).

In developing nations, such as Pakistan, where ICU resources, infection control protocols, and nurse to patient ratios may differ, the impact of VAP is especially pronounced. There is insufficient local evidence concerning the efficacy of structured oral hygiene protocols, particularly those that include medicated mouthwash, in the prevention of VAP. In addition, routine oral care practices are often not consistent and may not follow evidence based guidelines that are widely accepted. Consequently, assessing the effectiveness of structured medicated mouthwash oral hygiene care in these contexts is essential to enhance clinical practice and optimize patient outcomes.

Literature Review

Ventilator-associated pneumonia (VAP) remains a significant challenge in critical care, especially in mechanically ventilated patients, as it markedly elevates morbidity, mortality, and healthcare expenditures. Preventing VAP has become a top priority in intensive care, and there is more and more focus on evidence-based treatments like oral hygiene care. The mouth is known to be a major source of harmful microorganisms, and their colonization is a key step in the development of VAP through micro aspiration into the lower respiratory tract (9). As a result, improving oral hygiene has been widely studied as a way to lower the amount of bacteria in the mouth and prevent lung infections.

Numerous studies have shown that structured oral care protocols can lower the number of VAP cases. Koeman et al. (2006) conducted a randomized

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clinical trial that demonstrated that oral decontamination with antiseptic agents significantly diminished the incidence of VAP in comparison to standard care (10).). Likewise, Munro et al. (2009) indicated that the application of medicated mouthwash in oral care substantially reduced early-onset VAP in intubated patients, especially when integrated with thorough oral hygiene protocols. (11). These findings endorse the incorporation of medicated mouthwash into standard ICU care; nevertheless, the extent of its impact differs among studies.

The concentration and frequency of medicated mouthwash application have been recognized as significant factors affecting its efficacy. A study conducted by Tantipong et al. (2008) indicated that a 2% medicated mouthwash solution was more effective in decreasing the incidence of VAP compared to lower concentrations, implying a dose-dependent relationship (12). Grap et al. (2011) contended that the timing and consistency of oral care delivery are more pivotal than concentration alone (13). This shows how important it is to have structured and standardized protocols instead of just doing things on their own. Some studies have raised concerns about the regular use of medicated mouthwash, even though the results were positive. A meta-analysis conducted by Zhang, Qi et al. (2020) determined that although medicated mouthwash decreases the incidence of ventilator-associated pneumonia (VAP), its effects on mortality and the duration of mechanical ventilation are not statistically significant (14). Zand et al. (2017) also reported possible negative effects of using medicated mouthwash for a long time, such as irritation of the mucous membranes and changes in the oral microbiota (15). These contradictory results suggest that although medicated mouthwash is advantageous, its use must be meticulously assessed within particular clinical settings.

Recent research has investigated alternative and supplementary oral care techniques. Vidal et al. (2017) conducted a study that demonstrated that mechanical oral cleaning, such as tooth brushing, substantially improves the efficacy of antiseptic agents in mitigating VAP risk (16). Berry et al. (2011) also talked about how important it is for nurses to follow oral care protocols, saying that doing so consistently is necessary to get the results you want (17). These results indicate that oral hygiene care ought to be regarded as a holistic intervention rather than depending exclusively on chemical agents.

In settings with limited resources, the execution of standardized oral care protocols continues to pose a considerable challenge. Research in analogous settings has indicated erratic practices, insufficient training, and limited access to oral care supplies, all of which elevate VAP rates (18). This highlights the necessity for organized, practical, and economical interventions customized to local healthcare systems.

The literature suggests that organized oral hygiene care, especially when utilizing medicated mouthwash, may diminish the occurrence of ventilator-associated pneumonia. Nonetheless, discrepancies in study results underscore the necessity for additional research employing rigorous methodologies, such as repeated measures designs, to enhance comprehension of the temporal impacts of oral care interventions. This study seeks to fill these gaps by assessing the effectiveness of structured medicated mouthwash oral hygiene care at various time intervals, thereby aiding the advancement of evidence-based practices in ICU environments.

Methodology

This study employed a quasi-experimental, two-group repeated measures design to evaluate the efficacy of structured medicated mouthwash oral hygiene care in preventing ventilator-associated pneumonia (VAP) among mechanically ventilated patients admitted to the intensive care unit (ICU) of a tertiary care hospital in Bahawalpur. A total of 22 patients were recruited using a non-probability consecutive sampling technique and were equally allocated into two groups: a control group (n=11) receiving routine oral hygiene care and an intervention group (n=11) receiving structured oral hygiene care with medicated mouthwash. Inclusion criteria comprised adult patients (≥18 years) requiring mechanical ventilation for more than 48 hours, while patients with pre-existing pneumonia or oral infections were excluded. The intervention

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protocol involved standardized oral care using medicated mouthwash solution administered at defined intervals, whereas the control group received conventional oral care as per existing hospital practice. Data were collected at three time points (Day 1, Day 3, and Day 6) using a structured assessment tool to evaluate clinical indicators of VAP based on established diagnostic criteria. Ethical approval was obtained from the institutional review board, and informed consent was secured from patients' attendants or legal representatives.

Data were analyzed using SPSS version 27. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were used to summarize demographic and clinical characteristics of participants. For inferential analysis, a two-way repeated measure ANOVA (mixed design ANOVA) was applied to assess the effect of the intervention over time and between groups. This analysis evaluated within-subject effects (changes across Day 1, 3, and 6), between-subject effects (control vs intervention), and interaction effects (time × group) to determine the efficacy of medicated mouthwash oral care. A p-value ≤ 0.05 was considered statistically significant.

Results

A total of 22 mechanically ventilated patients were included, with 11 patients in the control group (routine oral care) and 11 in the intervention group (structured medicated mouthwash oral care). The mean CPIS scores for both groups across Day 1, Day 3, and Day 6 are presented in Table 1.

Table 1: ***Comparison of Mean CPIS Scores between Groups Across Time***

Time Point	Control Group (n=11) Mean ± SD	Case Group (n=11) Mean ± SD
Day 1	3.73 ± 0.47	3.55 ± 0.52
Day 3	5.91 ± 1.30	3.64 ± 1.69
Day 6	6.09 ± 2.26	3.36 ± 1.80

At baseline (Day 1), CPIS scores were comparable between groups. However, over time, CPIS scores increased in the control group, whereas they decreased in the intervention group, indicating a potential beneficial effect of medicated mouthwash oral care.

Table 2: ***Repeated Measures ANOVA Results for CPIS Scores***

Effect	F	df	p-value	Partial Eta Squared
Time	6.980	1.36, 27.26	0.008	0.259
Time × Group	7.770	1.36, 27.26	0.005	0.280
Group	12.060	1, 20	0.002	0.376

(*Greenhouse–Geisser correction applied)

A mixed-design repeated measures ANOVA was conducted to evaluate the effect of structured medicated mouthwash oral hygiene care on CPIS scores over time. There was a statistically significant main effect of time*(F = 6.980, p = 0.008)*, indicating that CPIS scores changed significantly across Day 1, Day 3, and Day 6. A significant interaction effect between time and group*(F = 7.770, p = 0.005)* was observed, demonstrating that the pattern of change in CPIS scores over time differed significantly between the control and intervention groups. Additionally, there was a significant main effect of group*(F = 12.060, p = 0.002)*, indicating an overall difference in CPIS scores between the two groups. The effect sizes (partial eta squared) suggest moderate to large effects, particularly for the interaction effect (η^2 = 0.280), highlighting the clinical importance of the intervention.

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Conclusion

The findings indicate that structured oral hygiene care significantly reduced CPIS scores over time compared to routine oral care, suggesting its effectiveness in the prevention of ventilator-associated pneumonia among mechanically ventilated patients.

Discussion:

The current study assessed the effectiveness of structured medicated mouthwash oral hygiene care in decreasing the occurrence of ventilator-associated pneumonia (VAP) in mechanically ventilated patients through a repeated measures design. The results showed that the intervention group had a statistically significant drop in CPIS scores over time compared to the control group. There was also a significant interaction effect between time and group. This suggests that patients utilizing medicated mouthwash for oral care exhibited a more advantageous clinical progression, thereby validating the intervention's efficacy in preventing VAP.

The rise in CPIS scores among patients receiving regular oral care, in contrast to the decline in the intervention group, underscores the essential function of organized oral hygiene in infection prevention. These results align with prior studies demonstrating that enhanced oral hygiene diminishes bacterial colonisation of the oropharynx, consequently reducing the risk of aspiration-related pulmonary infections (19). The substantial temporal effect identified in this study reinforces the dynamic progression of infections in ICU patients and highlights the necessity for ongoing and consistent oral hygiene practices during mechanical ventilation.

The substantial interaction effect (time × group) identified in this study is particularly significant, as it validates that the intervention not only impacted overall CPIS scores but also modified the trajectory of change over time. This finding is consistent with the outcomes of a randomized trial conducted by Segers et al. (2006), which indicated that medicated mouthwash oral decontamination significantly diminished respiratory infections in critically ill patients (20). In the same way, a systematic review by Chan et al. (2007) found that using antiseptic agents to clean the mouth lowers the risk of VAP, especially when done as part of a structured care plan (21). These studies emphasize the necessity of integrating medicated mouthwash into standardized oral care protocols in ICU environments.

The notable intergroup difference identified in this study reinforces the efficacy of medicated mouthwash oral care compared to standard practices. The reported moderate to large effect size signifies both statistical significance and clinical relevance, indicating that the intervention possesses substantial implications for patient outcomes. Klompas et al. (2017) found that using medicated mouthwash oral rinse in mechanically ventilated patients lowered the rates of VAP (22). Furthermore, a study conducted by Mastrogianni et al. (2023) illustrated that structured oral care protocols markedly decrease the occurrence of nosocomial infections, including ventilator-associated pneumonia (VAP), in intensive care unit (ICU) environments (23).

Nonetheless, notwithstanding these corroborative findings, certain studies have indicated contradictory evidence concerning the efficacy of medicated mouthwash. A comprehensive meta-analysis conducted by Klompas et al. (2014) indicated that although medicated mouthwash may decrease the incidence of ventilator-associated pneumonia (VAP), it does not substantially enhance mortality rates and may even pose risks of harm in specific patient demographics (22). Likewise, de Lacerda Vidal et al. (2017) found no significant decrease in VAP incidence with regular use of medicated mouthwash, prompting doubts regarding its widespread effectiveness (16). These differences may be due to differences in study design, patient groups, and intervention protocols. This shows that more research is needed in specific contexts.

The results of this study add to the ongoing discussion by providing evidence from a controlled, repeated measures design in a setting with limited resources. The steady drop in CPIS scores in the intervention group shows that using medicated mouthwash for oral care in a structured way, rather than just using it on its own, is important for getting the best results. Additionally, the repeated

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evaluations at various intervals bolster the reliability of the results by documenting the evolution of clinical status over time.

From a clinical standpoint, the findings of this study hold significant ramifications for nursing practice and ICU protocols. Using medicated mouthwash as part of a structured oral hygiene routine can be a cost-effective and practical way to lower the risk of VAP, especially in developing countries where healthcare resources are limited. The study also stresses how important it is to follow standardized care protocols and keep an eye on how patients are doing all the time.

This study has some limitations that should be taken into account, even though it has some strong points. The limited sample size may restrict the applicability of the findings, and the quasi-experimental design may introduce potential selection bias. The study concentrated on short-term outcomes, neglecting the evaluation of long-term effects associated with medicated mouthwash use. Subsequent research employing larger sample sizes, randomized controlled methodologies, and prolonged follow-up durations is essential to corroborate and enhance these findings.

In conclusion, the current study demonstrates that structured medicated mouthwash oral hygiene care is effective in lowering CPIS scores and preventing ventilator-associated pneumonia in mechanically ventilated patients. Although the results align with several prior studies, discrepancies in the literature underscore the necessity for ongoing research to develop standardized and context-specific guidelines for oral care in ICU environments.

REFERENCES

1. Fu LS, Zhu LM, Yang YP, Lin L, Yao LQ. Impact of oral care modalities on the incidence of ventilator-associated pneumonia in the intensive care unit: A meta-analysis. 2023;102(13):e33418.
2. Cai Y, Booraphun S, Li AY, Kayastha G, Tambyah PA, Cooper BS, et al. Cost-effectiveness of a short-course antibiotic treatment strategy for the treatment of ventilator-associated pneumonia: an economic analysis of the REGARD-VAP trial. The Lancet Global Health. 2024;12(12):e2059-e67.
3. Ulsamer A, Bonilla S, Pérez-Fernández X, Rello J, Sabater-Riera J. The pathogenesis of ventilator-associated pneumonia: old and new mechanisms. Expert Review of Respiratory Medicine. 2025;19(7):655-71.
4. Dai W, Lin Y, Yang X, Huang P, Xia L, Ma J. Meta-Analysis of the Efficacy and Safety of Medicated mouthwash for Ventilator-Associated Pneumonia Prevention in Mechanically Ventilated Patients. 2022;2022:5311034.
5. Yamakita S, Unoki T, Niiyama S, Natsuhori E, Haruna J, Kuribara T. Comparative efficacy of various oral hygiene care methods in preventing ventilator-associated pneumonia in critically ill patients: A systematic review and network meta-analysis. Plos one. 2024;19(12):e0313057.
6. Sadeghigolafshani M, Papi S, Maghsoodloo E, Rostamvand M. The role of oral care in reducing hospital-acquired infections and improving the health of critically ill patients: A narrative review. Journal of Dental Advances in Clinical Sciences. 2025;1(1):38-42.
7. Zhao T, Wu X, Zhang Q, Li C, Worthington HV, Hua F. Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia. The Cochrane database of systematic reviews. 2020;12(12):Cd008367.
8. De Cassai A, Pettenuzzo T, Busetto V, Legnaro C, Pretto C, Rotondi A, et al. Medicated mouthwash is not effective at any concentration in preventing ventilator-associated pneumonia: a systematic review and network meta-analysis. Journal of anesthesia, analgesia and critical care. 2024;4(1):30.
9. Scannapieco FA, Bush RB, Paju S. Associations between periodontal disease and risk for nosocomial bacterial pneumonia and chronic obstructive pulmonary disease. A systematic review. Annals of periodontology. 2003;8(1):54-69.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

10. Helman DL, Jackson WL, Shorr AF, editors. Oral decontamination with medicated mouthwash reduces ventilator associated pneumonia due to gram positive but not gram negative pathogens. CRITICAL CARE MEDICINE; 2007: LIPPINCOTT WILLIAMS & WILKINS 530 WALNUT ST, PHILADELPHIA, PA 19106-3621 USA.
11. Munro CL, Grap MJ, Jones DJ, McClish DK, Sessler CN. Medicated mouthwash, toothbrushing, and preventing ventilator-associated pneumonia in critically ill adults. American journal of critical care. 2009;18(5):428-37.
12. Tantipong H, Morkchareonpong C, Jaiyindee S, Thamlikitkul V. Randomized controlled trial and meta-analysis of oral decontamination with 2% medicated mouthwash solution for the prevention of ventilator-associated pneumonia. Infection Control & Hospital Epidemiology. 2008;29(2):131-6.
13. Grap MJ, Munro CL, Hamilton VA, Elswick Jr R, Sessler CN, Ward KR. Early, single medicated mouthwash application reduces ventilator-associated pneumonia in trauma patients. heart & lung. 2011;40(5):e115-e22.
14. Zhang Q, Li C, Worthington HV, Hua F. Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia. Cochrane Database of Systematic Reviews. 2020(12).
15. Zand F, Zahed L, Mansouri P, Dehghanrad F, Bahrani M, Ghorbani M. The effects of oral rinse with 0.2% and 2% medicated mouthwash on oropharyngeal colonization and ventilator associated pneumonia in adults' intensive care units. Journal of critical care. 2017;40:318-22.
16. de Lacerda Vidal CF, Vidal AKdL, Monteiro Jr JGdM, Cavalcanti A, Henriques APdC, Oliveira M, et al. Impact of oral hygiene involving toothbrushing versus medicated mouthwash in the prevention of ventilator-associated pneumonia: a randomized study. BMC infectious diseases. 2017;17(1):112.
17. Berry AM, Davidson PM, Nicholson L, Pasqualotto C, Rolls K. Consensus based clinical guideline for oral hygiene in the critically ill. Intensive and Critical Care Nursing. 2011;27(4):180-5.
18. Azab SF, Sherbiny HS, Saleh SH, Elsaeed WF, Elshafiey MM, Siam AG, et al. Reducing ventilator-associated pneumonia in neonatal intensive care unit using "VAP prevention Bundle": a cohort study. BMC infectious diseases. 2015;15(1):314.
19. Fourrier F, Dubois D, Pronnier P, Herbecq P, Leroy O, Desmettre T, et al. Effect of gingival and dental plaque antiseptic decontamination on nosocomial infections acquired in the intensive care unit: a double-blind placebo-controlled multicenter study. Critical care medicine. 2005;33(8):1728-35.
20. Segers P, Speekenbrink RG, Ubbink DT, van Ogtrop ML, de Mol BA. Prevention of nosocomial infection in cardiac surgery by decontamination of the nasopharynx and oropharynx with medicated mouthwash gluconate: a randomized controlled trial. Jama. 2006;296(20):2460-6.
21. Chan EY, Ruest A, Meade MO, Cook DJ. Oral decontamination for prevention of pneumonia in mechanically ventilated adults: systematic review and meta-analysis. Bmj. 2007;334(7599):889.
22. Klompas M, editor Oropharyngeal decontamination with antiseptics to prevent ventilator-associated pneumonia: rethinking the benefits of medicated mouthwash. Seminars in respiratory and critical care medicine; 2017: Thieme Medical Publishers.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

23. Mastrogianni M, Katsoulas T, Galanis P, Korompeli A, Myrianthefs P. The impact of care bundles on ventilator-associated pneumonia (VAP) prevention in adult ICUs: a systematic review. Antibiotics. 2023;12(2):227.