

# The trend of research on oral hygiene in intubated patient based on bibliometric analysis

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## Abstract

**Background:** ICU patients with critical conditions are generally intubated due to their inability to breathe independently. These patients require assistance from nurses in meeting their basic needs, one of which is oral hygiene. ICU nurses use several protocols when doing oral hygiene in intubated patients.

**Purpose:** This study was conducted to reveal the trend of research on oral hygiene in intubated patients in the last two decades through bibliometric analysis.

**Methods:** This study is a quantitative research. The research publications were collected from the Scopus and PubMed databases through the Publish or Perish application. Then, for further analysis, the VOSViewer application was used to create visualization maps of co-occurring terms that include the research themes.

**Results:** There were a total of 88 publications from two databases in the last two decades that discussed oral hygiene in intubated patients. Visualization in VOSViewer illustrates five main clusters on oral hygiene-intubated patients. Most of the publication themes were oral hygiene protocols and the relationship between the oral hygiene and VAP incidence. However, suction toothbrush as one of the oral hygiene protocol did not appear in the co-occurring terms in the first search; therefore, the researchers conducted a separate search about this term.

**Conclusion:** Based on the analysis, the most common themes used are oral hygiene protocols and the relationship between oral hygiene and VAP in the last two decades. However, research on suction toothbrush as one of the protocols is still lacking, so it can be used as a novelty in conducting further research.

**Keywords:** bibliometric; intubated patient; oral hygiene; suction toothbrush

## Introduction

Patients admitted to the Intensive Care Unit (ICU) are patients with critical conditions who are generally intubated and use mechanical ventilation to help them breathe (Zhao et al., 2020). In intubated patients, oral immunity will tend to decrease, which causes the colonization of microorganisms in the mouth to develop rapidly and cause oral health problems. These patients need help from nurses in meeting their basic needs, including oral hygiene. Oral hygiene is a form of personal hygiene measure to maintain the health of the mouth, teeth, and orofacial structures. Maintaining oral hygiene is essential to support humans in daily activities (World Health Organization, 2023). In dependent patients, such as in the ICU, oral hygiene care must be carried out by health professionals, one of which is a nurse, to prevent aspiration of oral cleaning fluids. Routine oral hygiene care is carried out to remove plaque and debris and replace the function of saliva in moisturizing and cleaning the oral cavity (Zhao et al., 2020).

Poor oral hygiene can lead to severe complications such as pneumonia and other infections (Murray & Scholten, 2018). Oral hygiene in intubated

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patients is closely related to the incidence of ventilator-associated pneumonia (VAP), which is the most common cause of morbidity and mortality in the ICU. VAP is pneumonia within two days of a patient being placed on a ventilator (National Healthcare Safety Network, 2023). VAP causes prolonged length of stay and increases mortality by up to 70% (Micik et al., 2013). A plugged ETT allows bacteria to enter the respiratory tract quickly, leading to VAP (McHugh et al., 2015). Several studies have examined the relationship between oral hygiene measures and the incidence of VAP. Research studies mention that patients in the ICU who get oral care have a lower incidence of VAP than those who do not get oral care (Atashi et al., 2018; de Araújo et al., 2023; Haghghi et al., 2017). Based on research, nurses in intensive care rooms agree that the oral hygiene of patients must be maintained, but as many as 40.8% of nurses agree that the implementation of oral hygiene care is challenging (Saddki et al., 2017). Research in Indonesia states that as many as 99% of nurses agree that oral hygiene is essential for patients. As many as 59.7% of nurses have good knowledge, but the implementation of oral hygiene care in the ICU room is in the poor category, namely as much as 60% (Setianingsih et al., 2017; Werdani et al., 2021).

Oral hygiene care for patients in the ICU can be done through several protocols. Some of them are oral hygiene using chlorhexidine liquid, swabs using gauze, manual and electric toothbrushes, petroleum jelly to moisturize lips, and suction. Swab using gauze is one of the most common protocols performed by nurses, due to the ease of obtaining the tools. Suction is done to reduce fluid, toothpaste, and debris from the oral cavity (Zhao et al., 2020). One of the practical tools for oral hygiene is a toothbrush. When used optimally, a toothbrush can remove plaque and debris from the oral cavity (Dejuilio et al., 2023). Another method that can be used for oral hygiene is the suction toothbrush. Studies state that using a suction toothbrush as a tool for oral hygiene effectively reduces plaque and the incidence of VAP in patients (Dejuilio et al., 2023; Rayanti et al., 2023; Samim et al., 2022).

Oral hygiene in intubated patients is a widely discussed issue because of its role in preventing secondary infections such as VAP. Several publications on oral hygiene in intubated patients mention that the implementation of oral hygiene in the ICU room is still in the poor category (Setianingsih et al., 2017; Werdani et al., 2021). This study was conducted to reveal the trend of research on oral hygiene in intubated patients in the last two decades through bibliometric analysis, so that we can find new themes about oral hygiene in intubated patients that have not been researched widely. Hopefully, after we do this research, new research can be done to optimize the implementation of oral hygiene in intubated patients to prevent from VAP.

## Materials and Methods

### Design

This study is a quantitative research using bibliometric analysis, which is used to determine research trends and analyze the themes found in order to identify those that have not been widely researched and afford novelty for future studies (Donthu et al., 2021).

### Data Collection

Research publication searches were conducted in August 2023 and were collected from the Scopus and PubMed databases through the Publish or Perish application by the two researchers using the keywords "oral hygiene intubated patient." The collected publications were published in the last two decades, namely from 2003-2023.

### Data Analysis

The publications that have been collected were then checked for completeness and visual analysis carried out using the VOSViewer\_1.6.18 application. The VOSViewer application is used to visualize bibliometric maps of co-occurring terms in titles and abstracts (Donthu et al., 2021) through three different types of visualization: network visualization, overlay visualization, and density visualization (Van Eck & Waltman, 2014).

### Ethical Consideration

Approval from the ethics committee is unnecessary since this study uses bibliometric analysis and does not use humans as an object.

## Results

### Volume and Types of Publications

Based on the results of the publication search through the Publish or Perish application, 114 publications were collected, consisting of 85 publications from the Scopus database and 29 publications from the PubMed database that discussed oral hygiene intubated patients in the last two decades. All publications collected were then checked for duplication through the Mendeley Desktop application, and, out of 114 articles, 88 publications were produced. Original article was the most common type of publication related to oral hygiene intubated patients, 79.54% (n=70), followed by review (n=11; 12.5%), case report (n=2; 2.27%), comparative study (n=2; 2.27%), abstract (n=2; 2.27%), and letter (n=1; 1.13%).

### Growth Research Analysis

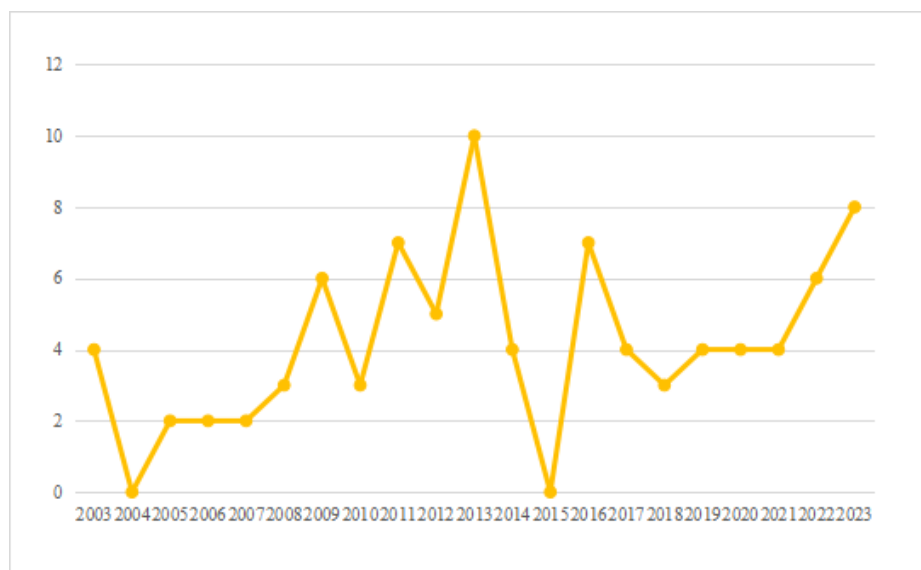
Over the last two decades (from 2003 to 2023), publications that discuss oral hygiene in intubated patients have fluctuated, as shown in Figure 1. It can be seen from the graph that there were years when there were no publications published on oral hygiene intubated patients, namely in 2004 and

**Table 1. Top 10 Most Cited Publications about oral hygiene intubated patient over the last two decades (from 2003 to 2023)**

Ranking	Authors (year)	Source	Cited by
1st	Labeau et al.(2011)	The Lancet Infectious Diseases	217
2nd	Scannapieco et al. (2009)	Critical Care	140
3rd	Grap et al. (2003)	American Journal of Critical Care	139
4th	Rello et al. (2007)	Intensive Care Medicine	116
5th	Berry et al. (2007)	American Journal of critical Care	104
6th	Klarin et al. (2008)	Critical Care	89
7th	Terezakis et al. (2011)	Journal of Clinical Periodontology	88
8th	Feider et al. (2010)	American Journal of critical Care	85
9th	Dennesen et al. (2003)	Critical Care Medicine	81
10th	Pobo et al. (2009)	Chest	75

**Table 2. Publication related to suction toothbrush from 2003-2023 from Scopus and PubMed database**

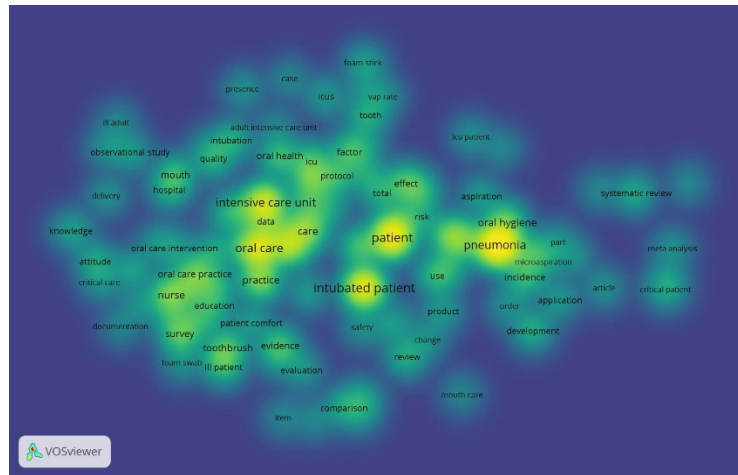
Authors (year)	Source
Warren et al. (2019)	American Journal of Nursing
Zhao et al. (2020)	Cochrane Database of Systematic Reviews
Ferozali et al. (2007)	Special Care in Dentistry
Di Filippo et al. (2011)	Scandinavian Journal of Infectious Diseases
Letsos et al. (2013)	Nursing Leadership (Toronto, Ont.)
Yamazaki et al. (2006)	Special Care in Dentistry
Sumi et al. (2003)	Gerodontology
Schlosser & Hebbes (2016)	General Dentistry
Saddki et al. (2017)	Nursing in Critical Care
Kjonegaard et al. (2010)	American Journal of Critical Care
Hirokawa & Kimata (2023)	Anesthesia Progress
Prendergast & Chapple (2021)	Cureus
Hutchins et al. (2009)	American Journal of Infection Control



**Figure 1. Graph of publications on oral hygiene intubated patients from 2003 to 2023**







**Figure 4. Density visualization map of terms in the title/abstract fields of publications related to oral hygiene intubated patient from 2003-2023**

interest in the relationship between oral hygiene and the incidence of pneumonia in critical patients. The blue cluster consists of 26 keywords and has a research publication on the intensive care unit patient study. The yellow cluster consists of 14 keywords describing the research focus on intubated patients, evidence, and comparison. The purple cluster has 12 keywords. In this cluster, the main research focus is on oral health and observational studies.

Figure 3 shows the overlay visualization. This visualization is used to see the keywords that often appear and are used in the titles and abstracts of publications from 2003 to 2023. In this visualization, the lighter the color, the more recent the publication year, and the larger the circle and letter of the keyword, the more often the word appears (Van Eck & Waltman, 2014). Blue is the color for keywords that appear extensively in publications before 2005. Green is for keywords appearing in publications between 2005 and 2020, and yellow is for those appearing in publications after 2020. From this visualization, we can conclude that publications about oral hygiene in intubated patients mainly were published between 2010 and 2020.

Figure 4 shows the density visualization of keywords. In this visualization, the color indicates how the keywords are distributed in the two-dimensional space underlying the visualization (Van Eck & Waltman, 2014). Figure 4 shows that some keywords have more vivid colors and more giant letters than others, indicating that more of these keywords appear in publications. Figure 4 concludes that the most frequently used keywords are patient, intubated patient, oral care, intensive care unit, and pneumonia.

### Suction Toothbrush

Based on the results of the publication search that has been carried out, oral hygiene protocols were one of the most common themes but there were no suction toothbrush keywords that appeared in the VosViewer analysis. Therefore, the researchers continued to search for publications on Publish or

Perish using the suction toothbrush keyword. The search was conducted through two databases Scopus and PubMed, with the same period and method as the search for the keyword oral hygiene intubated patient. The result was 22 publications in the last two decades (2003 to 2023). Then, a duplication check was carried out and 13 publications were found which discussed the suction toothbrush.

### Discussion

The analysis results using the VOSViewer application show that publications discussing oral hygiene intubated patients create five main clusters. The red cluster consists of 34 keywords. In this cluster, the research focuses on oral care and nurses as implementers of oral care actions. A study states that nurses are one of the professionals responsible for meeting the self-care needs of dependent patients, one of which is oral hygiene (Zhao et al., 2020). The protocols most often used by nurses to perform oral hygiene in intubated patients are moisturizers, gauze or cotton swabs, suction, toothbrushes, and mouthwashes. In one study, it was mentioned that hospital supplies for oral hygiene were sufficient but needed to be improved. A Malaysian study said that some nurses stated that using a suction toothbrush was beneficial in performing oral hygiene in intubated patients, but most nurses still found it difficult and uncomfortable to perform oral hygiene in intubated patients (Saddki et al., 2017).

The green cluster consists of 29 keywords and illustrates the researchers' interest in the relationship between oral hygiene and the incidence of pneumonia in critical patients. The most common pneumonia in ICU patients is ventilator-associated pneumonia (VAP), which causes morbidity and mortality in the ICU (National Healthcare Safety Network, 2023). Oral hygiene is closely related to VAP, but there are different results regarding the relationship between the two. For example, Pobo et al. (2009) found that using an electric toothbrush and chlorhexidine was ineffective in preventing VAP.

However, some studies confirm that chlorhexidine liquid positively prevents VAP (Pobo et al., 2009).

In the blue cluster, the keywords found totaled 26 keywords. This cluster contains a research publication on the intensive care unit patient study. A prospective study states that patients admitted to the ICU have inadequate saliva flow and poor oral mucosal conditions. These patients also had bacterial colonization in the oropharynx, which increased in the second and third weeks after intubation (Dennesen et al., 2003). From the results of this study, it is essential to do oral hygiene to improve the oral health of patients in the ICU.

The yellow cluster consists of 14 keywords describing the research focus on intubated patients, evidence, and comparison. One study in Taiwan compared the use of boiled water and green tea to improve the oral mucosal status of intubated patients. The result was that the mucosal status of patients given oral hygiene using boiled water was better than green tea (Hsu et al., 2011). Another study that discussed the comparison of oral hygiene in intubated patients stated that using a comprehensive protocol in ICU patients was more effective than using a manual toothbrush alone. This comprehensive protocol uses an electrical toothbrush, tongue scraper, and moisturizer (Prendergast & Chapple, 2021).

The purple cluster has 12 keywords and the main research focus is on oral health and observational studies. Of all the publications that have been collected, three publications focus on these keywords. The first study was an observational study conducted to consider oral health and the prevalence of microorganisms present in the oral cavity of patients with the potential to cause nosocomial infections in non-intubated patients (Cruz et al., 2022). Lin et al. (2009) conducted an observational study investigating nurse actions and factors that influence oral care actions for patients in the ICU. The results of this study showed that nurses in the ICU needed to follow the procedures and recommendations of the latest evidence-based practices (Lin et al., 2009). Another observational study stated that nurses in the ICU experienced difficulties when performing oral care on intubated patients, as much as 83%. The difficulties experienced by nurses include patient cooperation, difficulty inserting oral care tools, and difficulty reaching areas that need to be visible (Dale et al., 2018).

A suction toothbrush is one of the tools that can be used as a protocol for implementing oral hygiene. According to Saddki et al. (2017), a suction toothbrush effectively removes dental plaque in patients. However, from the VOSViewer visualization of oral hygiene intubated patients, the keyword suction toothbrush did not appear. Therefore, we conducted a search again using the keyword suction toothbrush. Of the 22 publications obtained from two databases through Publish or Perish, several duplicates were found, so the total publications

became 13. Of the 13 publications obtained, not all focused on discussing suction toothbrushes. For example, some publications discussed electric toothbrushes used for oral hygiene in older adults (Schlosser & Hebbes, 2016; Sumi et al., 2003). There were only two publications that discussed suction toothbrush as an oral hygiene protocol in intubated patients. Both publications mentioned that suction toothbrush can be effective in removing plaque and reducing the incidence of VAP in intubated patients. However, in its implementation, nurses still find it difficult to use the suction toothbrush, and the availability of tools is still limited in the hospital (Saddki et al., 2017; Zhao et al., 2020). From all the publications that we collected, we can conclude that research about suction toothbrush as oral hygiene protocols in intubated patients is still lacking.

This is the first bibliometric analysis study about oral hygiene in intubated patients and shows information about the research so it can be used as a reference in choosing the theme of further research on oral hygiene in intubated patients. However, there are several limitations to this study. It should be noted that this study only uses two databases, so it cannot represent all research published in other databases. Secondly, this study was limited to the search term "oral hygiene," thus any publication that used another term, like "oral care," may have been missed in this analysis. Further bibliometric research is expected to complete this limitation.

## Conclusions

Despite the importance of oral hygiene in intubated patients, research on protocols and appropriate tools for oral hygiene in intubated patients still needs to be done. As evidenced by the last two decades, only 88 publications were collected from two databases after duplication check.

There is consensus on the association between inadequate oral hygiene and increased incidence of VAP. However, there has yet to be a standard protocol regarding intubated patients' most appropriate oral hygiene (Hajibagheri & Fini, 2012). In addition, many studies have shown that nurses find it difficult to perform oral hygiene on intubated patients. This is due to the difficulty of reaching oral cavities that are not visible, so many nurses do not carry out oral hygiene according to procedures and recommendations (Dale et al., 2018).

Based on the analysis conducted using VOSViewer, it is concluded that most of the publication themes were oral hygiene protocols and the relationship between the oral hygiene and VAP incidence. However, suction toothbrush as one of the oral hygiene protocols did not appear in the co-occurring terms in the first search. From the second round of search, there were only two publications that discussed suction toothbrush as an oral hygiene protocol in intubated patients. From this, we can conclude that research on suction toothbrush as one of the oral hygiene protocols in intubated

patients is still lacking, so it can be used as a novelty in conducting further research. Further research can be done to optimize the implementation of oral hygiene in intubated patients to prevent from VAP.

### Declaration of Interest

This study stated that there is no conflict of interest in this study.

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### Data Availability

The corresponding author will provide interested parties with access to the dataset upon reasonable request.

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