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Oral care of intubated patients, challenging task of ICU nurses: a survey of knowledge, attitudes and practices

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Abstract

Introduction Patients' health outcomes can be positively affected by the oral care provided by intensive care unit (ICU) nurses. Providing effective oral care for intubated patients is a challenging task. The purpose of this study was to examine the knowledge, attitudes, and practices(KAP) of oral care among ICU nurses for intubated patients, as well as the underlying factors that influence these behaviors.

Method This cross-sectional survey was conducted on 200 nurses from adult ICUs in referral hospitals located in the central eighth area of healthcare management in Iran. The timeframe for data collection was April to June in 2023. Data were collected by questionnaires which consisted of four sections: demographic information, knowledge, attitudes and practices of oral care for intubated patients. The Pearson Correlation Coefficient was employed to determine the correlation between KAP and its main variables, which were distributed normally.

Results The result showed that nurses were 32.19 ± 6.23 years old, with an average total work experience of 8.91 ± 5.54 years and an average ICU work experience of 5.89 ± 4.31 years. The mean KAP score were 17.66 ± 3.04, 15.46 ± 4.23, and 7.57 ± 2.21, respectively. The knowledge of nurses was significantly impacted by their level of education ($p = 0.04$), and an increase in work experience each year was associated with improved attitudes among nurses ($p = 0.04$). A significant association was found between the nurses' oral care practice, knowledge ($p = 0.03$), and attitude ($p = 0.04$).

Conclusion This study revealed that ICU nurses possess a moderate level of knowledge, a higher-than-average level of practice, and they have a favorable attitude towards giving oral care to intubated patients. Therefore, providing continuous education about oral care is essential for ICU nurses.

Keywords Nursing practice, Attitudes, Intensive care, Knowledge, Oral care

Introduction

The maintenance of oral health is a critical duty for intensive care unit (ICU) nurses, as it significantly affects the well-being and comfort of patients in long term [1]. ICU nurses play a crucial role in improving the oral health outcomes of patients in ICU [2].ICU patients who are intubated and mechanically ventilated are particularly susceptible to developing oral infections or systemic infections, including nosocomial pneumonia [3]. Adequate oral care can play a significant role in preventing negative consequences, such as respiratory infections,

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and also minimize the presence of bacteria in the oropharyngeal cavity [4].

Several studies demonstrated that ventilator-associated pneumonia (VAP) remains a prevalent infection among ICU patients and has been linked to higher mortality rates [5]. Oral colonization is widely recognized as a major risk factor for VAP [6]. Previous studies have demonstrated that intubated patients experience a shift in their oral microbiome, with an increase in gram-negative bacteria and a specific group of highly virulent organisms that are linked to VAP [7–9]. The use of certain medications can alter saliva production, leading to an unbalanced oral environment and potentially increasing the risk of biofilm formation [10]. The significance of oral care in patients undergoing mechanical ventilation is highlighted, as the dental plaque may harbor respiratory pathogens [11].

The VAP incidence can be minimized by timely management and early diagnosis of potential complications [12]. Maintaining good oral health care has been proven to decrease the likelihood of hospital pneumonia by 45%, making it an essential component of preventive measures against this condition [13]. In addition, studies have shown that the execution of an oral care protocol in ICUs has a substantial impact on reducing the occurrence of VAP, with a decrease from 10.4 to 3.9 per 1000 ventilator days [14]. Oral care is usually included in the basic nursing curriculum. The basic nursing curriculum typically covers oral care, but the significance of this practice for ventilated patients is often overlooked by nursing schools [15].

Studies on nurses providing oral care to critically ill patients have demonstrated that there are several factors that hinder them from fulfilling this responsibility. These factors may include placing oral care as a secondary priority during medical treatments; failure to employ oral care assessment tools; absence of standardized oral care protocols in medical units; and insufficient education or training regarding oral care [1, 15–17]. In recent years, the prevention of respiratory tract infections has become a crucial aspect of oral care for patients in ICU [2]. In light of a recent study, it has been discovered that Korean nurses hold different viewpoints on the oral health and care of ICU patients, and a common concern is the inadequate training they have received. The significance of creating a plan and educating nurses on sustainable and appropriate oral care for ICU patients was emphasized in this study [18]. According to a national study, nurses did not apply the most up-to-date evidence-based practices for oral care. However, Jones et. al. argued that the methods used by nurses in the UK were appropriate and based on evidence [1, 19].

Research on the knowledge, attitudes, and practices (KAP) of ICU nurses in Iran is limited. A study conducted by Adib-Hajbaghery et. al. in 2013 surveyed 130 nurses in an Iranian city's hospitals and revealed that the nurses lacked the required knowledge for oral care in ICU patients, resulting in poor performance [20]. The study by Haghighat et. al. in 2015 involving 214 nurses in a city in Iran highlighted the insufficient knowledge of nurses in providing oral care for intubated patients. The researcher obtained their findings through a self-designed questionnaire [13]. Surveys utilizing researcher-made questionnaires are the primary source for determining the KAP of Iranian ICU nurses. This makes it difficult to compare findings from studies conducted different studies and regions. Additionally, a standard measurement that encompasses KAP is crucial for determining the effectiveness of oral health programs in ICUs on nurses.

The KAP of nursing staff plays a critical role in the recovery process of ICU patients who rely heavily on their attentive support. Furthermore, the ICU nurses' ability to care the patients' oral health is impacted by their individual circumstances, such as their understanding, expertise, and accurate beliefs about oral care [4]. The principal aim of this study is to evaluate the KAP of ICU nurses in the oral care of intubated patients, utilizing a comprehensive and standardized questionnaire.

Methods
Design and sample
This study was a cross-sectional survey that conducted on nurses working in adult ICUs affiliated with the Kerman University of Medical Sciences, located in the central eighth area of healthcare management in Iran. In order to collect data for the study, a multistage cluster sampling method was employed, involving the selection of all hospitals in the first stage, followed by all ICUs in the second stage, and a proportion to size random sample of nurses working in the ICUs in the final stage. The mean of KAP was estimated with a margin of error of 1.5 and a 95% confidence level, taking into account a standard division of 10 and a 15% dropout rate based on the pilot study. The calculated sample size consisted of 214 ICU nurses.

The criteria for inclusion were: (1) being employed as a nurse in an adult ICU and (2) having prior experience in administering oral care to intubated patients. Participants who were uncooperative, did not respond to more than five questions, and those who were on leave during the research period were excluded. The supervisor in each department was given the task of delivering the questionnaires to eligible nurses. After three days, completed questionnaires were gathered.

Ethical approval

This research received approval from the Ethics Committee at Kerman University of Medical Science, under the reference number IR.KMU.REC.1401.558. All research procedures were conducted in compliance with applicable guidelines and regulations. Participation in this research was voluntary. Written informed consent was obtained from the nurses to utilize the data for research, in accordance with the Declaration of Helsinki.

Scale

We contacted the corresponding author of the Lin et. al. study [16] by email and asked for their permission to use the questionnaire in our study. Our chosen instrument for data collection was Lin's questionnaire [16], a practical and comprehensive tool. It comprises of detailed inquiries regarding the use of oral disinfectant solutions in intubated patients, making it as the most practical and efficient option for intubated patients. Notable features of this questionnaire include a rating scale for evaluating oral hygiene practices. The instrument consisted of the following sections:

Sociodemographic and clinical data

The following section contains data on age, gender, nursing education level, years spent in the ICU, time to graduate from nursing school, and the means of training for oral care for intubated patients.

Knowledge of oral care for intubated patients

There were 6 questions in the multiple-choice format that evaluated the qualities of oral cleansing solutions and instruments. The scoring range was 0 to 29.

Attitudes about oral care of intubated patients

The first part of attitudes section centered on the priority of various physical care and various nursing treatment activities. Nurses were asked to prioritize physical care activities and rank nursing treatments based on their level of importance. The second part consisted of a pair of inquiries regarding the significance of maintaining oral care. Participants were scored on a scale of 2–20 based on a 10-point scale, with a higher score reflecting a positive attitude towards oral care.

Practices of oral care for intubated patients

This particular section covers four inquiries about the frequency of oral care routines, including brushing, using cotton swabs, helping patients keep their mouths moist, and aiding patients in removing oral secretions. The recommended minimum standard was taken as the cut-off point and a score of one was assigned to it. The total score was 0–4. A higher score indicated a higher frequency of oral care practice. The cut-off point was determined by the recommended minimum standard and was assigned a score of one. The total score range was between 0 and 4, with a higher score indicating a more frequent practice of oral care.

The questionnaire was translated into Persian language by back translation method. To ensure the questionnaire's simplicity and clarity, it was tested by 10 nurses as a pilot. They were instructed to read the questionnaire and rate each question on a scale of 1 to 5, with 1 being completely incomprehensible and 5 being completely understandable. Ultimately, the score of 4 and 5 was awarded by all 10 nurses for each question. A four-point scale was used by four experts in the field to assess content validity of questionnaire (4 points indicating high relevance, 3 indicating moderate relevance, 2 indicating low relevance, and 1 indicating no relevance at all).

Afterward, we determined the content validity index (CVI) for each question, only deeming responses with a score of 3 or 4 as acceptable. Consequently, the formula for item CVI was found to be: item CVI = number of experts giving a score of 3 or 4/total number of experts [21]. The mean CVI for each section was determined by taking the average of all item CVIs. The resulting scores were as follows: the section on knowledge of oral care for intubated patients scored 0.96, the section on attitudes towards oral care for intubated patients scored 0.91, and the section on practices of oral care for intubated patients scored 0.97.

In order to measure the validity and reliability of the finalized questionnaire, test–retest and Cronbach's alpha were used. To assess the dependability, a group of 40 ICU nurses completed the questionnaire and were then instructed to complete it once more after a two-week period. The intra cluster correlation coefficient of questionnaire questions ranged from 0.82 to 0.92. Also, Cronbach's alpha was higher than 0.8 and for each question and for three sections 0.80, 0.83 and 0.86, respectively.

Data analysis

The data was analyzed with SPSS 22 and described using descriptive statistics such as percentage, mean, and standard deviation. The Pearson Correlation Coefficient was applied to determine the correlation between KAP as all the main variables in the study followed a normal distribution. The level of significance was set at 0.05.

Results

A total of 214 questionnaires were distributed to ICU nurses, and 200 of them were chosen for analysis in this study. The mean age of the nurses was 32.19 ± 6.23

years. The mean total work experience was 8.91 ± 5.54 years and the mean ICU work experience was 5.89 ± 4.31 years. Most of the participants had a Bachelor's degree ($n=190$). The mean time off from nursing school was 9.32 ± 5.84 years. The main source of the nurses' knowledge about oral care for intubated patients was the senior nurses in their ICUs ($n=116$) (Table 1).

The mean knowledge, attitude, and practice score were 17.66 ± 3.04 (range:13–27), 15.46 ± 4.23 (range: 2–20), and 7.57 ± 2.21(range: 1–10), respectively. In other words, by converting to percentage: The average levels of KAP among ICU nurses regarding oral care in terms of percentage were 60.90%, 77.30%, and 70.50%, respectively.

The questions regarding the knowledge of sodium bicarbonate solution properties and the most suitable tool for reducing dental plaque received the lowest correct responses (Table 2).

In terms of the attitude towards oral care of intubated patients, the ICU nurses ranked oral care fourth in order of priority of physical care activities. They ranked oral care eighth in order of priority among nursing treatment activities (Table 3).

The mean score on importance of oral care in nursing treatment activities was 7.92 ± 2.31(range: 1–10). The average ICU nurses' practice of oral care was 2.82 ± 0.69(range: 0–4).

Nurses with a master's degree had a higher knowledge score than bachelors($p=0.04$). The increase of each year's work experience, the attitude of the nurses improves ($r=0.32$, $p=0.04$). Nurses who chose 'personal study' as the source of their learning about oral care for intubated patients scored significantly higher on such practices than those who did not choose that option ($p=0.02$) (Table 4).

There was a significant correlation between oral care practice, knowledge ($r=0.35$, $p=0.03$) and attitude ($r=0.23$, $p=0.04$) among the nurses, in that a higher score on attitude and knowledge of oral care reflected a more ideal performance of oral care.

Discussion

This study found that ICU nurses possess a moderate level of knowledge, a higher-than-average level of practice, and they have a favorable attitude towards giving oral care to intubated patients. The knowledge and attitude of ICU nurses were significantly affected by their education and work experience respectively. Additionally, their practice improved with increased knowledge and attitude. The aim of this study is to evaluate the KAP of ICU nurses in the oral care of intubated patients by a standardized questionnaire.

The current study reveals that the mean percentage of KAP among ICU nurses in terms of oral care is 60.90%, 77.30%, and 70.50%, respectively. Consistent with this finding, Lin et. al. [16] reported that the knowledge and attitude of nurses in northern Taiwan were 58.8% and 79.4%, respectively. However, the nurses included in this survey performed better than those examined by Lin et. al., with a significant difference of 70.50% compared to 49.8%. The improved practice scores observed in this survey can be attributed to the concept that an nurses' practice is not solely dependent on their knowledge and attitude, but may also be impacted by other variables like information sources, workplace environment,

Table 1 Characteristics of participants, their sources of knowledge, and the type of ICU

Characteristic		Mean ± SD (Range)	N	%
Sex	Male		29	14.5
	Female		171	85.5
Age		32.19 ± 6.23(22–47)		
Level of nursing education	Bachelor's degree		190	95
	Master's degree		10	5
Type of ICU	Medical		33	16.5
	Surgical		29	14.5
	Stork		27	13.5
	Trauma		111	55.5
Total work experience (Year)		8.91 ± 5.54(1–30)		
Total ICU work experience (Year)		5.89 ± 4.31(1–21)		
Time off from nursing school		9.32 ± 5.84(1–30)		
The source of oral care training for intubated patients:	Nursing school		38	19
	In-service education at ICU		35	17.5
	From senior ICU nurses		116	58
	Personal study		11	5.5

Table 2 ICU nurses' knowledge of oral care for intubated patients

Questions/items	N (%)	Correct response
What is the characteristic of ideal oral cleaning solution?		
A. Contains alcohol[a]	5(2.5)	88%
B. Anti-bacterial or inhibits bacteria	108(54)	
C. Maintains oral moistness	46(23)	
D. Increases viscosity of oral mucus[a]	19(9.5)	
E. Promotes wound healing	22(11)	
What is the characteristic of chlorhexidine as oral cleaning solution?		
A. Anti-bacterial	93(46.5)	88%
B. Appropriate concentration is 0.1–0.12%	32(16)	
C. Decreases viscosity of oral mucus[a]	24(12)	
D. Treats oral infections	37(18.5)	
E. Causes oral pain	14(7)	
What is the characteristic of sodium chloride as oral cleaning solution?		
A. Eliminates debris attached to oral mucus[a]	80(40)	85.5%
B. Maintains oral moistness[a]	44(22)	
C. Tends to cause mouth dryness	9(4.5)	
D. Removes dental plaque[a]	47(23.5)	
E. Promotes wound healing	20(10)	
What is the characteristic of hydrogen peroxide as oral cleaning solution?		
A. Anti-bacterial	81(40.5)	78%
B. Remove bad odors	45(22.5)	
C. Decreases viscosity of oral mucus[a]	20(10)	
D. Irritating to oral mucus	30(15)	
E. Promotes wound healing[a]	24(12)	
What is the characteristic of sodium bicarbonate as oral cleaning solution?		
A. Anti-bacterial[a]	58(29)	45%
B. Tends to encourage bacterial growth	9(4.5)	
C. Increases viscosity of oral mucus[a]	52(26)	
D. Remove cell debris from inside mouth	34(17)	
E. Neutralizes excessive oral acidity	47(23.5)	
Which oral care supplies and equipment effective for removing dental plaque?		
A. Cotton swab[a]	57(28.5)	54.5%
B. Foam swab[a]	18(9)	
C. Toothbrush	109(54.5)	
D. Gauze pad[a]	16(8)	

[a] Incorrect answers

Table 3 ICU nurses' ranking of priority of oral care for critically ill patients

Physical care activities	Mean rank ± SD	Nursing treatment activities	Mean rank ± SD
Physical assessments	2.32 ± 1.65	Processing patients' entrance into ICU	1.69 ± 1.56
Bowel and bladder care	3.66 ± 1.61	Oxygen therapy	2.34 ± 1.23
Changing position	3.65 ± 1.77	Administering medication	2.51 ± 1.53
Oral care	4.12 ± 2.13	Suctioning sputum	3.28 ± 1.42
Chest physiotherapy	4.17 ± 1.44	Observing and recording status of patients	4.04 ± 2.28
Gastrointestinal care	4.64 ± 1.7	Catheter care	4.84 ± 1.96
Bed bath	5.91 ± 1.95	Assisting physician with invasive procedures	4.99 ± 2.17
		Oral care	5.12 ± 2.49

Table 4 Knowledge, attitude and practice of ICU nurses with different demographic characteristics

Characteristic		Mean ± SD Knowledge	P	Mean ± SD Attitude	P	Mean ± SD Practice	P
Sex	Male	17.44 ± 3.44	0.41	15.57 ± 2.21	0.67	2.88 ± 0.66	0.14
	Female	17.23 ± 2.35		14.47 ± 1.21		2 ± 2.3	
Age		-0.94[a]	0.33	-1.04[a]	0.13	2.04[a]	0.11
Level of nursing education	Bachelor's degree	17.37 ± 2.52	0.04	15.19 ± 1.96	0.36	1.98 ± 0.1	0.40
	Master's degree	18 ± 3.76		16.68 ± 1.77		2.15 ± 0.96	
Type of ICU	Medical	17.37 ± 1.52	0.33	15.17 ± 1.32	0.23	2.05 ± 1.66	0.87
	Surgical	17.1 ± 2.16		14.43 ± 2.66		2.15 ± 0.56	
	Stork	17.27 ± 1.42		15 ± 2.12		2.03 ± 1.06	
	Trauma	16.98 ± 2.96		14.01 ± 1.76		2.98 ± 0.98	
Total work experience (Year)		0.24[a]	0.24	0.32[a]	0.04	1.63[a]	0.54
Total ICU work experience (Year)		0.04[a]	0.31	0.39[a]	0.84	0.03[a]	0.98
Time off from nursing school		0.12[a]	0.1	0.53[a]	0.97	0.8[a]	0.79
The source of oral care training for intubated patients	Nursing school	16.12 ± 2.76	0.23	15.01 ± 1.02	0.34	2.95 ± 1.02	0.02
	In-service education at ICU	17.3 ± 3.23		14.29 ± 2.06		2.15 ± 0.61	
	from senior ICU nurses	16.87 ± 2.11		15.47 ± 2.92		2.07 ± 0.83	
	Personal study	16 ± 1.76		14.18 ± 2.95		3.1 ± 1.14	

[a] Pearson correlation

workload and work experience. On the other hand, a study by Haghighat et. al. revealed that one-third of the nursing staff in Isfahan (Iran) were not well-informed about oral care standards, and another one-third had no understanding of oral care at all [13]. In comparison to the Haghighat et. al. study, it was discovered that nurses in Iran are now better informed about the critical role of oral care in intubated patients. However, the questionnaire employed in the two studies was not the same. More recent studies have also revealed that nurses have little knowledge about oral care. In this regard, Jun (2022) reported a large number of Korean nurses needed oral care education, and majority of them had never received oral care education [18].

According to Adib-Hajbaghery et. al. (2016), Iranian nurses may not prioritize the oral care of ICU patients. As a result, the researchers emphasized the importance of implementing training programs to enhance the knowledge and attitude of ICU nurses towards oral care [20]. The findings of Adib-Hajbaghery et. al. study contradicted our own. One possible explanation for this discrepancy is the improved oral care practices of ICU nurses in Iran for intubated patients. While the questionnaire utilized in the two studies differs. Moreover, Iran's nursing care protocol is being updated to include mandatory oral care in intubated patients.

It was noted by Sreenivasan et. al. (2018) that oral health procedures in India tend to prioritize patient comfort rather than targeting bacteria elimination, as they do not commonly follow evidence-based protocols

[22]. Despite this, required training has the potential to enhance the understanding of oral care among healthcare workers. The results of study emphasized the significance of dental and oral health, yet it remains a neglected aspect of nursing and many nurses require education on proper oral care protocols [22]. The current study revealed that intubated patients in Iran do not receive adequate oral and dental care. However, it is worth noting that the results of studies differ from one country to another. This is due to cultural differences, socioeconomic development and differences in the authority and competence of nurses.

In the present study, a number of nurses shared conflicting opinions regarding the characteristics of mouthwashes as observed in a study in Taiwan [12]. Although chlorhexidine was believed to have antibacterial properties by nearly half of the nurse population, only a small percentage agreed that it could effectively treat oral infections. According to a survey in Iran (Isfahan) [9], the majority of nurses stated using chlorhexidine, while the remaining 20.6% preferred normal saline most frequently. Additionally, Korean nurses stated that their most common use of chlorhexidine was after dinner or before bedtime. In a study by Saddki et. al. (2017), majority of Malaysian nurses preferred using chlorhexidine mouthwash solution and majority preferred using a swab for oral care [23]. A small percentage of nurses utilized sodium bicarbonate, tap water, and hydrogen peroxide to cleanse their patients' mouths, while the majority employed these solutions twice a day. A limited number

of nurses employed sodium bicarbonate, tap water, and hydrogen peroxide for oral care, with most adhering to a twice-daily schedule. In light of this, it can be inferred that nurses are in need of additional education regarding mouthwashes and should take training courses.

The present study showed that more than half of the nurses chose brushing for plaque removal. In contrast, Lin et. al. [12] demonstrated that a majority of nurses preferred brushing as a method for removing plaque. Despite this, Lin et al. [12] found that brushing was the favored technique for nurses in eliminating plaque. Previous studies have indicated that dental plaque can only be removed by mechanical brushing with a toothbrush [24, 25] and that cotton and foam swabs are not effective in removing oral secretions and dental plaque [24]. According to the findings of the study, nurses did not possess a comprehensive understanding of the most efficient oral cleaning equipment for plaque removal. Gauze pads were found to be the preferred choice for nurses over toothbrushes in a recent Korean study [18]. This finding was consistent with previous studies that indicated toothbrush was not used due to the difficulty of brushing the teeth of intubated patients [24]. Similar to the studies noted, in our research, a significant percentage of ICU nurses do not use a toothbrush to remove dental plaque. The difficulty of using a toothbrush for intubated patients might be the primary cause of this problem. In this case, an electric toothbrush is a viable option.

Our study revealed that ICU nurses had a knowledge score of 60.90% (17.66 out of 27) in relation to intubated patients oral care, highlighting the necessity for updated training that adheres to current oral health protocols. This result is in line with previous researches [18, 20]. According to the findings of Lin et. al. [16], this study revealed that attitudes towards oral care were given the fourth highest priority, following physical assessment, bowel and bladder care, and changes in the list of physical care tasks. Nurses in the ICU may prioritize other nursing care activities over oral care for patients, as they believe the former to have a larger impact on patient survival. Furthermore, a study conducted in India demonstrated that nurses placed a high importance on assisting patients' overall health, yet were hesitant to provide oral care to intubated individuals due to the risk of tube displacement and challenges with cooperation [22]. The research demonstrated that mechanical barriers greatly hindered the provision of oral care. The fear of an endotracheal tube becoming dislodged is a legitimate concern and could lead to a life-threatening emergency. Due to the heavy workload on nurses, oral hygiene tends to be neglected. Adib-Hajbaghery et. al. [20] reported that "lack of time" and "lack of healthcare staff" are important obstacles to oral care.

The current study revealed that ICU nurses had a positive attitudes towards oral care, with an attitude score of 77.30% (15.46 out of 20).This result was replicated by previous studies [14, 16]. The results of both studies indicated that nurses hold a positive attitudes towards oral care. Nevertheless, recent studies have presented conflicting outcomes. According to a recent study in Korea (2022), over half of the nursing staff rated oral care as either "important" or "more important. Therefore, the respondents had negative attitudes toward oral care [18]. However, a study by Ghauri et. al. [7] in Pakistan (2020) showed nurses' positive attitudes toward oral care. Nevertheless, factors such as the country under investigation, nurses' level of knowledge, their training based on new guidelines, and work experience can account for these contradictory findings. Nonetheless, factors such as the investigated country, nurses' level of knowledge, adherence to newly established guidelines in their training, and work experience may play a role in these opposing findings.

According to the present study, nurses scored 70.50% (2.82 out of 4) in practice, which was notably higher than the score (49.8%) reported by Lin et. al. in Taiwan [16]. In the present study, the vast majority of nurses (99%) cleaned oral secretions every 2 to 4 h or more, while in a similar study [16], 69.3% of nurses responded positively to this option. Based on the current study, it was found that almost all nurses (99%) followed a protocol of cleaning oral secretions every 2 to 4 h or more. This is in line with results from a previous study [16] where 69.3% of nurses reported the same practice. As a result, the current study showed that most nurses effectively followed oral care practices based on the high practice scores. In light of the higher practice scores observed in the present study, it can be concluded that most nurses were successfully carrying out proper oral care practices. Consequently, the oral care practices were found to be well-implemented by a large number of nurses, as indicated by the higher practice scores in this study. A study in Malaysia [23] also showed that almost every single nurse performs oral care at least twice a day using different methods and products, such as suction toothbrushes (90.4%), manual toothbrushes (49.5%), cotton swabs (91.5%), and foam swabs (65.7%). The oral care process may be different depending on the nurses' shift. Night shift nurses rarely or probably never perform oral care for patients using cotton or foam swabs or toothbrushes [16]. This issue can lead to differences in the results of studies on nurses' practice.

A strong and positive association between nurses' knowledge, attitudes, and practices was found in the present study. In a similar vein, Lin et. al. [16] reported a significant correlation between nurses' knowledge and practice and Jun et. al. reported that nurses' attitude and

practice were correlated. In their study, Jun et. al. noted a connection between the importance of oral care and receiving education on oral care [18]. Participants who considered their oral care practices to be "adequate" and received education showed a more favorable attitude towards oral care.

In their study, Ross and Crumpler [26] found that educating individuals on oral care correlates with an increase in oral care procedures and ultimately leads to better oral care for patients with endotracheal intubation. More knowledge and a more positive attitude led to improved practice. On the other hand, this relationship can be affected by a number of factors, including age, work experience, workload, and workplace.

Nurses' attitude had a significant direct relationship with work experience, and nurses' practice was influenced by the source of information. A similar study [16] also showed that senior nurses with more years of experience in the ICU performed more oral care procedures for intubated patients. Additionally, another similar study showed nurses working in the ICU for 6 years or longer had more positive attitude [18]. These findings revealed that higher clinical experience and knowledge can lead to more positive attitude and, as a result, better oral care practice. Besides, previous studies [18, 20] highlighted the necessity for oral care training including "oral health management procedures" for nurses. Consequently, the provision of oral care programs and sustained professional training for nurses is vital in the proper care of ICU patients. Such training programs can encourage nurses to develop a positive attitude towards oral care. Accordingly, an effective training program should be formulated for ICU nurses, especially those with less work experience, to increase their knowledge of oral care and improve their practice.

Limitations
Our study was restricted to 200 nurses due to budget constraints. The research tool is a self-report that can affect the results. Additionally, 14 nurses declined to participate in the study. This study's findings could be influenced if the excluded participants hold vastly different opinions compared to the included participants.

Conclusion
Considering the limitations of the present study, the following conclusions can be made:

- The ICU nurses' knowledge fell within the moderate range, but their practices were above average. Moreover, they showed a positive attitude towards tending to the oral care of intubated patients.

- Nurses' attitude and knowledge were enhanced through increased work experience and higher education.
- A significant and direct association was evident between the attitudes and practices of nurses. Therefore, providing continuous oral care education is essential for nurses.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of Kerman University of Medical Science with No. 401000992 and the code of ethics IR.KMU.REC.1401.558. All methods were carried out in accordance with relevant guidelines and regulations. Participation in this study was voluntary. All participants were explained about the objectives and process of the study and their informed consent was obtained.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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