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Original Article

Effect of a Multi - Component Educational Intervention on Nurses' Performance Regarding Oral Health Care of Mechanically Ventilated Children

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ABSTRACT

Background: Application of standardized oral care for children receiving artificial respiration can improve the mouth integrity and the overall health status. In addition to preventing infections that may spread to the respiratory tract and consequently shortening the hospital length of stay. **The study aimed to** determine the effect of a multi - component educational intervention on nurses' performance regarding oral health care of mechanically ventilated children. **Research Design:** A quasi experimental design was utilized. **Subjects:** A convenient sample included 60 nurses from Pediatric Intensive Care Units of Tanta International Educational Hospital and Tanta Main University Hospital. **Two tools were used:** Nurses' knowledge assessment questionnaire and oral health care practices observational checklist. **Results:** Three quarters and all of nurses had low knowledge and unsatisfactory practice pre educational intervention respectively whereas, immediately and one month post the intervention, mothers' knowledge and practice scores have been improved. **Conclusion:** Educational intervention significantly improved nurses' performance regarding oral health care of ventilated children. **Recommendations**: Continuous training for nurses about oral care interventions should be provided. Oral care protocol should be available in every pediatric setting.

Keywords: Mechanically ventilated children, Multi- Component educational intervention, Nurses' performance, Oral health

Introduction

Oral health maintenance is a fundamental task inside intensive care facilities. It affects children's psychological, physical and social welbeing, speech, oral intake, and disease outcomes. Poor oral health causes pain that dramatically worsens general health status, lengthens hospital stays, and raises hospital expenses. Critically ill children with mechanical ventilation are susceptible for colonization of oral bacteria and tooth plaques which appeared within one or two weeks after hospital admission **(Lei et al., 2023 & Dagnew et al., 2020)**.

Children admitted to pediatric intensive care units experience acute failure of one or more vital organs that can be life-threatening. Many equipments and invasive procedures are used to maintain the function of the body, as the mechanical ventilation, nasogastric tubes and suction catheters causing oral tissue damage, mucosal pressure ulcers from endotracheal tubes, colonization of bacteria and inflammation. In addition, insufficient oral care and many drugs such as bronchodilators, sedatives, anti-histamines and diuretics causes oral mucosa dryness. These conditions can worsen the oral health of intubated children (**Ganatra., Marques., & Langner, 2023; Causey., ElKarim., Blackwood., McAuley., & Lundy, 2023).**

The most prominent complications associated with poor mouth hygiene is oral mucositis. It is a severely debilitating inflammation or ulceration of the oropharyngeal mucosal membranes manifested by extreme pain, erythema, edema and restlessness that worsen children's nutrition and sleep leading to deterioration of health related quality of life **(Guimarães et al., 2021)**. Oral mucositis is becoming increasingly common in ventilated children, and their oral hygiene has worsened. A survey was done in Egypt claimed that, nearly two thirds of the studied subjects had moderate level of oral mucositis compared to one quarter of children had severe oral mucositis (**Ebrahim., Ahmmed ., Eltayeb ., & Sayed, 2021).**

Chronic infections of the oral cavity, poor infection control measures and prolonged supine body positioning facilitates pulmonary aspiration of pathogenic bacteria which alters the host defense mechanism and resulting in ventilator associated pneumonia. It is a lower respiratory tract infection that develops in patients that are intubated for greater than 48 hours and represents 36-60% of all infection-associated deaths especially in developing countries **(Lei et al., 2023)**. The risk increasing at a rate of 1-3% per day of intubation,

signifying 6-20 fold higher risk of developing pneumonia compared to non-ventilated ICU children **(Getahun et al., 2022)**.

The gold standard of oral care intervention is based primarily on oral cavity assessment (lips, gum, tongue, teeth, mucosa membrane and saliva) for presence of erythema, white patches, or discolored lesions, bleeding, discoloration of teeth, cracks, ulcers, blisters and tooth brushing techniques **(Mohammed & Badr, 2023)**.

In addition, multi – component nursing interventions as oral care bundles in conjunction with the standard infection prevention and control measures are priorities for the effective management of children with artificial respiration. These mainly involve providing regular oral hygiene with antiseptic rinse, head of bed elevation to 30° to 45°, preventing pressure arising from adhesive tape or trauma, removal of oral/nasal and subglottic secretions, avoiding normal saline instillation prior to endotracheal suctioning, regular control of endotracheal tube cuff pressure, avoiding change of ventilator circuits, and filters unless contaminated or malfunctioning, daily weaning from mechanical ventilator, , minimization of sedation, early mobilization and correct feeding tubes placement and care. Standardized updated written oral care protocol has to be available and implemented for children with mechanical ventilation in every intensive care unit **(Rashed., Salama, ., & Zayed, 2023; Mastrogianni., Katsoulas., Galanis., Korompeli., & Myrianthefs, 2023)**.

Nurses in intensive care units play a crucial role in preserving oral wellness and preventing associated infection when applying evidence-based practices. Nurses who possess adequate and updating knowledge and skills able to provide high quality of care and accurate decision-making that eliminate patient risks. Therefore, continuous teaching programs are recommended (**Al-Bdairy & Hassan, 2021)**

Significance of the Study

Mechanically ventilated children are at high risk for oral cavity deterioration as their normal host defense mechanism are impaired, as well as various interventions and connected devices that can damage mouth tissues and mucosa. Oral complications can negatively affect disease outcomes and increase death rates. The incidence of pneumonia associated with artificial ventilation in Egypt is about 54.8% (**Elsayed., Attia., & Arafa, 2024)**. However, mouth care is not a priority among nurses and they have inadequate information about practices of oral care **(Abdelaziz & Naeem, 2023)**. Further, few studies implemented on the pediatric subjects in this

aspect. Comprehensive oral care protocol application in pediatric critical care units can promote oral wellness, recovery and consequently quality of life. **(Philip., Villarosa., Gopinath., Elizabeth., & George, 2019 ; Damascena et al., 2020)** .

Aim of the study was to:

Evaluate the effect of a multi - component educational intervention on nurses' performance regarding oral health care of mechanically ventilated children.

Research hypotheses:

1-Nurses' Knowledge regarding oral health care of mechanically ventilated children is expected to be improved after implementing a multi - component educational intervention.

2-Nurses' practice regarding oral care for children on mechanical ventilation is expected to be improved after a multi - component educational intervention implementation.

Operational definition

Multi- component educational intervention is a continuous education initiative which included nurses' knowledge and practices regarding oral care of intubated children through multiple dimensions as assessment of oral cavity, mouth hygiene, oral and nasal suctioning, care of endotracheal intubation and feeding tube.

Subjects and method

Study design:

A quasi-experimental design was used in the present study to fulfill the objectives of the study.

Settings: The research took place at:

Pediatric Intensive Care units (PICU) of Tanta International Educational Hospital which is affiliated to the Ministry of Higher Education and Scientific Research. It locates in the fourth floor and consisted of three rooms, one of them is big and contains 4 beds and the others are small with 2 beds in each. There were 8 ventilators in all rooms.

-Pediatric Intensive Care Unit (PICU) of Tanta Main University Hospital locates in the fifth floor and contains four beds with four ventilators.

Subjects:

A convenience sampling of sixty nurses who working in the previous stated settings (30 nurses from each hospital). The participated nurses provided care for children undergoing mechanical ventilation who aged from 2-6 and were of both sexes. The size of the sample was measured according to power analysis

depended on the level of significance (95), study power (80%) with margin of error (5%) on Epi Info-Software Program.

Tools of data collection

Tool I: Nurses' Knowledge Assessment Questionnaire

This questionnaire was constructed by the researchers subsequent to recent literatures (**Abdelaziz & Naeem, 2023; Albougami, 2023**; **Al-Zaru., Batiha., Younis., & Alhalaiqa, 2020)**. It was revised by pediatric nursing professionals and employed to assess the characteristics of nurses and children as well as their knowledge regarding oral health of ventilated children pre, immediate and one month after educational intervention. It consisted of three parts:

Part (1): Nurses' Socio-demographic and professional data such as: age, sex, marital status, qualifications, experience years, previous training courses regarding oral hygiene of children with mechanical ventilation, applicability of oral care protocol and the incidence of oral problems among intubated children.

Part (2): Children's Bio-Socio-demographic characteristics that included: age, sex, residence, diagnosis and duration of ventilation.

Part (3): Nurses' knowledge regarding oral health care of mechanically ventilated children: This part was written in Arabic language and composed of:

a-Nurses' knowledge regarding oral care of mechanically ventilated children such as importance of mouth hygiene and frequency per day, oral care protocol/ guidelines, oral assessment scale and it's items, recommended endotracheal tube route and suction (7 questions).

b-Nurses' knowledge regarding oral complications associated with mechanical ventilator: including; types of oral problems, definition, causes, signs and symptoms of ventilator associated pneumonia, definition and causes of oral mucositis, oral inflammation induced drugs and preventive measures (8 questions).

Scoring system for Nurses' knowledge:

This part consisted of 15 multiple-choice questions. The score for each question was from (0-2 points). Complete and accurate answer had a score of 2, an answer that was both incomplete and correct had a score of 1 and not answered questions or wrong answers had a score of zero except two questions related to oral care protocol and suction scored from (0-1), correct answer was given 1 point and

incorrect answer given zero. The sum of all questions was 28 points.

The total scores of nurses' knowledge about oral health care of mechanically ventilated children were calculated and classified as follows:

- Equal to 80%: 100% was considered high knowledge.
- From 60: less than 80% was considered moderate knowledge.
- Below 60 % was considered low knowledge.

Tool II: Oral Health Care Practices of Mechanically Ventilated Children Observational Checklist

The investigators designed this tool based on relevant updated literatures review (**Lei et al., 2023; Jun, 2022; Khasanah., Sae-Sia., Damkliang, 2019 & Centre for Health Protection, 2018)** to assess nurses' practice regarding oral care of children on mechanical ventilation. It consisted of ten dimensions covered through 38 items. Each item scored 1 point when done correctly and not-done item was scored zero.

Oral health care practices involved the following dimensions:

1- Routine hand washing
2- Child preparation and position
3- Wearing of personal protective equipment (gloves, mask, goggles)
4- Equipment and supplies preparation
5- Assessment of oral cavity (gums, mucous membranes, tongue, teeth, saliva, lips)
6- Suction of oral cavity discharge
7- Standardized Oral hygiene procedure
8- Mechanical ventilator care
9- Feeding tube care
10- Documentation

The total scores of nurses' practices about oral health care of mechanically ventilated children will be calculated and classified as follows:

- From 80% to 100% represented satisfactory level.
- Less than 80% represented unsatisfactory level.

Method

1- A formal permission was acquired from Faculty of Nursing Dean, Tanta University& directors of Pediatric Intensive Care units of International Educational Hospital and Tanta Main University Hospital to undertake the present research.

2-Ethical considerations:

The researchers got an ethical approval to perform the current study from ethical committee at the Faculty of Nursing, Tanta University **(276-6-2023)**. The participants

received assurance that the data they provided would be kept confidential and utilized mainly for the study's objectives. The research nature not harm the whole sample. Nurses were provided written informed consent to participate in the study and were allowed to terminate participation at any time they wanted.

3- Development of Tools: After reviewing the updated and evidence based literatures, the researchers designed two tools, nurses' knowledge assessment questionnaire (Tool I) & oral health care practices observational checklist (Tool II), which were used in the study.

4- Content validity: The study's tools were examined for validity by five pediatric nursing specialists. The index of content validity was 97.5%.

5- Tools Reliability was tested through Cronbach's Alpha test which was 0.894.

6- A Pilot study: Six nurses (10% of the sample) were participated in a pilot study to examine the tool's clarity, applicability and feasibility and then excluded from the research sample. Additionally, the necessary adjustments were performed.

7-Phases of the study

Phase of Assessment:

The researchers conducted interviews with each nurse to collect the baseline characteristics in addition to knowledge of nurses about oral health of children receiving artificial ventilation using **Tool I**.

-Nurses' practice regarding oral health care of mechanically ventilated children was determined pre, immediately after educational intervention implementation and one month later using **Tool II**

Phase of Planning

The teaching intervention was planned according to nurses' needs assessment and literatures review which focused on setting the objectives. Content preparation was included the rational for implementing the sessions. The educational intervention was translated into Arabic language. A variety of teaching materials were prepared as booklets, pictures, video and PowerPoint presentations in addition to equipment required for oral care procedures as (Pediatric doll, light source, tongue depressor, gloves, clean gauze for mouth assessment, Oropharyngeal suction catheter, suction device pediatric tooth brush, sterile water and feeding tube).

Implementation Phase

The investigators met the participants in the study settings and began with introducing themselves and explaining the purpose of the

study. The studied nurses were divided into ten groups; each group contained 6 nurses. First, individualized interview with each nurse carried out to collect personal characteristics with the use of tool I part (1). The researcher collected data related to children by tool I part (2). Nurses' knowledge in relation to oral health care for critical ventilated children was obtained through Tool I part (3). Each nurse was observed during applying oral care procedures for children with the usage of tool II. Then, educational intervention was given to nurses through 5 sessions. The researchers were available at Pediatric Critical Units four days per week. Each session is approximately 30-45 minutes, including discussion time based on nurses' progress and feedback. Each session began by a conclusion about the content of the previous session and the topics of the current session, using different teaching strategies; Interactive lectures, group discussions, brain storming, demonstration and re demonstration.

Sessions of educational intervention comprised the following items:

- The first session: focused on mouth hygiene importance and frequency per day, types of oral problems

- The second session: related to definition, causes, signs and symptoms of ventilator associated pneumonia

- The third session: described definition and causes of oral mucositis, oral inflammation induced drugs and preventive measures against oral problems of intubated children

-The fourth session: concentrated on oral care as: beck oral assessment tool and suctioning oral discharge

- **The fifth session:** emphasized on procedures of oral care, mechanical ventilator and feeding tube care

Evaluation Phase

Nurses' performance regarding oral health care of mechanically ventilated children was evaluated three times before, immediate and one month after a multi - component educational intervention. The duration of the study phases (assessment, planning, implementation and evaluation phases) was about 4 months (from the first of June to the end of September 2023).

Statistical analysis

Data collection was processed and statistically analyzed employing Statistical Package for the Social Sciences (SPSS) version 23. Range, mean and standard deviations were for numerical values. The difference among mean values of more than two categories was done using analysis of variance (ANOVA) and differences within groups repeated measures ANOVA. Correlation between variables was

assessed through Pearson and Spearman's correlation coefficient r. Level of significance was adopted at $p < 0.05$ **(White. 2019)**.

Results

Table (1): demonstrates nurses' socio-demographic and professional data percentage distribution. It was found that, the age range of nurses was from 21-55 years with the mean of 28.35±8.5. Less than three quarters (73.3%) were female and 50% were married. In relation to nurses' qualifications, experience and previous workshops regarding oral care during mechanical ventilation, it was noticed that, 46.7%, 28.3 % and 63.3% of nurses had bachelor of nursing, their experience ranged from 3 to 6 years and didn't receive any training courses about oral care respectively.

As regards nurses' opinion about oral care protocol and oral problems occurred for intubated children, less than two thirds of them (61.7%) stated that oral care protocol wasn't applicable in pediatric intensive care unit. Most nurses (85%, 80 %) reported that mucositis, ventilator associated pneumonia and dental plaques are common among mechanically ventilated children respectively.

Table (2): displays that, 52.5% of children their age ranged from 4 to < 5 years and the mean was 3.60 ±1.07. More than half of them (57.5%) were males and 62.5% were from rural areas. As regards diagnosis of children, it was observed that, 45% of them had respiratory failure, followed by 17.5% post operation, 15% had cardiovascular diseases and 12.5% had central nervous system diseases. In relation to duration of using mechanical ventilation, more than half of them used mechanical ventilation from one week to less than two weeks.

Table (3): clarifies total scores of nurses' knowledge regarding oral care and complications of mechanically ventilated children. Three quarters of nurses (75%) had low knowledge before the teaching intervention while 96.7% and 95% of the studied participants got high knowledge levels immediately after teaching intervention and one month later. It was realized that the highest mean score was found immediately after intervention **26.3±1.9** followed by one month later **25.1±2.2**.There were statistically significant differences during all the study phases ($p = 0.001$, $p= 0.001$, $p = 0.013$) respectively.

Table (4): presents percentage distribution of nurses' practices regarding oral assessment and oral hygiene. It was observed that there were statistically significant differences in all items of oral assessment and hygiene practices pre and immediately after

educational intervention (p= 0.001, p= 0.001) respectively.

Table (5): illustrates percentage distribution of nurses' practices regarding oral and nasal suctioning. This table reveals a statistic significant difference of oral / nasal suctioning practices between pre - immediate phase and pre - one month later of intervention (p= 0.001).

Table (6): reveals the percentage distribution of nurses' practice regarding endotracheal tube care. It was clear that, the highest mean score was found immediately after the educational intervention **4.91±0.33** followed by one month later **4.41± 1.01**. There was a significant difference before, immediately and after one month of educational intervention (p= 0.001, p=0.006).

Table (7) explicates that, the highest mean score was found immediately after the educational intervention (6.40±0.86) followed by one month later (5.48±1.59). There were a significant difference between before-immediate & pre- after one month of educational intervention (p= 0.001).

Table (8): demonstrates total scores of the studied nurses regarding oral care practices of ventilated children. It illustrates that, all nurses (100) had unsatisfactory practice prior the intervention while, 100% & 90% had satisfactory practice during the immediate and after one month of intervention respectively. All phases of the study showed a statistically differences (p = 0.001, p= 0.001, p = 0.002)

Table (9): reveals a positive correlation among nurses' knowledge and practice pre, immediate and post one month of teaching intervention (r = 0.563, p = 0.028* and r = 0. 880, p = 0.001* and r = 0.762, p = 0.001*) respectively.

Table (1): Percentage Distribution of Nurses' Socio-Demographic and Professional Data

Socio-demographic and Professional Data	The studied Nurses (n=60)	
	No	%
1-Age (Years)		
20:< 30	42	70
30:<40	12	20
≥40	6	10
Range	21-55	
Mean ±SD	28.35±8.5	
2-Sex		
Male	16	26.7
Female	44	73.3
3- Marital status		
Single	29	٤٨,٣
Married	30	50
Widow	1	1.7
4- Qualifications		
Nursing diploma	6	10
Technical nursing Institute	24	40
Bachelor of Nursing	28	46.7
Post graduate studies	2	3.3
5- Experience (years)		
< 3	16	26.7
3: ≤ 6	17	28.3
6: 10	14	23.3
> 10 years	13	21.7
6- Previous workshops		
Yes	22	36.7
No	38	63.3
7-Application of oral care protocol in Pediatric Intensive Care Unit		
Yes	23	38.3
No	37	61.7
8-* **According to clinical experience, which oral problems occur for mechanically ventilated children?**		
Mucositis	51	85
Ventilator associated pneumonia	48	80
Dental plaques	48	80
Cracked lips.	36	60

*** More than one answer allowed**

Table (2): Distribution of Bio-Socio-demographic Characteristics of Children

Bio-Socio-demographic characteristics	The participant children (n=40)	
	No	%
1-Age (Years)		
2: < 3	7	17.5
3: < 4	8	20
4: < 5	21	52.5
5-6	4	10
Range	**2-6**	
Mean ±SD	**3.60 ±1.07**	
2-Sex		
Male	23	57.5
Female	17	42.5
3- Residence		
Rural	25	62.5
Urban	15	37.5
*** 4- Diagnosis**		
Respiratory failure	18	45
Cardiovascular diseases	6	15
Central nervous system diseases	5	12.5
Post operation	7	17.5
Sepsis	3	7.5
Renal failure	3	7.5
Complicated diabetes mellitus	1	2.5
5- Duration of using mechanical ventilation		
Less than one week	12	30
1: < 2 weeks	22	55
≥ 2 weeks	6	15

Table (3): Total Scores of Nurses' Knowledge regarding oral care and complications of Mechanically Ventilated Children

Nurse' knowledge	Total Studied Nurses (n=60)								
	Pre		Immediate		Post one month		Chi-Square		
	No	%	No	%	No	%	P1	P2	P3
Low	45	75	0	0.0	13	6.5	104.28	96.73	18.43
Moderate	7	11.7	2	3.3	3	5	0.001*	0.001*	0.013*
High	8	13.3	58	96.7	57	95			
Range	4-24		21-28		18-28				
Mean & SD	**14.7±4.5**		**26.3±1.9**		**25.1±2.2**				

***Significance at p< 0.05 P1: Pre & immediately after intervention P2: Pre & one month later p3: Immediately & post one month**

Table (4): Percentage Distribution of Nurses' Practices Regarding oral assessment and oral hygiene of Mechanically Ventilated Children

Oral assessment items		Total Nurses (n=60)								
		Pre		Immediate		Post one month		P1	P2	P3
		No	%	No	%	No	%	X2\ P	X2\ P	X2\ P
Hand washing and wearing gloves	Not Done	31	51.7	9	15.0	6	10.0	18.15 0.001*	24.91 0.001*	0.686 0.408
	Done	29	48.3	51	85.0	54	90.0			
Oral Assessment										
Assess the skin under and around the tape and ET tube	Not Done	33	55	1	1.7	4	6.7	42.03 0.001*	31.90 0.001*	1.87 0.171
	Done	27	45	59	98.3	56	93.3			
Assess gums, mucosa, lips and tongue and teeth for (Bleeding-pallor or erythema)	Not Done	34	56.7	3	5.0	6	10.0	37.55 0.001*	30.24 0.001*	1.08 0.298
	Done	26	43.3	57	95.0	54	90.0			
Total Mean of oral Assessment		**.883±0.73**		**1.93±0.31**		**1.78±0.49**		**F\P value 797.56 0.001***		
Oral Hygiene										
Gently brush teeth twice daily.	Not Done	33	55.0	6	10.0	12	20.0	27.69 0.001*	15.19 0.001*	2.35 0.200
	Done	27	45.0	54	90.0	48	80.0			
Use oral swab with 1.5% (H2O2) solution every 2 to 4 hours	Not Done	23	38.3	5	8.3	10	16.7	13.81 0.001*	6.44 0.01*	1.91 0.26
	Done	37	61.7	55	91.7	50	83.3			
Brush the tongue surface gently	Not Done	30	50.0	6	10.0	6	10.0	22.86 0.001*	21.97 0.001*	0.000 1.000
	Done	30	50.0	54	90.0	54	90.0			
Applying mouth moisturizer to oral mucosa and lips as ordered	Not Done	22	36.7	4	6.7	8	13.3	15.92 0.001*	7.73 0.001*	1.48 0.36
	Done	38	63.3	56	93.3	52	86.7			
Limiting continuous use of drugs increase mouth dryness	Not Done	22	36.7	5	8.3	9	15.0	23.64 0.001*	15.96 0.001*	1.29 0.39
	Done	38	63.3	55	91.7	51	85.0			
Total mean of oral hygiene		**٢,٧١±0.23**		**٤,٤٠±1.23**		**3.65±0.34**		**(F\P)= 746.67 0.001***		

***Significance at p< 0.05 (2 tailed)** **P1: Pre & immediately after intervention**
P2: Before and one month later **P3: Immediately & one month post educational intervention**

Table (5) Percentage Distribution of Nurses' Practices Regarding Oral and Nasal Suctioning

Oral/ nasal Suction Practice Items		The studied nurses (n=60)								
		Pre		Immediate		Post one month		P1	P2	P3
		No	%	No	%	No	%	X2\ P1	X2\ P2	X2\ P3
Hand hygiene & wearing sterile gloves	**Not Done**	30	50.0	5	8.3	5	8.3	**25.21 0.001***	**25.90 0.001***	0.000 1.000
	Done	30	50.0	55	91.7	55	91.7			
Suction as needed & start mouth then nose	**Not Done**	36	60.0	8	13.3	10	16.7	28.13 **0.001***	23.02 **0.001***	0.26 0.62
	Done	24	40.0	52	86.7	50	83.3			
Ensure Pressure of suctioning <100 mm Hg	**Not Done**	33	55.0	3	5.0	4	6.7	35.71 **0.001***	31.90 **0.001***	0.152 0.697
	Done	27	45.0	57	95.0	56	93.3			
Decontamination of respiratory equipment	**Not Done**	31	51.7	3	5.0	10	16.7	32.18 **0.001**	16.95 **0.001**	4.23 **0.040***
	Done	29	48.3	57	95	50	83.3			
Single use of suction catheter	**Not Done**	27	45	7	11.7	10	16.7	14.42 **0.001***	10.58 **0.001***	0.617 0.432
	Done	33	55	53	88.3	50	83.3			
Perform gentle oral suctioning	**Not Done**	27	45	8	13.3	9	15.0	14.56 **0.001***	15.45 **0.001***	0.069 0.793
	Done	33	55	52	86.7	51	85.0			
Drain, wash and rinse well suction canister	**Not Done**	21	35	2	3.3	11	18.3	19.42 **0.001***	18.44 **0.001***	3.37 0.66
	Done	39	65	58	96.7	49	81.7			
Put adequate sterile water in humidifiers during O2 therapy	**Not Done**	28	46.7	4	6.7	12	20	24.54 **0.001***	10.05 **0.001***	0.355 0.557
	Done	32	53.3	56	93.3	48	80.0			
Total Suction Mean		**4.11±1.7**		**7.33±1.15**		**6.816±1.17**		**F value: 996.81 & P= 0.001***		

P1: Pre and immediately after educational intervention
P2: pre and one month later
P3: Immediately and post one month after educational intervention
Value of Significance p< 0.05 (2 tailed)

Table (6) Percentage Distribution of Nurses' Practice Regarding Endotracheal Tube Care

Endotracheal tube Care Items		The studied nurses (n= 60)								
		Pre		Immediate		Post one month		P1	P2	P3
		No	%	No	%	No	%			
Clean the ET tubes and ventilator circuits	Not Done	46	76.7	0	0.0	8	13.3	74.59 0.001*	50.14 0.001 *	8.57 0.006*
	Done	14	23.3	60	100	52	86.7			
Maintain endotracheal tube cuff pressure at 20-30 cm H_2O	Not Done	28	46.7	0	0.0	5	8.3	36.52 0.001*	22.72 0.001 *	5.22 0.57
	Done	32	53.3	60	100	55	91.7			
Avoid unnecessary aspirations as saline instillation before tracheal suction.	Not Done	51	85	3	5.0	7	11.7	77.58 0.001*	63.66 0.001 *	1.75 0.322
	Done	9	15	57	95.0	53	88.3			
Recognize and inform physician of infant readiness to trial off the ventilator	Not Done	39	65.0	6	10.0	7	11.7	50.72 0.001*	35.42 0.001 *	3.003 0.163
	Done	21	35.0	54	90.0	53	88.3			
Enhance use of minimally invasi ventilator support techniques	Not Done	34	56.7	0	0.0	8	13.3	47.44 0.001*	25.56 0.001 *	8.57 0.006*
	Done	26	43.3	60	100	52	86.7			
Total Mean Endotracheal Tube Care		**1.70 ± 1.39**		**4.91±0.33**		**4.41± 1.01**		**F\P Value 1635 0.001***		

***Significance value at p< 0.05 (2 tailed) P1: Before and immediately after educational intervention P2: Before & one month later P3: Immediately & one month after intervention**

Table (7) Distribution of the Studied Nurses According to Feeding Tube Care

Feeding Tube Care items		The study group (n= 60)								
		Pre		Immediate		Post one month		P1	P2	P3
		No	%	No	%	No	%			
Check and Clean skin around the feeding tube daily.	Not Done	40	66.7	3	5.0	8	13.3	49.62 0.001*	36.66 0.001*	2.50 0.204
	Done	20	33.3	57	95.0	52	86.7			
Replace tape if it appears contaminated.	Not Done	28	46.7	4	6.7	7	11.7	24.54 0.001*	18.36 0.001*	0.902 0.264
	Done	32	53.3	56	93.3	53	88.3			
Avoid unnecessary pressure to oral passage when securing tape.	Not Done	51	85.0	5	8.3	7	11.7	70.85 0.001*	63.66 0.00\1*	0.370 0.381
	Done	9	15.0	55	91.7	53	88.3			
Assess feeding tube placement before each feed	Not Done	39	65.0	8	13.3	6	10	33.61 0.001*	39.82 0.001*	0.323 0.777
	Done	21	35.0	52	86.7	54	90			
Flushing with 20- 30 ml of water, before and after checking for residuals, administering drugs	Not Done	29	48.3	3	5.0	11	18.3	28.81 0.001*	12.66 0.001*	5.175 0.043*
	Done	31	51.7	57	95.0	49	81.7			
Check for aspirates	Not Done	39	65.0	7	11.7	10	16.7	36.19 0.001*	30.01 0.001*	0.617 0.602
	Done	21	35.0	53	88.3	50	83.3			
Elevate head of bed ≥ 45 degree during feeding	Not Done	18	30.0	6	10.0	9	15.0	45.00 0.001*	36.26 0.001*	0.689 0.582
	Done	42	70.0	54	90.0	51	85.0			
Total Mean Feeding Tube Care		**2.53± 1.86**		**6.40±0.86**		**5.48±1.59**		**F\P Value: 1661.9 0.001***		

***Significant at p< 0.05 (2 tailed)**
P1: Before & immediately after intervention **P2: Before & post one month** **P3: Immediately & post one month**

Table (8): Total Scores of the Studied Nurses regarding Oral Care Practices of Ventilated Children

Nurses' Total Practice Scores	Total Studied Nurses (n=60)								
	Pre		Immediate		Post one month		Chi-Square		
	No	%	No	%	No	%	P1	P2	P3
Unsatisfactory	60	100	0	0.0	6	10	120 0.001*	109.35 0.001*	30.58 0.002*
Satisfactory	0	0.0	60	100	54	90			
Range	10-30		31-39		27-39				
Mean & SD	**18.9±4.7**		**36.6±1.9**		**34.7±2.7**				

Significance value at p< 0.05 (2 tailed) **P1: pre & immediately after educational intervention**
P2: pre & post one month **P3: Immediately & one month later**

Table (9): Correlation between Nurses' Total Knowledge and Practice Scores

	Total knowledge Scores					
Total pract\ice Scores	Pre		Immediately		One Month	
	R	P	R	P	R	p
	0.563	0.028*	0. 880	0.001*	0.762	0.001*

*** Correlation is significant at the 0.05 level (2-tailed**

Discussion

Improved the whole health status of infants and children at the Pediatric Critical Care Units are based initially on standardized oral hygiene practices. Children undergoing intubation has to open the oral cavity for long periods of time, thus causing xerostomia, threatening oral health and teeth integrity. They are reliant on nurses to carry out mouth cleansing in order to alleviate the pain. Oral care protocol was group of evidence-based practices improves children's wellbeing and fosters recovery **(Alsoda et al., 2019)**.

Regarding nurses' training workshops regarding oral care of intubated children, about two thirds of them didn't receive any training about oral care standards. This could be due to unawareness of nurses about health risks associated with poor oral care, excessive workload, insufficient resources allocated for oral hygiene and lack of supervision on oral care implementation inside critical care units. These findings supported by **Abou Zed & Mohammed (2019)** who reported that, about two thirds of the studied nurses didn't attend any training regarding oral hygiene and prevention of ventilator associated pneumonia. Additionally, **Haresaku., Miyoshi., Kubota., & Obuse. (2023)** who added that developing multidisciplinary educational programs in different nursing fields is imperative to enhance nursing knowledge and oral care skills.

The study demonstrated that less than two thirds of nurses stated that oral care protocol wasn't applicable in pediatric units. This could be attributed to absent written standardized oral care protocol, absent or little educational workshops provided by hospital and poor nurses' knowledge about oral care bundles of children receiving mechanical ventilation. This finding approved with **Karimi., Kolyaei., Karimi., & Rahmani. (2023)** who claimed that oral health issues and other serious medical complications were considerably decreased with oral hygiene protocol compliance. Moreover, it is economical, cost-effective, and vital to the survival of patients. Similarly, **Arpaci., Semerci., & Yılmaz. (2023)** declared that evidence-based oral care protocol is important for the prevention and management of oral mucositis.

As regards nurses' opinion about common oral problems in the pediatric intensive care unit, most nurses believed that mucositis was prevalent among mechanically ventilated children. This could be explained in the light of many nurses weren't concerned with oral care procedure, little nurses' knowledge and poor practice. Also, prolonged intubation, feeding tubes, suction catheters and excessive drugs which deteriorate the integrity of oral mucosa causing inflammation. This finding was in acceptance with **Ebrahim., Ahmmed., Eltayeb., & Sayed. (2022)** who found that, all the studied children had mild mucositis associated with long duration of intubation; more than one week. A study was done by **Rashed et al. (2023)** showed that most children had severe oral problems before intervention.

This current research showed that, most nurses reported that ventilator associated pneumonia was common among intubated children. This could be due to poor nurses' knowledge and practice about oral care guidelines for critically ill children leading to oral infection and excessive oropharyngeal secretions that can be aspirated into lungs causing ventilator associated pneumonia. Additionally, persistent intubation weakens the upper airway's immune system and raises the risk of bacterial colonization which can disrupt swallowing, coughing, and mucociliary clearance **(Lei et al, 2023)**. This explanation was supported by **Ozaki., Tohara., Baba., & Komatsumoto. (2023)** who mentioned that, Oral hygiene practices can lessen the incidence of ventilator-associated pneumonia, which is common in hospitals. On the same line, **Antalová etal**. **(2022)** who revealed that, ventilator-associated pneumonia is the most prevalent infection associated with healthcare in both neonatal and pediatric intensive care settings, resulting in substantial expenses and mortality globally.

Concerning total scores of nurses' knowledge regarding oral care and complications of mechanically ventilated children. It was detected that, three quarters of nurses had low knowledge pre intervention. It could be due low level of education as more than one thirds of them had technical nursing education, absence of oral care protocols and policies, unawareness of nurses about severe health consequences associated with poor oral care and inadequate hospital training. This result was consistent with **Getahun et al. (2022)**, who indicated that, knowledge of nurses about preventive measures of oral problems is minimal. Also, **Gawili et al. (2023) & Philip et al. (2019)** reported that, intensive care nurses had inadequate information about evidence based oral care guidelines.

The results showed that, the majority of nurses had good knowledge immediately and one month post educational sessions. This could result from the content of teaching sessions was established according to nurses' needs and updated evidence – based nursing practice, it's clarity and simplicity, moreover, the use of different audiovisual aids. All these elements lead to knowledge improvement. These findings were consistent with **Getahun et al. (2022)** who stated that higher educational qualifications and ongoing nursing training are strongly linked to a high knowledge score. Consequently, implementing comprehensive training is required. Similarly, **Gawili et al. (2023)** who pointed to multifaceted training initiatives to raise the awareness of nursing staff in hospitals.

The study declared that, more than half of nurses didn't perform oral assessment for intubated children before teaching intervention whereas the majority of them performed it after educational sessions. This could be due to little nurses' knowledge and concerns as some of them believed that it wasn't the nurses' responsibility to perform mouth assessment, absence of oral care protocol and lack of supervision on oral assessment practice by senior nurses before

intervention then their practice improved due to impact of learning sessions. On the same way, **Ebrahim et al. (2021)** who reported that, inter professional training programs regarding oral assessment of intubated children are vital for nurses to enhance their performance as well as detect and treat oral infections early. Similarly, **Mohammed & Badr (2023)** asserted that children who are intubated should have regular oral cavity evaluation in the intensive care unit using oral assessment tools for oral health maintenance. Additionally, **Albougami (2023)** who found that the total mean scores of oral assessment of nursing students increased after educational program.

In relation to nurses' practice of endotracheal tube care, the mean scores were high shortly following the instructional intervention and after one month. This reflected the efficacy of training programs conducted for nurses regarding mouth hygiene and prevention of oral risks. This conclusion was supported by **El-Sayed., Khalil., & EL-kazaz. (2023)** who noticed that more than fifty percent of nursing staff showed poor practice toward preventive measures of endotracheal tube pre teaching and then improved after educational sessions. Similarly, **Mohammed., Ahmed., Reyad., Mohamed. (2023)** who realized that almost all nurses had incompetent endotracheal care performance

Regarding total scores of nurses' practices towards oral care. It was demonstrated that, all nurses had unsatisfactory practice prior the intervention. This observation might be due to poor nurses' knowledge and inadequate educational programs regarding evidence based oral care practice. This finding was aligned with **Al-Zaru et al. (2020)** & **Dagnew et al. (2020)** who found that, nurses had poor practice about ideal oral care practices. **Terzi & Kökcü (2022)** added that practice of oral care is considered one of the primary responsibilities of nursing care in intensive care units.

In relation to influence of educational sessions on nurses' practice, it was identified that, all nurses had satisfactory practice immediately after intervention sessions which reflected the importance and effectiveness of continuous educational programs about oral care guidelines. This result was in agreement with **Behzadi., Khanjari., & Haghani. (2019)** who reported that mouth care nurses' performance enhanced following educational program and recommended continuous nursing training. **Samim., Vahedian-Azimi., Jouzdani., & Bashar. (2022); Khasanah et al. (2019)** reported that, the repetition of evidence-based training courses can increase nurses' competency of oral hygiene practices.

The study revealed a positive correlation between nurses' knowledge and practice pre, and immediate educational intervention and after one month. This could be due to increasing nurses' knowledge about importance of oral hygienic care and oral problems that can worsen disease outcomes of children with mechanical ventilator as well as practices oral care can undoubtedly contribute to better practice. On the same way, **Sobeih., Abd-Elsalam., & Ahmed. (2018)** who

confirmed that, the nurses' practice and their knowledge about oral hygiene bundle showed a positive correlation. Also, this result was in line with **El-Sayed et al. (2023),** who discovered a significant connection among knowledge of nurses regarding oral hygiene and VAP prevention and their practice pre and post program application.

Conclusion:

The study confirmed that, following the application of a multi-component educational intervention, nurses' performance in the area of oral health care of mechanically ventilated children has significantly improved.

Recommendations:

According to the study results, these recommendations can be suggested:

1. Oral care bundles should be implemented as a routine daily care for children on mechanical ventilation.

2. All pediatric intensive care units should have adequate oral hygiene supplies and equipment.

3- Regular training and continuing education for nurses about the oral care should be carried out.

4. Policies of oral care practices should be available in the whole pediatric settings.

5. Integration of oral health literacy into nursing curriculum to improve nurses' knowledge and practice.

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