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# Effects of hydrogen peroxide mouthwash on preventing ventilator-associated pneumonia in patients admitted to the intensive care unit

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ABSTRACT

*Aims:* The aim of the study was to determine the effect of hydrogen peroxide (HP) mouthwash on the incidence of ventilator associated pneumonia (VAP) in patients admitted to the intensive care unit (ICU).

*Methods:* This was a randomized clinical trial conducted on 68 patients. The intervention group used 3% HP as mouthwash and the control group used mouthwashes with 0.9% normal saline (NS) twice a day. Data were collected using a questionnaire and the Modified Clinical Pulmonary Infection Score (MCPIS). MCPIS includes five items, body temperature: white blood cell count, pulmonary secretions, the ratio of pressure of arterial oxygen ($PaO_2$) to fraction of inspired oxygen ($FiO_2$), and the chest X-ray. Each of these items scored 0–2. Scores $\geq$6 were considered as VAP signs. The SPSS-20 software was employed to analyze the data.

*Results:* In total, 14.7% patients of the HP group and 38.2% patients of the NS group contracted VAP. The risk of VAP in the NS group was 2.60 times greater than that in the HP group (RR = 2.60, 95% CI: 1.04–6.49, $p = 0.0279$). The mean $\pm$ SD MCPIS was calculated as $3.91 \pm 1.35$ in the HP group and $4.65 \pm 1.55$ in the NS group, a difference statistically significant ($p = 0.042$). There were no significant differences in the risk factors for VAP between the two groups.

*Conclusion:* HP mouthwash was found more effective than NS in reducing VAP. HP mouthwash can therefore be used in routine nursing care for reducing VAP.



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## Introduction

Nosocomial pneumonia is the most common intensive care unit (ICU) infection.[1–3] Around 80–90% of patients with nosocomial pneumonia are mechanically ventilated.[4,5] Ventilator associated pneumonia (VAP) is the inflammation of the lung parenchyma caused by infection after the patient is connected to the mechanical ventilator.[6,7] Therefore, patients with VAP have a tracheal tube inserted or are under tracheostomy or might even be in the process of disconnecting from the ventilator in the 48 h preceding the onset of symptoms.[6,7] VAP represents a major public health issue in Asian countries and worldwide.[8] The prevalence of VAP is 22.5% and 18.2% in general and intensive surgical wards of the hospitals affiliated to Tehran University of Medical Sciences in Iran,[9] and 16.2% in China.[10] VAP is one of the most common nosocomial infections in Asian countries,[11] caused by highly resistant bacterial,[8] and a mortality rate ranging from 18.7% to 40.8%.[11] Access to appropriate antibiotic therapy for VAP is costly[12]; moreover, Asian countries exhibit different patterns of epidemiology, etiology, and drug resistance profile compared with Western countries.[13]

The best way to prevent VAP is to use mouthwash.[14] The American Association of Critical-Care Nurses (AACN) (2003) proposed mouthwash not only to bring comfort to the patients, but also as a nursing care for the prevention of VAP.[15,16] The AACN guideline recommends to brush the teeth twice a day, swab the mouth every 2–4 h, and suction to clear secretions from the mouth.[15] Oral rinsing with a solution, gel, and brush, or a combination of these along with aspiration, reduces the risk of VAP in patients under ventilation. Previous studies that have aimed to assess the incidence of VAP have shown no difference between mouthwash and oral care without brushing, with or without the use of mouthwash solution.[7] Although some institutions do not follow the AACN recommendations, it is actually oral care that helps preventing VAP.[15] Using mouthwash in the patients is one of the main responsibilities of ICU nurses. However, despite the importance of using mouthwash for reducing VAP, its application is often neglected or carelessly performed due to the critical conditions of the patients and their severe physiological deficiencies.[15,16]

Various solutions are used as mouthwash. Tap water might be plentiful and economical; however, it is a source of nosocomial infections and is therefore not recommended.[16,17] The application of NS is restricted due to the dry mouth and patients intolerance.[17] The long-term use of povidone–iodine as a mouthwash solution at ICUs is also not recommended due to its absorption, modifications of the normal oral flora and microbial resistance it may cause.[18] Sodium bicarbonate solution is a mouthwash that softens the hardened mucosa[17] but causes greater bacterial plaque accumulation compared to chlorhexidine. Chlorhexidine is therefore considered an anti-plaque agent with antimicrobial properties that does not lead to bacterial resistance in the oral cavity.[1,17,18] Most of the evidence suggests that the use of chlorhexidine is preferred for cardiac surgery patients; yet, its benefits in ICUs are unknown and its routine use is not recommended for all ICU patients.[15,17] The Society of Critical Care Medicine and the Centers for Disease Control and Prevention have recommended the use of chlorhexidine mouthwash for cardiac surgery patients and stated that its benefits for other patients are unknown.[19] In addition, chlorhexidine has certain side-effects, mainly including tooth discoloration, bitter taste, impaired palate, mucosal damage, oral edema, facilitating tartar build-up above the gum line, and unilateral and bilateral parotid inflammation.[20]

HP is a colorless liquid with a strong oxidizing activity that has been used as a tooth whitener and anti-plaque agent for over 100 years. Through producing free radicals, this solution has a killing effect on Gram-positive and Gram-negative bacteria – particularly anaerobic bacteria. In addition to its antibacterial properties, at 1.5–3% concentrations, it effectively reduces gingival infections and dental plaque.[20] The use of maximum 3% concentrations of HP as a mouthwash has been approved by the American Food and Drug Administration.[21] The most common side-effects of 3% and lower concentrations of HP include temporary tooth sensitivity and gingival disorders, which are clinically negligible and do not prohibit the use of HP as a mouthwash.[22]

During the past decade, a wealth of evidence have confirmed HP safety; today, many oral hygiene centers use HP.[22] In another review study, Berry et al. emphasized the need for assessing the effect of HP in preventing VAP.[17] Given there are no definitive choice of solutions for this purpose, and considering that the effect of HP solutions has not been studied on the incidence of VAP, and also given the high prevalence of VAP in ICUs, the increasing medical costs associated with it, its mortality rate and the substantial effect of mouthwash in its prevention, conducting a study that seeks to find an effective disinfectant solution for reducing VAP seemed essential. The present study therefore aimed to determine the effect of HP mouthwash on the incidence of VAP in ICU patients.

### *Type of study*

Sixty-eight patients with endotracheal tube and mechanical ventilation were enrolled in this randomized controlled clinical trial, which was conducted at the medical and at the surgical ICUs, between May 23rd and December 23rd, 2013. The study inclusion criteria consisted of being over the age of 18, having been under mechanical ventilation for over 48 h, having had no more than one intubation attempt, no facial or oral trauma, no contra-indications to neither mouthwash use nor to 30° bed head elevation, no history of HP allergies, and no evidence suggesting VAP or aspiration. The study exclusion criteria consisted of having had pneumonia prior to the beginning of the study and in the first 48 h of mechanical ventilation, transfer from other departments and the elapse of 24 h since the insertion of the tracheal tube, the removal of the tracheal tube for any reason during the 5 days the study was being conducted, and the patient's death or transfer from the internal unit to the surgery ICU and vice versa at any time during the 5 days of the study.

Those who met the aforementioned criteria were selected as study subjects and were randomly assigned to either the intervention group or the control group using block randomization and after matching for age (maximum 5 years difference), type of ICU (medical or surgery), and APACHE II