

Effect of Oral Health-Based Care Program on Ventilator-Associated Pneumonia in Intensive Care Units: Systematic Review and Meta-Analysis in Iran

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ABSTRACT

Background: Ventilator-associated pneumonia (VAP) is a highly prevalent complication of ICU admission. the aim study This systematic review and meta-analysis aimed to determine the effect of an oral care program on oral health (OH) status and prevention of VAP in ICUs in Iran.

Methods: This systematic review and meta-analysis were conducted on the group of articles published on patients hospitalized in ICUs in Iran in 2024. This review included published articles that aimed to assess the effectiveness of care programs or educational interventions in preventing VAP in patients hospitalized in ICUs in Iran. Data search and extraction were performed by two independent researchers in Persian and English between 2004 and 2024. The extracted articles were entered into EndNote software and analyzed using CMA software.

Results: The results showed that, at the beginning of the search, 92 articles were found, and after the final conclusion, five articles entered the meta-analysis stage. Also, VAP prevalence in intervention group was 15% (CI: 6.2-31.9%), and VAP prevalence in control group was 39.5% (CI: 21.1-61.4%).

Conclusion: It is recommended for preventing VAP that OH programs and interventions be carried out in an ICU.

Introduction

Oral health care (OHC) is an important and integral factor in human health and well-being. OHC refers to the way in which the oral cavity remains healthy [1-3].

In Iran, the costs of treating oral and dental expenses are high. So one of the most expensive treatment costs is related to dental expenses, and for this reason, many dental services have been ignored. OHC, an important branch of public health, prevents diseases and promotes health. Therefore, maintaining oral and dental health

plays a crucial role in preventing or worsening chronic systemic diseases [4-6].

Although oral diseases affect all age groups, some groups in society are more vulnerable than others due to specific physiological conditions. Hospitalized patients, especially those admitted to the ICU, are at higher risk of various diseases and complications of hospitalization [7-10]. Complications of hospitalization in the ICU include infection, pressure ulcers, delirium, and ventilator-associated pneumonia [11-15].

VAP is a complication of ICU admission. VAP is defined as pneumonia that occurs approximately 48-72 hours after intubation. *Staphylococcus aureus* and

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Pseudomonas aeruginosa and other pathogens are also implicated in VAP [16-18].

Given the association between oral microbial flora and VAP and the role of dental plaque as a reservoir of microorganisms involved in VAP, more importance should be given to the role of oral hygiene in preventing VAP [19-20]. Patients admitted to the ICU are at higher risk of developing VAP due to their inability to perform self-care and comply with oral hygiene protocols, including rinsing the oral cavity, using antimicrobial agents, and brushing [17, 21].

Methods

This study was conducted in the group of published articles on patients hospitalized in ICUs in Iran in 2024. This review included published articles (Persian and English) that aimed to assess the impact of care programs or educational interventions on preventing VAP in patients hospitalized in ICUs in Iran.

The keywords used included ventilator-associated pneumonia, ventilator-associated, ventilator bundle, VAP, nose, tooth brushing, intensive care units, intratracheal intubation, oral health, oral hygiene, oral care, and pneumonia. These keywords were searched in Google Scholar and domestic databases in Iran and

international databases, including ISI, Scopus, PubMed, Science Direct, and EBSCO.

Data search and extraction were conducted by two independent researchers (one Associate Professor of Periodontology and one Associate Professor of Anesthesiology) in Persian and English between 2004 and 2024. Initially, the title and abstract of the extracted articles were studied, and if they met the inclusion and exclusion criteria, the full article file was extracted for further review.

To extract data, a data extraction form was used, which included sections such as the authors' characteristics and year of publication, the purpose of the study, the type of research, the sample size and the method of data collection, and the results of the prevalence of VAP. The extracted articles were imported into EndNote software and analyzed using CMA software.

Results

At the beginning of the search, 92 articles were found, and after the final conclusion, 5 articles entered the meta-analysis stage (Table 1). Overall, VAP prevalence in the intervention group was 15% (CI: 6.2-31.9%), and VAP prevalence in the control group was 39.5% (CI: 21.1-61.4%) (Figure 1 and 2).

Table 1– Article specifications

-	Author	Year	City	Number	Intervention%	Control%
1	Karimi et al [17]	2023	Kermanshah + Kurdistan	200	5%	64%
2	Halili et al [22]	2024	Isfahan	62	32.2%	55%
3	Haghighi et al [23]	2016	Mazandaran	100	10%	14%
4	Atashi et al [24]	2018	Isfahan	76	7.9%	23.7%
5	Khalifehzadeh et al [25]	2012	Isfahan	54	37%	48.1%

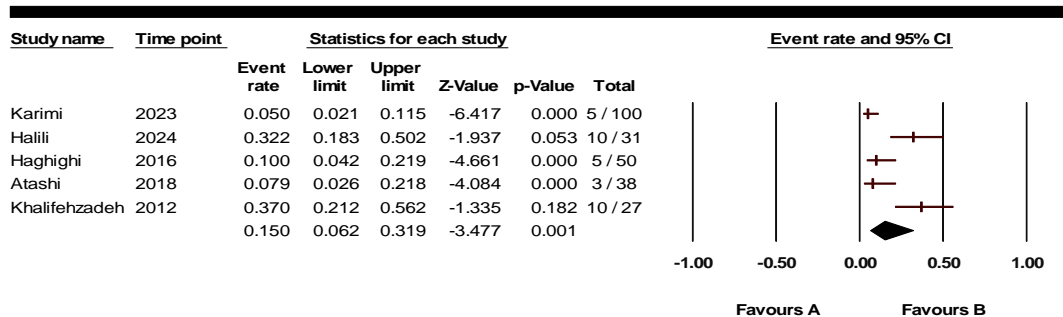


Figure 1- Prevalence of VAP in patients in the intervention group

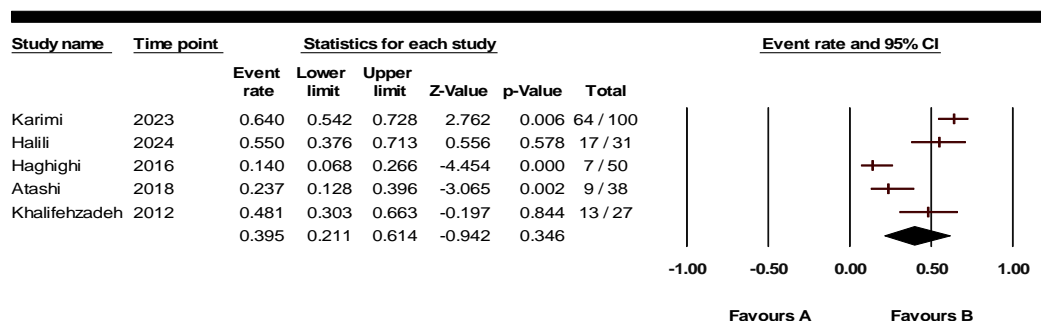


Figure 2- Prevalence of VAP in patients in the control group

Article specifications

1- In the study by Karimi et al. [17], in the ICU ward with neurological diseases in Kermanshah and Kurdistan. For the control group, routine care was performed, including.

1: Use regular saline for rinsing the mouth and mouth and lung suctioning. 2: Cleansing with gauze (tongue and tooth), 3: Rinsing with chlorhexidine 0.2%. For the intervention group, in addition to the items performed for the control group, interventions included monitoring the implementation of oral hygiene instructions, including 7 steps of personnel hand washing, oral examination, and reporting of abnormal cases; increasing the patient's bed height and how to suction the subglottic area; how to properly brush the patient's teeth; rinsing the patient's mouth with normal saline solution; using chlorhexidine gluconate 0.2%; and using a moisturizing gel every 4 hours. According to the findings, DMFT, mean \pm SD for the experimental group was 17.15 ± 4.97 , and for the control group was 15.92 ± 4.54 (P value = 0.07) [17].

2- In the study by Halili et al. [22], control group received routine care, including cleaning the external nostrils. For the intervention group, a 5-day nasal care program was designed and implemented, which included the following items.

3- In the study by Haghighi et al. [23], from Mazandaran city were experimental group received care designed by researchers. Researchers used Mucosal-Plaque and BOAS tools to diagnose VAP. The experimental group underwent endotracheal tube cuff pressure adjustment. Then, tooth brushing was performed with toothpaste, and disinfectants and moisturizers were used in the next stage. According to the findings, 5 days after the intervention, the rate of VAP was reported to be 14% in the control group and 10% in the experimental group.

4- In the study by Atashi et al. [24], number of times of care provided varied depending on the patient's needs and between 4 and 12 hours. According to the findings, the rate of VAP on the third day after the intervention in the

control group was 15.8% and, in the test group, was 10.5%.

5- In the study by Khalifehzadeh et al. [25], experimental group received oral care along with brushing. According to the findings, the rate of VAP was reported to be 37%.

Discussion

Hospitalization of patients, especially in the ICU, leads to problems in oral and dental health. In fact, these patients suffer from oral lesions due to factors such as medication use, swallowing disorders, chewing disorders, and intubated patients. Therefore, implementing OHC in hospitals can lead to improving patient health [26].

The results of various studies show the effect of educational interventions based on oral health on improving the health of patients. So that in the study of Soltani et al., after the intervention, the score of oral care behaviors in mothers and children increased 3 and 6 months later [27]. Also, in the review study of Bashirian et al., which reviewed 25 articles, the training given to the elderly improved their oral health [28]. The results of the aforementioned studies are consistent with this review study that implementing a care program can improve the health of patients and reduce VAP in them.

The results of the studies show a change in the patient's OH after hospitalization. So that in the systematic review study of Terezakis et al. that examined hospitalized patients, it was shown, the level of gingival inflammation and mucosal health worsened. In fact, the OH status of hospitalized patients, especially intubated patients, was worse than before hospitalization [29].

This review showed that the content of the oral health-based care program included methods such as teaching how to suction the subglottic area, teaching how to brush your teeth, examining your mouth and reporting abnormalities, raising the patient's bed, rinsing your mouth with normal saline, using a 65% sodium chloride nasal spray, and providing necessary training to staff. While in the review study by Dos Santos et al., who

reviewed 8 articles, routine dental care methods performed in ICU wards included the use of a soft bristle brush, lip moisturizing, and use of chlorhexidine [30]. It seems that since the care items performed in this care program were more and more effective, the rate of VAP decreased.

Conclusion

It is recommended for preventing VAP that OH programs and interventions be carried out in an ICU.

References

- [1] Heidarpour P, Tajari M. Evaluating oral and dental health and the related factors regarding the elderly in Aliabad city of Golestan province in 2022. *Tolooebehdasht*. 2024;22(6):15-29.
- [2] Karami K, Shakerinejad G, Kabiry B. Effect of education based on health belief model on students' oral health behavior change. *J Ilam Univ Med Sci*. 2014;21(7):134-41.
- [3] Jones J, Roberts E, Cockrell D, Higgins D, Sharma D, editors. Barriers to oral health care for autistic individuals—a scoping review. *Healthcare*. 2024;12(1):1-15.
- [4] Karimi Shahanjarini A, Makvandi Z, Faradmal J, Bashirian S, Hazavehei SM. Assessing the tooth decay status of 2-5 years children and the role of their mothers' caring behaviors. *Avicenna J Nurs Midwifery Care*. 2013;21(4):41-50.
- [5] Ebrahimipour H, Mohamadzadeh M, Niknami S, Ismaili H, Vafaii Najjar A. The effect of educational programs based on the theory of planned behavior to improve the oral health behavior of pregnant women attending urban health facilities Ashkhaneh city in 2014. *J North Khorasan Univ Med Sci*. 2015;7(1):7-18.
- [6] Allen F, Tsakos G. Challenges in oral health research for older adults. *Gerodontology*. 2024;41(1):2-8.
- [7] Chanthavisouk P, Ingleshwar A, Theis-Mahon N, Paulson DR. The oral health impact of dental hygiene and dental therapy populations: a systematic review. *J Evid Based Dent Pract*. 2024;24(1):101949.
- [8] Henni SH, Skudutyte-Rysstad R, Ansteinsson V, Hellesø R, Hovden EAS. Oral health and oral health-related quality of life among older adults receiving home health care services: a scoping review. *Gerodontology*. 2023;40(2):161-71.
- [9] Cheon H-W, Yu M-S, Choi M-H. The association of oral diseases and chronic diseases in Korean adult population. *J Korean Soc Dent Hyg*. 2012;12(2):235-49.
- [10] Lee HJ, Huh Y, Sunwoo S. Association between the number of chronic diseases and oral health problems in Korean adults. *Oral Health Prev Dent*. 2024;22(1):1-10.
- [11] Karimian M, Khalighi E, Salimi E, Borji M, Tarjoman A, Mahmoudi Y. The effect of educational intervention on the knowledge and attitude of intensive care nurses in the prevention of pressure ulcers. *Int J Risk Saf Med*. 2020;31(2):89-95.
- [12] Khalighi E, Tarjoman A, Abdi A, Borji M. The prevalence of delirium in patients in Iran: a systematic review and meta-analysis. *Future Neurol*. 2019;14(4):FNL34.
- [13] Mohammadi HR, Erfani A, Sadeghi S, Komlakh K, Otaghi M, Vasig A. Investigating factors affecting mortality due to spinal cord trauma in patients admitted to the intensive care unit. *Bull Emerg Trauma*. 2024;12(3):136-41.
- [14] Mohammadi HR, Asadoola Y, Erfani A, Ghoreishi Amin N, Karimiyarandi H, Sadeghi S, et al. Effectiveness of pulse intravenous infusion of methylprednisolone on pain in patients with lumbar disc herniation: a randomized controlled trial. *Anesth Pain Med*. 2024;14(4):e149442.
- [15] Young PJ, Delaney A, Hills T. Ventilator-associated pneumonia: a problematic outcome for clinical trials. *Crit Care Resusc*. 2023;25(4):159-60.
- [16] Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 clinical practice guidelines by the Infectious Diseases Society of America and the American Thoracic Society. *Clin Infect Dis*. 2016;63(5):e61-e111.
- [17] Karimi S, Kolyaei E, Karimi P, Rahmani K. Effectiveness of supervised implementation of an oral health care protocol on ventilator-associated pneumonia patients in intensive care units: a double-blind multicenter randomized controlled trial. *Infect Prev Pract*. 2023;5(3):100295.
- [18] Darbanian N, Nobahar M, Ghorbani R. Effect of propolis mouthwash on the incidence of ventilator-associated pneumonia in intensive care unit patients: a comparative randomized triple-blind clinical trial. *BMC Oral Health*. 2024;24(1):636.
- [19] Guillaumet CV, Kollef MH. Ventilator associated pneumonia in the ICU: where has it gone? *Curr Opin Pulm Med*. 2015;21(3):226-31.
- [20] Sands KM, Twigg JA, Wise MP. Oral hygiene with chlorhexidine in critically ill patients. *JAMA Intern Med*. 2015;175(2):316.
- [21] Johnstone L, Spence D, Koziol-McClain J. Oral hygiene care in the pediatric intensive care unit: practice recommendations. *Pediatr Nurs*. 2010;36(2):85-96.
- [22] Halili A, Ghafari S, Saghaei M, Atashi V. Prevention of ventilator-associated pneumonia by a nose care program combining with oral care among patients hospitalized in intensive care units: a single-blind randomized controlled trial. *Med Clin Pract*. 2024;7(1):100401.
- [23] Haghighi A, Shafipour V, Bagheri-Nesami M, Gholipour Baradari A, Yazdani Charati J. The impact

- of oral care on oral health status and prevention of ventilator-associated pneumonia in critically ill patients. *Aust Crit Care*. 2017;30(2):69-73.
- [24] Atashi V, Yousefi H, Mahjobipoor H, Bekhradi R, Yazdannik A. Effect of oral care program on prevention of ventilator-associated pneumonia in intensive care unit patients: a randomized controlled trial. *Iran J Nurs Midwifery Res*. 2018;23(6):486-90.
- [25] Khalifehzadeh A, Parizade A, Hosseini A, Yousefi H. The effects of an oral care practice on incidence of pneumonia among ventilator patients in ICUs of selected hospitals in Isfahan, 2010. *Iran J Nurs Midwifery Res*. 2012;17(3):216-9.
- [26] Jun M-K, Ku J-K, Kim I-h, Park S-Y, Hong J, Kim J-Y, et al. Hospital dentistry for intensive care unit patients: a comprehensive review. *J Clin Med*. 2021;10(16):3681.
- [27] Soltani R, Sharifirad G, Mahaki B, Eslami AA. The effect of oral health educational intervention program among mothers of children aged 1-6, based on the theory of planned behavior. *J Dent*. 2020;21(4):292-9.
- [28] Bashirian S, Khoshravesh S, Ayubi E, Karimi-Shahanjarini A, Shirahmadi S, Solaymani PF. The impact of health education interventions on oral health promotion among older people: a systematic review. *BMC Geriatr*. 2023;23(1):548.
- [29] Terezakis E, Needleman I, Kumar N, Moles D, Agudo E. The impact of hospitalization on oral health: a systematic review. *J Clin Periodontol*. 2011;38(7):628-36.
- [30] Dos Santos AA, Silva LDdA, Santos CCdO, Fonseca-Silva T. Oral care practices for patients in intensive care unit: a systematic review. *Int J Dent Hyg*. 2024;22(1):1-15.