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Application of the Modified Barrow Oral Care Protocol in Patients Receiving Mechanical Ventilation

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ABSTRACT

Objective: Adoption of an effective and feasible oral care protocol is vital for patients receiving mechanical ventilation (MV). This study aimed to examine the effectiveness of the modified Barrow Oral Care Protocol (MBOCP) in patients receiving invasive mechanical ventilation in ICU.

Methods: A double-blind clinical trial design was used to evaluate the effectiveness of MBOCP. A convenience sample of 90 patients admitted to two ICUs of a referral hospital from August 2019 to February 2020 were randomly assigned to intervention (n=45) and control (n=45) groups. Intervention group received oral care through MBOCP for 6 days and the control group received routine care. Repeated-measures ANOVA was used to compare the oral health between two groups.

Results: The bedside oral health score showed significant difference between the two groups from the third day and continued until to the last day of study, indicating oral health improvement in the intervention group (P<0.001).

Conclusion: The present study showed that the application of accessible oral care supplies such as toothbrush, non-foaming toothpaste, chlorhexidine and oral moisturizer through an evidence-based and protocolized care format is effective than a disorganized and routine oral care. It is recommended that nurses to apply available supplies in the form of established and evidence-based protocols for oral care in ICU.

Keywords: Barrow oral care protocol, bedside oral exam, mechanical ventilation, oral hygiene, Intensive care unit

Introduction

Oral care is one the important practices in intensive care units and maintaining a healthy oral cavity is one of the important goals for patients admitted to intensive care unit (ICU) (1). In ICU, patients' oral cavity is particularly vulnerable. Devices such as oral-pharyngeal airway, endotracheal and gastric tubes keep the mouth open and influence the homeostasis of oral cavity (2). Fixing the endotracheal tube (ETT) through the mouth can increase the transmission of microbial agents and also prevents easy access to perform oral cavity hygiene (3). Therefore, patients undergoing mechanical ventilation (MV) have no effective cough reflex and are unable completely to drainage respiratory secretions (4).

In general, sedation, loss of gag reflex, lack of swallowing ability, and artificial airway predispose patients to aspiration that can lead to microorganisms entering the lower airway, and thus causing complications such as ventilator associated pneumonia (VAP) (5). Furthermore, there is a possibility of bacteremia, sepsis as well as vital organs such as the heart and brain (6).

Saliva secretion disruptions due to drug use, physiological imbalance in the oral cavity along with poor oral hygiene can cause biofilm formation (5). Biofilms contain pathologic microorganisms and cause inflammation and infection in lower airway (7). Previous studies have also shown that oral colonization increases nosocomial infection, in which a review study reported the risk of developing nosocomial pneumonia 21 times higher in ICU patients. Moreover, mortality in these patients is 50% higher than in other patients (8, 9).

There are several clinical tools are used for assessing oral health in critically ill patients such as Bedside Oral Exam (BOE)(10), Revised Oral Assessment Guide (ROAG) (11), General Oral

Health Assessment Index (GOHAI)(12) and Intensive Care Oral Care Frequency Assessment Scale (ICOCFAS)(2). A study reported that the BOE guided oral care with contemporary supplies, including electric toothbrush, non-foaming toothpaste, oral moisturizers, tongue scraper and chlorhexidine provides a cost-effective and comprehensive oral care for critically ill patients and seems to be effective in decreasing VAP (12).

Since the oral cavity is the leading cause of respiratory tract infection in ICU patients, oral care can play a crucial role in reducing mortality and morbidity. A recent review study of the clinical practices of nurses working in ICU reported that although nursing care is a top priority for ICU nurses, they believe that oral care is not performed properly (13). This study aimed to examine the effectiveness of modified BOCP (MBOCP) guided by BOE in patients receiving invasive mechanical ventilation in ICU.

Materials and Methods

Study design and sampling

This study was a randomized clinical trial design which was conducted from August 2019 to February 2020 in two ICU centers of a referral hospital affiliated to Ardabil University of Medical Sciences, Ardabil, Iran. Permuted block randomization technique was used for patient allocation into routine and intervention groups. Permuted block randomization is a way to randomly allocate a participant to a treatment group, while maintaining a balance across treatment groups (14).

To determine the sample size, a pilot study was conducted to determine the current status of oral health status using 30 patients admitted to the ICUs and the results of the pilot study was used to estimate the sample size. Then, using statistical sampling formula, 90 (45 patients in each group) subjects were included to the study. Patients with eligibility criteria included in sampling process: being admitted in ICU and aged more than 18, being under treatment with mechanical ventilation, absence of oral problems such as facial trauma, absence of severe underlying diseases such as diabetes, asthma, renal failure, and bleeding disorders. Patients were excluded if endotracheal tube removal was necessary before completion of the study. Meanwhile, five patients were excluded due to sudden or necessary extubation.

Oral Health Assessment Tools

Data collection tools included of patient's demographic and contextual data form (patient's clinical information, cause of hospitalization, ventilator mode, vital signs and level of consciousness) and the Bedside Oral Exam (BOE). BOE was adopted from Prendergast et al. (12) and is a pictorial scale assesses eight criteria in the oral cavity of patients (swallowing, lips, tongue, saliva, mucous membrane, gingiva, teeth or dentures, mouth odor). Each item gets score between 1 and 3. The overall BOE score is obtained by summing the points from each item. The overall score ranged from 8 (high quality) to 24 (low quality). Score 8 to 10 indicates a normal condition of oral health. Score 11-14 shows a moderate threatening in oral health status. 15-24 demonstrate a severe deterioration in oral health status (Figure 2) (12).

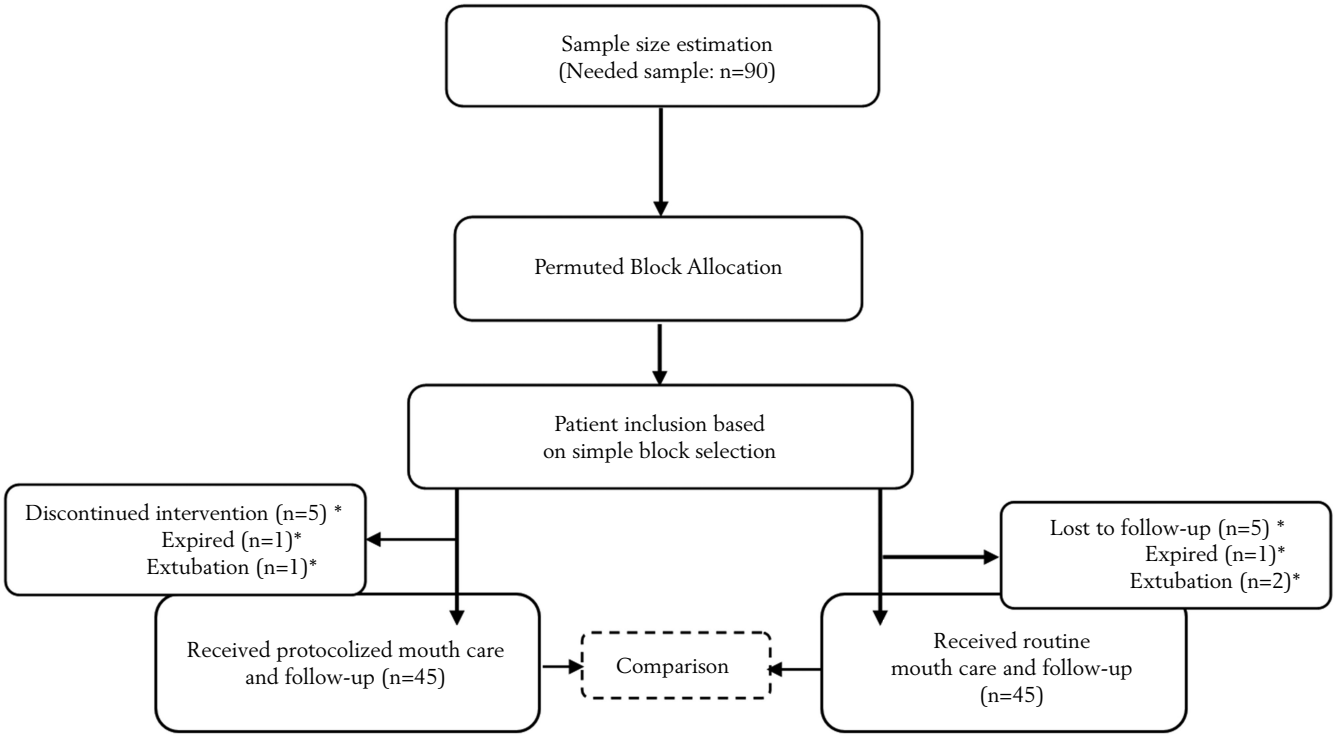

Figure 1. Algorithm of study process. * Sample loss was compensated by re-sampling.

Bedside Oral Exam (BOE)

Category	Numerical and descriptive ratings		
	1 Normal	2 Moderate dysfunction	3 Severe dysfunction
Swallow	Normal swallow	Pain or difficulty with swallow	Unable to swallow (intubated, absent gag)
Lips	Smooth, pink	Dry or cracked	Ulcerated or bleeding
Tongue	Pink, moist, papillae present	Coated or loss of papillae with shin appearance, with or w/o redness	Blistered, cracked, or w/o bleeding
Saliva	Watery	Thick or ropy	Absent
Mucosal membranes	Pink, moist	Red or coated, no ulcers	Ulcers with or w/o bleeding
Gingiva	Pink, firm	Edema, with or w/o redness; with or w/o bleeding	Bleeds easily
Teeth or dentures	Clean or no teeth	Local debris (between teeth)	General debris, decay
Odor	Normal	Slightly to moderately odor	Strong foul odor

Figure 2. Adopted by permission from: Prendergast et al (2013). The Bedside Oral Exam and the Barrow Oral Care Protocol: translating evidence-based oral care into practice. Intensive and Critical Care Nursing (2013) 29, 282—290

Type of care Oral health status	Tooth brushing	Oral mucosal care	Use of Chlorhexidine
Normal: Score 8-10	q 12 hours	PRN	____
Moderate dysfunction: Score 11-14	q 12 hours	q 4 hours	____
Severe dysfunction: Score 15-24	q 12 hours	q 2 hours	1 hour after tooth brushing swab CHG along gum line and surface of tongue
Tooth brushing instructions	1. Rinse mouth or swab with wet sponge. 2. Use soft pediatric toothbrush and non-foaming toothpaste, brush back to front inside/outside of teeth for 2 minutes. 3. Scrape tongue from back to front. 4. Suction oropharynx after brushing. 5. Conclude with mucosal care for comatose patients. 6. Apply thin layer of Vaseline to lips.		
Oral mucosal care	1. Rinse mouth with normal saline or swab with damp sponge. 2. Use new, dampened sponge and apply oral moisturizing spray to the tongue, gums and oral mucosa. 3. Apply thin layer of petroleum jelly to lips. **If hardened debris present:** 1. Saturate sponge with oral moisturizer and swab areas of debris. 2. Wait 1 minute and swab or scrape to remove. 3. Rinse with normal saline and suction. 4. Apply fresh application of oral moisturizing spray.		
Supplies and storage	o Children toothbrush. o Non-foaming toothpaste. o Tongue scraper. o Petroleum jelly (Vaseline) o Swabs, oral moisturizing spray o Suctioning system o CHG o Normal saline solution, Emesis basin		

Figure 3. Adopted and adapted by permission from: Prendergast et al (2013). The Bedside Oral Exam and the Barrow Oral Care Protocol: translating evidence-based oral care into practice. Intensive and Critical Care Nursing (2013) 29, 282—290

In the current study, BOE validated by a panel of experts specialized in critical care. After feasibility check by expert panel, the tool was translated to Persian. Then, the Persian version was revised by the expert panel and 10 nurses working in the ICU. Inter-rater reliability was checked using 30 nurses which was 0.89.

Modified Barrow Oral Care Protocol (MBOCP)

According to Prendergast et al. (12) BOCP and the BOE work together. Based on the scores patient gets from BOE, BOCP suggests three types of oral care options. Frequency and number of oral care increases as the total score obtained from BOE increases.

After the modification and application permission from the owner of BOCP, Barrow Neurological Institute, the experts imported accessible supplies including non-foaming toothpaste, pediatric toothbrush, mouth moisturizing spray, Vaseline jelly instead of well-known oral care devices used in Barrow protocol. Figure 3 shows more details of the MBOCP used in the current study.

According to BOCP, patients with optimal oral health (score 8-10) received the basic oral care consists of tooth brushing and oral mucosal care as needed (PRN). In patients with moderate dysfunction of oral health (score 11-14), beside the basic oral care, mucosal care was performed every 4 hours. When the oral health

score was in range of 15 to 24, patients received an additional care of Chlorhexidine (CHG) swabbing. In this form that one hour after tooth brushing, chlorhexidine-soaked swabs were rubbed on the gums and mucosal tissue of oral cavity.

Procedure and measures

All stages of the procedure were supervised by the main researcher. An introductory session was held for the nursing staff. For the 3 nurse specialists who performed the nursing care of the intervention group, a separate special and practical training session was held and during it the staff nurses were trained how to implement the protocol and related nursing care options. In the control group, the routine care was given for the patients. The routine or contemporary oral care for intubated patients was disinfecting the oral cavity using sterile gauze soaked in CHG 0.2%, three times a day without assessing the oral health status. The staff nurses were instructed to follow the routine care plan when they were caring for control patients.

The intervention started from endotracheal tube placement (ETT) and continued for 6 days (15)

The first or baseline BOE completion and oral care started 2 hours after intubation in both routine and intervention groups. In the intervention group, all 45 patients were assessed for oral health status using BOE every 6 hours and appropriate oral care protocol were performed using MBOCP. The frequency of the interventions was based on the oral health score which patients taken from BOE. Supplies and materials used in the intervention group were stored in a separate room and were not available to other nurses to use for their patients.

Data analysis

Data were analyzed using the IBM SPSS software, version 24. Descriptive statistics, repeated measures ANOVA, chi-square and t-test were used for data analysis. P-values less than 0.05 were considered as statistically significant.

Results

Data analysis showed that the mean age of the patients in the control and intervention groups were 35.82±8.31 and 33.55±10.08, respectively. Table 1 and 2 presents more demographic and clinical information about subjects in both groups.

Table 1. Frequency of participants based on sex and cause of admission

	Routine Group		Group received MBOCP	
	Number	Percent	Number	Percent
Male	22	48.90	35	**77.80**
Female	23	51.10	10	**22.20**
Trauma	34	75.60	41	**91.10**
Suicide	3	6.70	1	**2.20**
Surgery	8	16.60	3	**6.60**

Table 2. Clinical characteristics of patients in the routine and intervention groups

Variables	Routine Group Mean	Group received MBOCP Mean	p value
Age (yr.)	35.82 ±8.31	33.55±10.08	0.248
Oral health score (BOE)	15.97±2.52	17.02±2.76	0.065
Level of consciousness (GCS)*	6.66±2.00	6.37±1.77	0. 438
FiO2 (%)	55.55±13.92	59.88±13.92	0.662
Respiratory rate in ventilator (bpm)**	14.88±3.14	14.31±3.32	0.399
Patient's respiratory rate (bpm)***	8.20±4.07	8.33±4.17	0.878
Body temperature (°C)	37.40±0.59	37.52±0.79	0.422
Pulse rate (bpm)****	88.15±20.68	9.04±24.15	0.218
Systolic blood pressure (mmHg)	128.82±24.74	1.28±24.48	0.498
Diastolic blood pressure (mmHg)	71.13±12.02	68.53±13.04	0.328
Inspiratory flow rate (L/min)	6.35±9.18	6.00±13.58	0.949
PEEP (cmH2O)	5.00±0.36	5.22±0.65	0.844

*Glasgow coma scale, **breaths per minute, *** beats per minute, ****positive end-expiratory pressure

Table 3. Comparison of oral health status in two groups of receiving routine care and MBOCP

Care Group / Days	Control group (Routine Care) Mean	Intervention group (MBOCP) Mean	T-test (Between group)
BOE at day 1	15.97 ±2.52	17.02±2.16	P=0.065
BOE at day 2	15.35±2.14	14.40±2.86	P=0.077
BOE at day 3	15.68±2.17	12.33±1.97	P<0.001
BOE at day 4	15.86±2.17	11.24±1.35	P<0.001
BOE at day 5	16.00±2.88	10.84±2.76	P<0.001
BOE at day 6	16.11±2.06	10.84±2.76	P<0.001
	(P=0.09) *	(P<0.001) *	

*Day by day comparison in each group

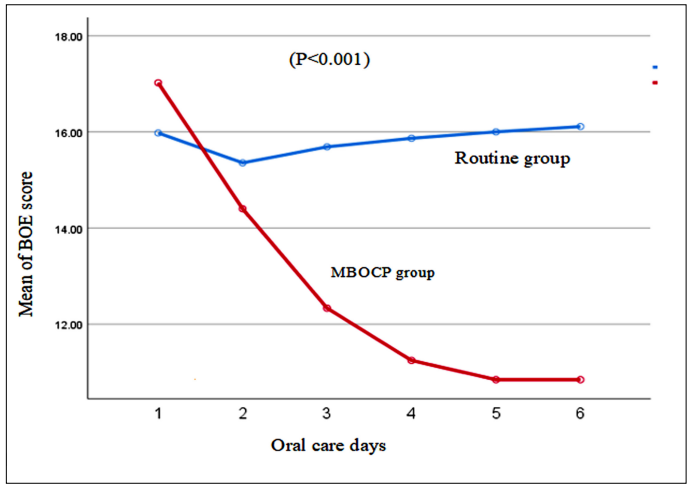

Figure 4. Comparison of oral health during 6 days of study in routine and MBOCP groups.

Repeated-measure ANOVA was used to test the between-group and within-group differences of BOE score of patients. As shown in the table 3 and Figure 4, there was no meaningful difference in control group when comparing oral health status trend from day 1 to day 6 (df=1.62, F=2.56, P=0.09). In contrast, there was significant within-group difference in group received oral care based on MBOCP (df=1.71, F=175.70, P<0.001). More importantly, between-group analysis showed a significant difference in BOE score of routine group and the MBOCP group (df=1, F=65.83, P<0.001).

Discussion

This study which aimed to investigate the impact of MBOCP on oral health status of patients receiving mechanical ventilation through oral endotracheal tube (ETT), showed that the MBOCP has a significant effect on oral health status of unconscious patients. Comparing the oral health scores of patients being cared by routine care and MBOCP during 6 days led to significant between and within group differences (P<0.001). It should be noted that in the MBOCP group, tooth brushing performed as a basic care every 12 hours and oral mucosal care and CHG also used based on BOE score. The routine oral care was disinfecting oral cavity by 10 cc CHG after rinsing the oral cavity by Normal Saline 0.9% solution every 6 hours.

In the routine care group, the average oral health score (BOE) was 15.97±2.52 at the first day of admission which increased to 16.11±2.06 at sixth day of ICU stay. Repeated measure ANOVA confirmed that routine care didn't improve oral health status of patients and in the majority of cases the oral health status worsened after admission to the ICU. Similar to our findings, a study from Indonesia reported that the oral health hygiene status of intubated patients get worse, despite routinely oral care with chlorhexidine gluconate (16).

In contrast to routine care group, within-group or day by day comparison of BOE score in the group receiving MBOCP showed a statistically significant improvement. Moreover, between group comparisons showed that MBOCP care plan is effective in improving oral cavity health of unconscious patients. Notably, between group difference started from day 3 and continued until the last day of study. Although most majority of prior studies tried to explore the secondary outcomes of oral health interventions such as ventilator-associated pneumonia (VAP) (17), the current study specially worked on the oral and mucosal outcomes of oral care. A clinical trial conducted by Atashi and et al. (18) obtained a similar finding; which used a systematic oral care program as an intervention program where showed that the oral care program is effective in improving oral health. Their study used a protocolized oral care program including tooth brushing, chlorhexidine, mouth moisturizing gel, and Vaseline which was similar to the current study. Another study in South Korea used a combined oral care program including tooth brushing, swabbing with chlorhexidine 0.1% and intermittent swabs of cold water which is consistent with the present study (15). In a cohort study in France, ICU caregivers implemented a care plan containing of foam stick, toothbrush and chlorhexidine and oral status evaluated by oral assessment guide (OAG). It concluded that implementation of combination care methods improves the oral health of patients in ICU. Although the effectiveness of single oral care modalities have been evaluated in different studies, the present study confirmed that combination of different oral care interventions through a systematic care protocol can lead to synergistic consequences. However, the presence of clinical guideline is no single determinant of high quality oral care in ICU and different factors such as staff knowledge and attitude (19), clinical competency, institutional supervision, continuing education, staff shortage, accessibility of supplies and equipment (19, 20)

Conclusions

This study which aimed to evaluate the effect of modified BOCP on the oral health of patients receiving invasive mechanical ventilation, showed that the protocolized and combined care improves oral health status of patients in ICU. This effect emphasizes on the importance of an evidence-based, managed and combined oral care protocol in ICU. However, application of accessible oral care supplies such as toothbrush, non-foaming toothpaste, chlorhexidine and oral moisturizer through an evidence-based and protocolized care format is effective than a disorganized and routine oral care. It is recommended that nurses and ICU staff to apply available supplies in the form of established and evidence-based protocols for oral care of patients.

The main limitation to conduct this study originated from staff nurse's low compliance to work through the MBOCP but resolved after training of key persons to perform the protocol. Availability of supplies and equipment were also important determinants which could affect the results of study. Moreover, outcomes of our intervention such as incidence of VAP, cost-effectiveness, staff satisfaction with the protocol were not explored in the current study that can be the subject of future studies

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AUTHOR CONTRIBUTIONS:

Concept: MS, RJ; **Design:** MS, RJ; **Supervision:** MS; **Materials:** MS, RJ; **Data Collection and/or Processing:** NM, SI, RJ; **Analysis and/or Interpretation**: MS; **Literature Search:** RJ; **Writing Manuscript**: MS, SI; **Critical Review:** MS, SI.

Ethics Committee Approval: This study approved by ethics committee of the research deputy of Ardabil University of Medical Sciences. IR.ARUMS.REC.1397.054.

Informed Consent: From patients\' legal guardian

Peer-review: Externally peer-reviewed.

Conflict of Interest: Authors have no conflicts of interest to declare.

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References

1. Saddki N, Mohamad Sani FE, Tin-Oo MM. Oral care for intubated patients: a survey of intensive care unit nurses. Nurs Crit Care 2017;22:89–98. [CrossRef]
2. Doğu Kökcü Ö, Terzi B. Development of an intensive care oral care frequency assessment scale. Nurs Crit Care 2020:1–8. [CrossRef]
3. Adib-Hajbaghery MAA, Azizi-Fini E. Oral care in ICU patients: a review of research evidence. KAUMS J (Feyz) 2011;15:280–93. http://feyz.kaums.ac.ir/browse.php?a_id=1250&sid=1&slc_lang=en
4. Gilbert C, Marik P, Varon J. Acute lobar atelectasis during mechanical ventilation: to beat, suck or blow. Acute lobar atelectasis during mechanical ventilation: to beat, suck or blow. Crit Care Shock 2009;12:67–70. https://www.semanticscholar.org/paper/Acute-Lobar-Atelectasis-During-Mechanical-To-Beat%2C-Gilbert-Marik/e53b90ce8d2a7a6d1d0d667e0f917162d38748a1
5. Wainer C. The importance of oral hygiene for patients on mechanical ventilation. Br J Nurs 2020;29:862–63. [CrossRef]
6. Munro CL, Grap MJ. Oral health and care in the intensive care unit: state of the science. Am J Crit Care 2004;13:25–34; discussion 34. [CrossRef]
7. Al Moaleem MM, Porwal A, Al Ahmari NM, et al. Oral Biofilm on Dental Materials Among Khat Chewers. Curr Pharm Biotechnol 2020;21:964–72. [CrossRef]
8. Azarpazhooh A, Leake JL. Systematic review of the association between respiratory diseases and oral health. J Periodontol 2006;77:1465–82. [CrossRef]
9. Shamshiri M, Fuh Suh B, Mohammadi N, et al. A survey of adherence to guidelines to prevent healthcare-associated infections in Iranian intensive care units. Iranian Red Crescent Med J 2016;18:e27435. [CrossRef]
10. Hanne K, Ingelise T, Linda C, et al. Oral status and the need for oral health care among patients hospitalised with acute medical conditions. J Clin Nurs 2012;21:2851–59. [CrossRef]
11. Mcmillian AS, Leung KCM, Pow EHN, et al. Oral health-related quality of life of stroke survivors on discharge from hospital after rehabilitation. J Oral Rehabil 2005;32:495–503. [CrossRef]
12. Prendergast V, Kleiman C, King M. The Bedside Oral Exam and the Barrow Oral Care Protocol: translating evidence-based oral care into practice. Intensive Crit Care Nurs 2013;29:282–90. [CrossRef]
13. Polit DF, Beck CT. Essentials of Nursing Research: Appraising Evidence for Nursing Practice, 7th ed. US: Wolters Kluwer, Lippincott Williams & Wilkins; 2018. http://opac.fkik.uin-alauddin.ac.id/repository/Denise_F._Polit_Essentials_of_Nursing_Research_Appraising_Evidence_for_Nursing_Practice_Essentials_of_Nursing_Research_Polit____2009.pdf
14. Broglio K. Randomization in Clinical Trials: Permuted Blocks and Stratification. JAMA 2018;319:2223–4. [CrossRef]
15. Jang CS, Shin YS. Effects of combination oral care on oral health, dry mouth and salivary pH of intubated patients: A randomized controlled trial. Int J Nurs Pract 2016;22:503–11. [CrossRef]
16. Anggraeni DT, Hayati AT, Nur'aeni A. The effect of oral care intervention on oral health status of intubated patients in the intensive care unit. Belitung Nurs J 2020;6:21–26. [CrossRef]
17. Jadot L, Huyghens L, De Jaeger A, et al. Impact of a VAP bundle in Belgian intensive care units. Ann Intensive Care 2018;8:65. [CrossRef]
18. Atashi V, Yousefi H, Mahjobipoor H, et al. Effect of Oral Care Program on Prevention of Ventilator-associated Pneumonia in Intensive Care Unit Patients: A Randomized Controlled Trial. Iran J Nurs Midwifery Res 2018;23:486–90. [CrossRef]
19. Tanguay A, LeMay S, Reeves I, et al. Factors influencing oral care in intubated intensive care patients. Nurs Crit Care 2020;25:53–60. [CrossRef]
20. Dagnew ZA, Abraham IA, Beraki GG, et al. Do nurses have barriers to quality oral care practice at a generalized hospital care in Asmara, Eritrea? A cross–sectional study. BMC Oral Health 2020; 20:149. [CrossRef]