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Oral hygiene for severe care: a literature review

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ABSTRACT

The efficacy and quality of oral hygiene are currently a major concern, especially in intensive care patients.

This literature review assessed the available data on oral hygiene in intensive care patients using various antiseptics, as well as the methods of their use.

The literature search was performed using databases Scopus, PubMed, Web of Science, eLIBRARY.RU, and Google Scholar. Original peer-reviewed research on the clinical efficacy of oral care published between 2000 and 2023 were analyzed. The studies assessed the efficacy of hydrogen peroxide (*n*=2, 10%), chlorhexidine (*n*=10, 50%), Povidone-Iodine (*n*=2, 10%), and herbal formulations (*n*=4, 20%).

According to the majority of studies, oral hygiene in intensive care patients reduces the incidence of ventilator-associated pneumonia, but has no effect on the duration of artificial ventilation or the mortality rate.

The study discovered the absence of a universal, effective protocol for oral hygiene in intensive care patients, as well as guidelines for the selection of antiseptics, their concentration, and application methods. This subject necessitates further research.

Keywords: oral hygiene; ventilator-associated pneumonia; oral health; artificial ventilation; severe patients.

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Методы гигиены полости рта тяжелобольных пациентов в условиях реанимации и интенсивной терапии. Обзор литературы

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АННОТАЦИЯ

В настоящее время весьма актуальна проблема эффективности и качества гигиены полости рта, особенно для пациентов, находящихся в условиях интенсивной терапии.

В обзоре по данным литературы изучено состояние вопроса о гигиене полости рта у пациентов в условиях интенсивной терапии с использованием различных антисептических средств, а также проанализированы методы их применения.

Поиск литературы выполнен в базах данных Scopus, PubMed, Web of Science, eLIBRARY.RU, Google Scholar. Проанализированы оригинальные рецензируемые исследования с основным акцентом на оценку клинической эффективности ухода за полостью рта, изданные за 2000–2023 гг.: по эффективности применения пероксида водорода (*n*=2, 10%), хлоргексидина (*n*=10, 50%), Повидона-Йода (*n*=2, 10%), фитопрепаратов (*n*=4, 20%).

В большинстве исследований установлено, что гигиена полости рта пациентов, находящихся в условиях интенсивной реанимации, снижает частоту возникновения вентилятор-ассоциированной пневмонии, но не влияет на продолжительность пребывания на искусственной вентиляции лёгких и смертность.

Установлено, что отсутствуют универсальный и эффективный протокол проведения гигиены полости рта пациентов в условиях интенсивной терапии, а также рекомендации по выбору антисептика, концентрации и методу применения. Требуется дальнейшее изучение данного вопроса.

Ключевые слова: гигиена полости рта; ИВЛ-ассоциированная пневмония; здоровье полости рта; механическая вентиляция лёгких; тяжелобольные пациенты.

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ЭКО•ВЕКТОР

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INTRODUCTION

Oral hygiene is a key factor in ensuring general somatic health and maintaining the quality of patients' lives. The World Health Organization (WHO) defines oral health as "a condition free from pain in the maxillofacial area and the absence of oral diseases that limit the functions of chewing, speech formation, maintaining of facial expression and psycho-emotional state" [1]. During the patient's stay in the intensive care unit (ICU), oral hygiene indicators deteriorate [2]. Oral aeration is reduced in intensive care patients, which is a risk for the development of anaerobic infections. Due to reduced mobility of the mandible, tongue, oral muscles and soft palate muscles, saliva stagnates, which is also a risk of infections development, since saliva contains nutrients for bacteria [3–5]. Another predisposing factor for the development of bacterial infection is the presence of a foreign body in the respiratory tract and oral cavity of the patient (ventilator tube), since microorganisms can populate the surfaces of medical equipment and then move into the oral cavity, which provokes the spread of infection [6-10]. Insufficient oral hygiene contributes to the accumulation and colonization of dental plaque by pathogenic bacteria, which contribute to the spread of pathogens and increase the risk of pathology in other organs, especially the respiratory system [11–13]. Many studies show that the state of oral hygiene in the intensive care unit patients affects the occurrence of nosocomial pneumonia associated with artificial lung ventilator [11, 14, 15, 26]. Artificial lung ventilation is the most common cause of nosocomial infection in the resuscitation and intensive care unit and the second most common hospital-acquired infection. This serious disease with a mortality risk of up to 20% is closely related to intraoral bacteria [4]. Patients in this category need an extremely responsible approach to quality oral hygiene.

Mouth cavity treatment protocols for patients in intensive care unit and those on artificial lung ventilation vary in different countries and mainly include lifting the bed by 30-45 degrees, aspiration of the contents of the mouth cavity of patients, irrigation with antiseptic solutions, mechanical cleaning using a toothbrush and pressure control of the endotracheal tube cuff (ETT) [3, 4, 16]. The variety of aspiration systems in terms of stiffness and size, as well as the variation of antiseptic solutions in different concentrations, do not allow to standardize the hygiene procedure, but only recommend their frequency of use.

The end of 2019 marked the beginning of a pandemic in the world, namely, the emergence of the SARS-CoV-2 strain, a virus that causes COVID-19 in the human body, a disease characterized by shortness of breath, fever, and viral pneumonia, which can be fatal to vulnerable individuals. The pandemic had physical, social, and psychological consequences. All over the world, due to the rapid spread of the disease, many patients, and a shortage of doctors of profile specialties, doctors of all specialties were involved or retrained for the treatment of this category of patients. Similarly, in Russia, dentists, as volunteers, performed oral hygiene for critical patients in the resuscitation and intensive care unit. It was noted that nurses experienced difficulties in conducting oral hygiene due to the lack of proper training and knowledge in this field that dentists have, and that the protocol used does not produce high results. This determined the interest in studying the literature data on oral care of critically ill patients in the resuscitation and intensive care unit.

Currently, the problem of the effectiveness and quality of oral hygiene is very relevant, however, for patients in the resuscitation and intensive care unit this problem is extremely relevant.

Purpose: to study, according to the literature sources, the state of oral hygiene for patients in the ICU, with the use of various antiseptics and methods.

SOURCE SEARCH METHODOLOGY

A literature search was conducted in the Scopus, Pubmed, Web of science, Elibrary, Google Scholar databases for the study of methods and means of oral care for critical patients in intensive care unit for the period 2000–2023 by keywords: oral hygiene care, ventilator-associated pneumonia, oral health, mechanical ventilation, critical patients.

RESULTS

Scientific literature data for the period 2000-2023 indicate a wide range of oral hygiene methods using local/oral antimicrobial agents such as hydrogen peroxide, povidone iodine, chlorhexidine, sodium bicarbonate and phytopreparations [19–37].

In different countries, there are different protocols for the organization of oral hygiene in the intensive care unit patients, which are not always effective enough [5, 14, 17, 18].

The studies included in the review on the effectiveness of various antiseptics can be divided into groups of chlorhexidine (of different concentrations), sodium bicarbonate, povidone iodine, hydrogen peroxide (of different concentrations) and phytopreparations. The data of the search results are shown in Table 1.

Studies involving the use of hydrogen peroxide

In the studied literature, which met the search criteria, 2 (10%) papers present the use of hydrogen peroxide for oral hygiene of critical patients in comparison with control groups.

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Table 1. Oral hygiene products

Hygiene means	Number of studies *n* (%)	Study results
Hydrogen peroxide (H_2O_2)	2 (10)	The effectiveness of hydrogen peroxide for the prevention of VAP has been proven, and there are contraindications
Chlorhexidine (CHX)	10 (50)	The effectiveness of the use of chlorhexidine for the prevention of VAP in *n*=8 (40%) has been proven The effectiveness of the use of chlorhexidine for the prevention of VAP *n*=2(10%) has not been confirmed
Povidone iodine	2 (10)	Questionable (contradictory) results of effectiveness
Sodium bicarbonate	2 (10)	The effectiveness has not been proven
Phytopreparations	4 (20)	Contradictory results of VAP effectiveness

Hydrogen peroxide, due to the presence of free radicals, has an active effect on gram-positive and gram-negative bacteria, in particular, on aerobic bacteria. The use of hydrogen peroxide in concentrations of 1.5–3% effectively reduces dental plaque formation. At the same time, hydrogen peroxide has an irritating effect on the mucous membrane, an unpleasant taste and genotoxicity, which limits its use for oral hygiene in resuscitation and intensive care unit patients [17, 18].

In the work of Monir Nobahar et al. (2016), a randomized clinical trial was conducted to determine the effect of 3% hydrogen peroxide on the VAP frequency. 3% hydrogen peroxide (HP) was used as a mouthwash in the main group, and 0.9% normal saline (NS) was used in the control group. A total of 14.7% of patients in the main group and 38.2% of patients in the control group became infected with VAP. The risk of VAP in the NS group was 2.60 times higher than in the HP group (RR=2.60, 95% CI: 1.04-6.49, *p*=0,0279). There were no significant differences in risk factors for VAP between the two groups, however, HP mouthwash proved to be more effective in reducing VAP than NS [19].

In the study of Amiram Lev et al. (2015), patients in the main group received a com-prehensive oral hygiene procedure, which included brushing teeth with sodium bi-carbonate, suction Oral System from Sage Products LLC, rinsing with an antiseptic solution containing 1.5% hydrogen peroxide, and an oral moisturizer. Patients in the control group underwent oral hygiene with a sponge and 0.2% chlorhexidine solution. Among the 90 patients admitted to the intensive care unit, VAP developed in 8.9% of the main group compared to 33.3% of the control group (p <0.004). The average number of days of ventilation and the average number of days of hospitalization were also lower in the main group. Comprehensive oral hygiene regimen which included brushing teeth, antiseptic rinsing, and aspiration for patients on artificial lung ventilation is more effective in preventing VAP than traditional protocols [20].

Studies examining the use of chlorhexidine

Local application of chlorhexidine of various concentrations is widely used for hygiene in intensive care patients, since chlorhexidine is a broad-spectrum antiseptic that affects gram-positive and gram-negative bacteria, aerobes, facultative anaerobes, and fungi, increasing the permeability of the bacterial cell wall, causing lysis [38].

In the study of Koeman M. et al (2008) the effect of oral cavity treatment of intensive care patients with chlorhexidine (CHX, 2%) or combined chlorhexidine-colisterine (CHX-COL, 2–2%) on the frequency of VAP was determined. Irrigation was carried out every 6 hours. Smears were obtained daily and quantitative analysis for the presence of pathogenic microorganisms was performed. The results of the study showed comparable data in three groups. The risk of pneumonia was reduced in both treatment groups compared to placebo. The CHX-COL combination provided a significant reduction in colonization of the oropharynx by both gram-negative and gram-positive microorganisms, while CHX significantly affected only colonization by gram-positive microorganisms. The authors concluded that the use of chlorhexidine or the chlorhexidine-colisterine complex reduced the frequency of VAP [21].

In the study of Özçaka Ö. et al. (2012), the effectiveness of 0.2% chlorhexidine treatment and the risk of VAP in intensive care unit (ICU) patients were studied. Oral care included treatment of the oral mucosa four times a day with chlorhexidine solution (0.2%) and normal saline (0.9%) in the control group. Clinical studies of plaque accumulation indices were conducted, and exudate of the lower respiratory tract was studied by means of microbiological analysis. Pathogens were identified by quantitative colonies estimation using standard cultivation methods. The study found that VAP developed in 34 out of 61 patients (55.7%) within 6.8 days. The incidence of VAP was significantly higher in the control group than in the CHX group (68.8% vs. 41.4%,

respectively; *p*=0.03). *Acinetobacter baumannii* was the most common pathogen (64.7%) of all identified species. There were no significant differences between the two groups in clinical periodontal indices, VAP development time, pathogens detected, or mortality. The authors concluded that oral care using CHX reduces the risk of developing VAP in patients with mechanical ventilation, and recommended its use in intensive care units, noting the importance of proper oral hygiene in preventing medical complications [22].

In the study of Tantipong H. et al. (2008) the effectiveness of oral administration of chlorhexidine (2%) for the prevention of VAP compared with normal saline (0.9%) was determined. As a result, it was found that the incidence of VAP in the CHX group was 4.9% (5 out of 102), and the incidence in the normal saline group was 11.4% (12 out of 105) (*p*=0.08). The incidence of VAP in groups did not differ significantly [23].

In the randomized study of Claudia Fernanda de Lacerda Vidal et al. (2017) the effect of oral hygiene with toothbrushing and chlorhexidine (0.12%) in gel form on the frequency of VAP, duration of mechanical lung ventilation, length of hospital stays and mortality rate in intensive care units was checked, compared with oral hygiene without tooth-brushing only with irrigation with chlorhexidine solution (0.12%) in critical patients on artificial lung ventilation. The results showed that brushing teeth in combination with chlorhexidine gel (0.12%) demonstrated a lower frequency of VAP during the subsequent period, although the difference was not statistically significant (*p*=0.084). There was a significant reduction in the average mechanical ventilation time in the tooth-brushing group (*p*=0.018). Regarding the length of hospital stay in the intensive care unit and mortality rates, the difference was not statistically significant (*p*=0.064). The authors concluded that in the group of patients with mechanical brushing, there was a significant reduction in the duration of lung ventilation, as well as a tendency to reduce the frequency of VAP and the duration of stay in the intensive care unit, although without statistical significance [24].

Farid Zand et al. (2017) investigated the effect of mouth washing with chlorhexidine solution in two concentrations: 0.2% and 2% on colonization of the oropharynx and prevention of VAP. The results showed a significant decrease of VAP (*p*=0.007) and oropharynx colonization (*p*=0.007) in the group where oral care was performed with 2% chlorhexidine solution compared with the control group. However, no significant difference was found between the two groups in terms of oropharyngeal side effects (*p*=0.361). The authors concluded that oral disinfection with 2% CHX compared to 0.2% CHX is a more effective method of preventing VAP and reducing oropharyngeal colonization (especially gram-positive) [25].

In the study of Lorente L. et al. (2012), the efficacy of CHX was studied in two groups with or without a toothbrush. Patients of both groups received 0.12% chlorhexidine in the form of irrigation. Tracheal aspirate samples were analyzed during endotracheal intubation, then twice a week and during extubation. There were no significant differences between the two groups of patients in baseline characteristics, and no statistically significant differences were found between the groups in terms of the frequency of VAP (21 out of 217 (9.7%) with toothbrushing compared with 24 out of 219 (11.0%) without toothbrushing. The addition of manual brushing and chlorhexidine for oral care does not help prevent VAP in intensive care patients with mechanical lung ventilation [27].

In the study of Pobo A. et al. (2009) they studied the effectiveness of oral hygiene with 0.12% CHX (control group) and 0.12% CHX plus an electric brush (main group) in patients intubated for more than 48 hours on the development of VAP. As a result, it was found that both groups had the same indicators of VAP development (20.3% vs. 24.7%; *p*=0.55). The groups were comparable in duration of antibiotic administration, duration of artificial lung ventilation and mortality. The authors concluded that the addition of an electric toothbrush for brushing teeth to standard oral care using 0.12% CHX is ineffective for the prevention of VAP [28].

Roca Biosca A. et al. (2009) studied the DP plaque index in patients in the intensive care unit, where 0.12% CHX and an electric toothbrush were used in the main group, and only 0.12% CHX was used in the control group. As a result, it was found that the tendency to decrease the DP plaque index in the toothbrush group does not lead to decrease of VAP incidence rate. There were no significant differences in VAP incidence rate between the two groups (*p*=0,56) [29].

Meinberg M.C. et al. (2012) evaluated the effect of oral hygiene with chlorhexidine by brushing teeth on the frequency of VAP. The patients were randomly divided into two groups: in the main group, 2% chlorhexidine gel and tooth brushing were used, and in group 2 placebo gel with the same color and consistency and tooth brushing were used. The analysis of the results showed the development of pneumonia in 45.8% of cases in the placebo group and in 64.3% of cases in the group of chlorhexidine with tooth-brushing (RR=1.4; 95% CI=0,83–2.34; *p*=0.29). The authors discontinued the study and concluded that it was impossible to assess the effect of oral hygiene using 2% CHX and toothbrushing on the frequency of VAP in heterogeneous sampling of critical patients [30].

Zeynep Karakaya et al. (2022) in their study evaluated the effectiveness of oral care using the chlorhexidine solution (0.12%). Patients were randomly divided into two groups receiving CHX (0.12%) or placebo (0.9% NaCl). There was no difference in the

incidence of VAP, as well as in the type and distribution of microorganisms in the two groups (p >0.05). In the CHX and placebo groups, 21 and 22 patients with VAP were identified, respectively. Gram-negative bacteria were the most common (71.4% in the CHX group versus 54.5% in the placebo group). The authors concluded that a low concentration of CHX was ineffective for the prevention of VAP, especially in the presence of multi-resistant bacteria [31].

Studies examining the use of povidone iodine

Povidone iodine (PVP-I) is a water-soluble iodine complex that is widely used as a mouthwash for the prevention of oropharyngeal infections and VAP. Its antimicrobial action occurs after free iodine dissociates from polyvinylpyrrolidone, then iodine penetrates microorganisms, disrupting proteins and oxidizing the structures of nucleic acids, causing the death of pathogenic microorganisms [39, 40, 41, 42].

Philippe Seguin et al. (2006) conducted a study evaluating the effect of the use of povidone iodine on the prevalence of VAP. According to the results, it was concluded that regular administration of povidone iodine can be an effective strategy to reduce the prevalence of pneumonia associated with artificial lung ventilator [32]. A follow-up study by these authors in 2014 (Philippe Seguin et al. (2014) showed that ventilator-associated pneumonia occurred in 24 patients (31%) in the povidone iodine group and 20 (28%) in the placebo group (relative risk, 1.11 [95% CI, 0.67–1.82]; p=0,69). There was no significant difference between the two groups: eight patients (10%) in the povidone iodine group and five patients (7%) in the placebo group (relative risk, 1.48 [95% CI, 0.51–3.31; p=0.47). Acute respiratory distress syndrome occurred in five patients in the povidone iodine group, but not in the placebo group (p=0.06). The authors concluded that there is no evidence to recommend oral care with povidone iodine to pre-vent ventilator-associated pneumonia in high-risk patients [33].

Studies involving the use of sodium bicarbonate

Mouthwash solutions containing sodium bicarbonate reduce the viscosity of mucus and therefore facilitate the removal of biofilm. And high pH level suppresses the demineralization of hard tooth tissues and protects teeth from caries. However, solutions of high concentrations can have an irritating effect and cause chemical burns of the mucous membrane. Sodium bicarbonate preparations are not used independently, but only in combination with other hygiene means (hydrogen peroxide, phytopreparations and a toothbrush) [20, 34, 43, 44].

Studies involving the use of phytopreparations

A group of antiseptics based on phytopreparations (Listerine, Matrica, Persica) has mild anti-inflammatory and antibacterial properties, low toxicity, and low irritant effect on mucous membranes. In this regard, many researchers consider them as an alternative to the classic antiseptics.

Berry A.M. et al. (2013) tested the effectiveness of mouthwash with essential oil, Listerine(®) (Pfizer) and sodium bicarbonate after brushing with a soft brush in reducing dental plaque colonization by respiratory pathogens and subsequent development of VAP compared with control (distilled water). As a result of the study, no significant differences between the control and the studied groups in dental plaque colonization on day 4 were detected (p=0,243). Ventilator-associated pneumonia was diagnosed in 4.7% in the Listerine(®) group, 4.5% in the sodium bicarbonate group and 4.3% in the control group [OR, 0.99; 95% CI, from 0.31 to 3.16; p=0.92]. The authors concluded that mouth-washing with Listerine(®) or sodium bicarbonate was not more effective in reducing dental plaque colonization or VAP frequency. Considering the low frequency of VAP in this study, the factor of using a soft toothbrush for oral hygiene suggests possible efficacy [34].

Baradari A.G. et al. (2012) compared the antibacterial effect of chlorhexidine gluconate and herbal mouthwash in intensive care unit patients. Stimulated saliva was used to cultivate Staphylococcus aureus and Streptococcus pneumoniae. As a result, it was found that Matrica® mouthwash and chlorhexidine have a significant antibacterial effect against *Streptococcus pneumoniae* and *Staphylococcus aureus*. The decrease of the number of bacteria in the samples after mouth washing was significant in both groups (p <0.001), but chlorhexidine was significantly more effective than herbal mouthwash in reducing the number of colonies (p <0.001). The authors concluded that the herbal solution can be used as an alternative to chlorhexidine in intensive care units [35].

Darvishi Khezri et al. (2013) studied the antibacterial effects of 0.2% CHX, herbal mouthwash Matrica® (chamomile extracts) 10%, Persica™ 10% and normal saline in the intensive care unit patients. For the cultivation of Staphylococcus aureus and *S. pneumoniae*, unstimulated saliva was taken after six minutes of irrigation. As a result, decrease in the growth rate of bacterial colonies after irrigation was revealed in all groups (p <0.001). Chlorhexidine solutions (p <0.001), Persica™ (p=0.008) and Matrica® (p=0.01) had a significant antibacterial effect on *S. aureus* and *S. pneumoniae* (p <0.001). The authors came to conclusion that the herbal mouthwashes persica and matrica influenced *S. pneumoniae* and *S. aureus* in the oropharyngeal area in mechanically ventilated

patients. Thus, they can be used as an alternative to chlorhexidine for the prevention of VAP in the intensive care unit patients [36].

Azimi M. et al. (2016) determined the antimicrobial effect of chlorhexidine, Matrica mouthwash (chamomile extract) compared with normal saline in patients in the intensive care unit (ICU). Mouth washing was performed every 8–48 hours. The antibacterial activity of each mouthwash was measured based on the growth rate of microorganisms of Staphylococcus aureus, pneumococcus, enterococcus, pseudomonades and Escherichia coli. As a result, it was found that chlorhexidine mouthwash was more effective in preventing colonization of bacteria in the mouth compared to herbal solution and normal saline for the oral cavity. However, none of the mouthwashes tested were able to remove pathogens including Staphylococcus aureus, pseudomonades, klebsiella and actinobacteria. The authors concluded that chlorhexidine (0.2%) for mouth washing had a significant effect on the rate of bacterial colonization compared to Matrica and conventional salt mouthwash [37].

DISCUSSION

The results of this literature review suggest that oral care, including a set of measures (toothbrushing, aspiration, rinsing with antiseptics, water, herbal solutions, etc.) significantly reduces the prevalence of VAP, but does not affect other important clinical results, such as mortality in the intensive care unit, duration of stay in the in-tensive care unit, duration of mechanical ventilation.

Even though this study is based on full-scale peer-reviewed published research, there are some limitations in it. It should be noted that there was significant heterogeneity among the studies, including different sampling of patients, the diagnosis of the underlying disease, the type of surgery performed, the treatment protocol, VAP de-termination, antiseptic concentrations, agent forms (oral rinsing, gel, spray, brush) and frequency of use. These factors can have a potential impact on the results and conclusions. Studies with small patient groups were excluded in this review, however, some of the included studies had a modest amount of sampling, which could overestimate the results compared to larger trials.

The need for oral hygiene in the intensive care unit patients is noted by many re-searchers [11, 14, 15, 21, 24, 26], but data of Meinberg M.C. et al. (2012) did not find a correlation between the effect of oral hygiene on the risk of VAP occurrence, the general condition of patients and mortality in the intensive care unit. Studies of Philippe Seguin et al. in 2006 and 2014 on the use of povidone iodine have opposite conclusions, which characterizes these works as contradictory and requiring further research.

The “gold standard” of antiseptic used for oral hygiene is CHX. However, there is no single approach regarding the CHX concentration for hygiene, the form of application (solution, gel, paste) and the method of application that meets the requirements of the intensive care unit [21, 22, 24, 25]. The issues of patient safety and the frequency of the procedure require further study. In the works of Claudia Fernanda de Lacerda Vidal et al. (2017), Lorente L. et al. (2012), Pobo A. et al. (2009), Roca Biosca et al. (2011) and Meinberg M.C. et al. (2012) the similar study design [27, 28, 29, 30], the use of mechanical plaque removal (toothbrush) and irrigation with CHX are used. However, with the same study design, the authors obtained different results: Claudia Fernanda de Lacerda Vidal et al. (2017), Lorente L. et al. (2012) noted an unreliable decrease of the frequency of VAP. Pobo A. et al. (2009) and Roca Biosca et al. (2011) noted the lack of effectiveness of CHX for the prevention of VAP, and the results of Meinberg M.C. et al. (2012) were recognized by the authors as futile, and the study was discontinued.

Studies of other antiseptics, such as hydrogen peroxide, povidone iodine and phytopreparations for the prevention of VAP, give ambiguous, often contradictory results [19, 20, 32–37].

In general, considering the limitations mentioned above, we must interpret our results with caution. However, given the relatively small sampling and heterogeneity among the studies, further searches for methods and means of monitoring the state of oral hygiene in the intensive care unit patients are necessary.

CONCLUSION

As a result of most studies, it was found that oral hygiene in the intensive resus-citation unit patients reduces the incidence of VAP but does not affect the duration of stay on artificial lung ventilation, in resuscitation unit and mortality. There is no universal and effective protocol for conducting the oral hygiene in the intensive care unit patients, as well as recommendations on the choice of antiseptic, concentration, and method of application. Further study of this issue is required.

ADDITIONAL INFORMATION

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