

## Effectiveness of Educational Program on Nurses' Knowledge and Practices Regarding Neonatal Endotracheal Tube Suctioning

Mona Mosaad Ibrahim Ali1, LailaYounis Mostafa Abu Salem2, Fatma Mohamed Fathy Amin3



<sup>1</sup>Clinical instructor in training team of Mansoura University Children Hospital, Egypt.

<sup>2</sup>Lecturer Pediatric Nursing, Faculty of Nursing, Mansoura University, Egypt.

<sup>3</sup> Assistant Professor of Pediatric Nursing, Faculty of Nursing, Mansoura University, Egypt.

### 1.ABSTRACT

**Background:** To keep the airway open and avoid difficulties from secretion retention, one of the most frequent operations in newborn intensive care units is endotracheal tube aspiration. Suction should not be routine and should be done only when a knowledgeable, experienced, and competent nurse is needed to avoid complications. **Aims:** Evaluate the effectiveness of educational program on nurses' knowledge & practices regarding neonatal endotracheal tube suctioning. **Design:** A quasi-experimental one-group pretest/posttest research design was utilized in this study. **Setting:** the study was carried out in neonatal intensive care unit affiliated to Mansoura university children hospital. **Sample:** A convenience sample of 60 nurse over a period of six months were included. **Tools for data collection:** A structured questionnaire sheet, and observational checklist were used for data collection **Results:** The results showed that total knowledge and performance scores were higher in the posttest and follow-up than in the pretest, with statistically significant differences. In addition, there was a positive linear correlation between nurses' overall knowledge of neonatal endotracheal tube aspiration and practice scores. **Conclusion:** The study concluded that implementation of a training program improved nursing staff's knowledge and practice of neonatal endotracheal tube suctioning. **Recommendations:** Researcher recommended that. Nurses should engage in in-service training to advance their knowledge and improve their practices related to neonatal endotracheal suctioning.

**Keywords:** Educational program, Endotracheal tube suctioning, Knowledge, Neonates, Nurses, Practices

### 2.Introduction:

Endotracheal suctioning (ETS) is essential for intubated neonates to prevent tube occlusion and is one of the most common nursing procedures performed in the ICU. Intubation suction is a systematic process performed by critical care nurses aimed at keeping the airway open and thereby returning blood oxygen saturation to normal levels (Ahmed, & Hattab, 2022). The presence of ETT resulted in increased mucus production as a result of mild irritation of the airway mucosa, inhibited the associated mucociliary machinery, and by impairing the cough reflex, also impaired the ability to mobilize secretions to cough. Frequent endotracheal suctioning is required to prevent secretion build-up and airway obstruction. Failure to clear secretions can lead to obstruction or obstruction of the ETT, which, if left untreated, can impair oxygenation, ventilation, and gas exchange, leading to cardiopulmonary arrest. (Rashwan, Eweida, & Hamad, 2022)..

Although ETS is essential, it can cause side effects such as bradycardia, atelectasis,

hypertension, hypoxemia, and cardiac arrest, and the risk of these complications is associated with high-risk newborns (Rad, Carter, Curley, Copnell, and Tume)., 2021). Suction should not be done on a schedule but should be done as needed after understanding the course of the disease and evaluating it. Signs of aspiration include visible discharge, coarse or diminished breath sounds, desaturated or rapid changes in blood gas levels, agitation, changes in body sounds related to the respiratory system, or graphical pulmonary May contain monitor "noise" signals. The upper airway should be gently suctioned (LaMar, 2022).

Endotracheal tube suction is done only to maintain endotracheal tube patency and never beyond the endotracheal tube to attempt to actually clear the airway. Using a closed system that allows suction without disconnecting from the ventilator provides the following short-term benefits: B. Reduction of oxygenation and heart rate variability (Saad, Ahmed, Rezk, & Kandeel, 2022; Yilmaz & Özden, 2021). Therefore, the current study was conducted to evaluate the effectiveness of a

training program in terms of nurses' knowledge and practice of endotracheal tube suction in neonates.

### 2.1 Significant of the study

Every newborn has the right to safeguard against the possible morbidities and probably mortality. As a result, newborn survival is a major concern, particularly in underdeveloped nations, and new proposed global target to decline the neonatal mortality are ambitious (WHO, 2020).

Endotracheal tube suctioning is the most frequently performed invasive procedure for intubated neonates in NICU. It is considered unsafe procedure and remain problem worldwide. It is associated with serious complications if not done appropriately. This procedure need nurses who are knowledgeable and skillful in order to improve the neonates' status and increasing their chance for survival (Niaraki, Pouraboli, Fakhr, Mirlashari, & Ranjbar, 2022).

Different evidence showed that nurses often perform neonatal ET suction procedures traditionally/routinely (Blakeman, Scott, Yoder, Capellari, & Strickland, 2022) This indicates a gap between scientific evidence and current practice, due to resistance to change, little administrative support, lack of intensive training, lack of access to literature, etc. , indicating that nurses do not integrate ETS recommendations into clinical practice. Lack of time to read and understand literature, competitive work pressure, poor change control processes and lack of access to policies (Griton, Naud, Gruson, Bedel, & Boyer, 2021; Schults et al., 2021). Therefore, applying educational program for nurses about neonatal endotracheal tube suctioning is very important for improving their knowledge and practice.

### 2.2 Aim of the study

To evaluate the effectiveness of educational program on nurses' knowledge and practice regarding neonatal endotracheal tube suctioning.

### 2.3 Research Hypothesis

Nurses' Knowledge and Practices regarding endotracheal tube suctioning Expected to be Improved after implementation of the educational program than before.

## 3. Methods

### 3.1 Research design

A quasi-experimental, pretest-posttest one-group design was used.

### 3.2 Setting

The study was carried out at the neonatal intensive care unit (NICU) affiliated to Mansoura

University Children Hospital (MUCH), which provides health services to children from the surrounding area at Dakhliya governorate. The unit occupied with advanced equipment and facilities required for neonatal care.

### 3.3 Subject

A convenient sample of nurses (n= 60) from the previously mentioned setting who accepted to participate in the study over a period of six months from 1<sup>st</sup> of September 2020 to the end of February 2021.

### 3.4 Tools of Data Collection

#### Tool I: A structured questionnaire sheet (pre & post-test and follow up)

It was drafted in simple Arabic by researchers after reviewing relevant literature with relevant scientific content to assess nurses' knowledge about endotracheal tube suctioning in NICU. It was divided into three parts:

**Part 1:** *Nurses' demographic data* such as (age, gender, level of education, years of experience in NICU, as well as the attendance of training program related to neonatal endotracheal tube suctioning.

**Part 2:** *Nurses' knowledge regarding neonatal endotracheal tube suctioning.* It was adapted from (Dougherty, & Lister, 2015; Watters, & Mancuso, 2019), and was modified by the researcher. It composed of total (15) questions related to knowledge about anatomy and physiology of neonates' respiratory system, knowledge related to Endotracheal tube suctioning (ETS) and complications of endotracheal tube suctioning.

**Part 3:** *Nurses' practical knowledge regarding care of neonates with endotracheal tube suctioning.* It composed of total (15) questions which included; assessment needed before suctioning, appropriate positioning, size of endotracheal suction catheter, appropriate pressures for the pre term and full term baby, personnel protective equipment needed during suctioning, ETS complication of insufficient oxygen before suctioning, hazards of putting saline 0.9% inside the ETT during suctioning, role of the nurse to prevent complications and what should be done if complications occurred and the documentations of the procedure.

#### Scoring system:

A correct answer received a score of 2, a correct answer received a score of 1, and an incorrect answer received a score of 0. This scoring method was used for nurses' knowledge and

practical knowledge responses (0). Knowledge level was classified into two categories; satisfactory knowledge  $\geq 75\%$  ( $\geq 45$  marks), and unsatisfactory knowledge  $< 75\%$  ( $< 45$  marks) (Abdel Salam & Elshemy, 2016)

**Tool II: Nurses' practices regarding endotracheal tube suctioning (pre, post and follow up)**

After analyzing relevant literature, the researcher created this measure to evaluate nurses' practice. prior, during, and after neonatal endotracheal tube suctioning. The tool was adapted and modified from various references (Azizian et al., 2020; WHO, 2017). It was an Observational check list consisted of 35 items which was divided in to five areas based on selected sections of intervention. The nurses were observed and their practice was evaluated throughout their working shifts.

**Scoring system:**

The scoring system for nurses' practices responses as the following: Completely done received a score of 2, partially done received a score of 1, and not done received a score (0). Competent practice  $\geq 75\%$  (54-70marks), and incompetent practice  $< 75\%$  ( $< 54$  marks) (Abdel Salam & Elshemy, 2016).

**3.5 Ethical Considerations**

The Faculty of Nursing Research Ethics Committee (FNREC)/Mansoura University institutional review board gave the study its ethical approval. The director of MUCH provided the necessary official approval for the study to be carried out. After outlining the study's objectives, the head of the NICU gave his verbal consent for the study to proceed. Following a review of the study's purpose, each nurse gave her verbal and written consent to participate. Throughout all study phases, data and study subject privacy were guaranteed. The nurses were given the assurance that they might leave the study at any time without incurring any costs.

**3.6 Pilot study**

A pilot study was conducted with 10% (6 nurses). It was conducted prior to data collection to assess the feasibility and applicability of the tool, assess the time required to complete the tool, and determine if any changes to the tool were necessary. Then the corresponding changes were made. Due to minor changes, the study sample included participants from a pilot study.

**3.7 Content Validity:**

Content validation was conducted by five pediatric nursing experts from the Mansoura School of Nursing who reviewed the data collection tools and provided their opinions. Your comments have been taken into consideration.

**3.8 Reliability:**

Tool reliability was used to test the internal consistency of tools by researchers administering the same tools to the same subjects under similar conditions. The researchers used Cronbach's alpha test. Reliability of knowledge was 0.7570 and reliability of practice was 0.85.

**3.9 Field work:**

Data was extended over six months, the researcher started by introducing herself to the nurses, explained the aim and nature of the study, and asked them about their expectations. Every nurse was interviewed before conducting the program in order to collect the nurses demographic date as well as their theoretical and practical knowledge regarding neonatal endotracheal tube suctioning, the researcher provided educational sessions for all nurse's participants. All sessions were conducted in a group setting using a slide set presentation supported with booklet prepared by the researcher in simple Arabic language. The session was carried out in a small group (n=10 nurses) with duration of approximately 30-45 minutes, the educational program consisted of 5 consecutive sessions: First session: At the beginning of this session, the researcher introduced herself, welcomed the nurses, showed grateful to their sharing in the study, and explained the objectives of these educational sessions. The 1st session covered the following items; an overview on neonatal respiratory system, definition of endotracheal tube, definition of endotracheal suctioning, sites of suctioning, indications for tracheal suctioning, contra indications for suctioning, the duration of session was 45 minutes, Second session: Discussed items related to types of tracheal suctioning (open and closed suctioning), difference between shallow and deep suctioning, complication of tracheal suctioning and how to prevent it. The duration of session was 30 minutes, Third session: the session covered the items related to the practical knowledge related to the tracheal suctioning as pressure of suctioning, type of suctioning catheter and its size, depth of insertion, danger of instillation of saline inside endotracheal tube, oxygenation during suctioning procedure, maximum time for suctioning, frequency of tracheal suctioning, documentation after suctioning

procedure and how to deal with any complication during the procedure. The duration of the session was 30 minutes, fourth session: these were the practical sessions that included training (demonstration and re-demonstration) of the studied nurses on endotracheal tube suctioning procedure. The duration of the session was 45 minutes, Fifth session: started by taking a feedback about the previous sessions, answer any questions related to the tracheal suctioning, the researcher distributed the post test, using the same pretest format

### 3.10 Analytical Statistics

Data was categorized and sorted, and the outcomes were displayed in tables. On a suitable personal computer, the Statistical Package for the Social Sciences was used to examine the data (SPSS Inc; version 21; IBM Corp., Armonk, NY, USA). The data's normality was assessed using the Kolmogorov-Smirnov test. In order to describe quantitative data, percentages and numbers were used. The continuous variables were presented using means and standard deviations. The t-test was used to compare two means. The Chi-square test (2), Friedman test, Fisher exact test, and Wilcoxon Signed Ranks test were used to determine whether there was a statistically significant relationship between the research variables (Z test). A difference was declared significant when P 0.05 was reached.

### 4. Results

**Table (1)** represented that, two-third (65%) of nurses were in the age 25 to less than 30 years, while 23.4% were in the age more than 35 years with a mean age  $29.58 \pm 4.46$  years old. More than one third (36.7%) of them had 1 < 5 years of experience, whereas 28.3% had 5 to less than 10 years of experience. Majority of the participant (90%) were female and 10% were male. More than two-third (70%) of nurses had bachelor degree of nursing, 20%, and 10% of them were nursing technician and master's degree holder, respectively. High percentage of nurses (81.7%) did not attend training programs about suctioning.

**Table 2** showed that 8.3% of studied nurses had satisfactory knowledge about neonatal suctioning before educational program implementation, compared with 80%, and 73.3% immediately post, and after 3 months follow up, respectively. Moreover, the mean of the total knowledge score changed from  $14.96 \pm 3.98$  pre implementation to  $25.5 \pm 3.59$ , and  $24.36 \pm 5.03$  immediately post, and after 3 months follow up,

respectively with a highly statistically significant difference between means ( $P \leq 0.001$ ).

**Table (3)** showed that, 15% of nurses had satisfactory practical knowledge about neonatal suctioning before educational program implementation, compared with 86.7%, and 90% immediately post, and after 3 months follow up, respectively with a highly statistical significant difference in-between the three program phases' percentages at ( $\chi^2 = 66.39$ ,  $P \leq 0.001$ ). Moreover, the mean of the total practical knowledge score changed from  $17.03 \pm 4.39$  pre implementation to  $26.60 \pm 3.35$ , and  $25.55 \pm 4.53$  immediately post, and after 3 months follow up, respectively with a highly statistical significant difference between means ( $F=96.02$ ,  $P \leq 0.001$ ).

Figure (1) illustrated that, 96.7% of studied nurses had unsatisfactory knowledge about neonatal suctioning before educational program implementation, compared to 3.3% and 11.7% immediately post and after 3 months follow up respectively.

**Table 4** revealed that nurses had incompetent practical level regarding suctioning procedure domains as: assessment as mean changed from 4.18 (2.03) pre to 7.60 (0.80) post, and 7.33 (1.20) follow up. For preparation domain, Mean (SD) had been changed from 5.23 (1.72) pre to 7.55 (0.89) post, and 7.25 (1.25) at follow up. During procedure practice mean (SD) was 21.1 (5.12), 28.58 (4.00), and 27.28 (5.60) pre, post, follow up, respectively. Moreover for post care practices and documentation mean changed from 7.26 (2.44), 10.00 (0.0), 9.73 (1.10) for post care, and 2.98 (1.57), 12.10 (2.81), 11.71 (3.08) for documentation. A statistically significant difference between the three program phases was also present, with a p-value of 0.001.

**Table (5)** showed that, the majority of the studied nurses (88.3%) had incompetent level of observed practice before implementation, compared to 6.7%, and 15% of them immediately after and 3 months follow-up after implementation, respectively. While, the mean of the total practical score is  $40.76 \pm 9.81$  pre-implementation versus  $65.83 \pm 6.83$  and  $63.35 \pm 10.38$  immediately after and 3 months follow-up after implementation, respectively. Markedly, there was a statistically significant difference between the three program stages at ( $F=173.16$ ,  $P 0.001$ ) and ( $F=87.24$ ,  $P 0.001$ ).

**Table (6)** showed that there was a highly statistically significant positive linear association between nurses' knowledge and all of their

observed practice and practical knowledge level before, immediately after , and after 3 months follow up at ( $r=0.355$ ,  $P=0.005$ , and  $r=0.418$ ,  $P\leq 0.001$ ), ( $r=0.276$ ,  $P=0.033$ , and  $r=0.355$ ,  $P=0.005$ ), and ( $r=0.328$ ,  $P=0.011$ , and  $r=0.412$ ,  $P=0.001$ ), respectively.

### **5. Discussion:**

One of the most frequent airway procedures carried out on mechanically ventilated newborns is endotracheal tube (ETT) suctioning. Complications derive from ETT suction are common, they occur in nearly one quarter of ETS episodes and there is a wide differentiation in clinical practice. Complications such as, alveolar decruitment, decreased saturation and cardiovascular functioning contribute to neonate harm and may increase the days of stay in neonatal intensive care unit costs (Mohamed & Ahmed, 2022; Schults et al., 2021). ETS interventions with the most efficient and least complications could provide away to improve health for large numbers of critically ill neonates, and significantly saving. Endotracheal tube suctioning can lessen its negative effects and consequences when done by skilled healthcare professionals based on the best available evidence. (Heidari, & Shahbazi, 2017; Mohamed, & Ahmed, 2022). Therefore, the current study was conducted to evaluate the effectiveness of educational program on nurses' knowledge and practice regarding neonatal endotracheal tube suctioning.

According to the study's findings, more than two-thirds of the nurses were under the age of 30 years old with mean  $\pm$  SD was  $29.58 \pm 4.46$  years. This finding was disagreed with Mohamed, and Ahmed. (2022) who conducted a study on the "Effect of Clinical Guidelines About Endotracheal Tube Suctioning on Nurses' Knowledge and Practice at Neonatal Intensive Care Unit" and found that more than two-thirds of the nurses were under the age of 25 with a mean SD of 25.102.614.

It was clarified from the present finding that, the majority of the subject were female. Similarly, Ebrahimi et al. (2020) in his study entitled "Effect of simulation-based suction education on the knowledge and performance of pediatric intensive care unit nurses, Tehran, Iran". The study indicated that, the majority of nurses were female. The current finding was supported by Mohamed and Ahmed's (2022) study, "Effect of Clinical Guidelines About Endotracheal Tube Suctioning on Nurses' Knowledge and Practice at Neonatal Intensive Care Unit." who reported that the vast majority of the subject were female. This result could be due to the fact that old belief that nursing

may be a private profession to females with the fact that most of the nurses in Egypt are females.

The current study revealed that more than two-thirds of nurses had a bachelor's degree in nursing in relation to the educational background of the studied nurses. This finding incongruent with **Harjot, Kumar, & Krishan, (2016)**, who mentioned that only one quarter of nurses were bachelor degree in Nursing. The researcher suggested that the present study result might be related to the study setting which is a critical area where it needs more qualified nurses with a high level of education.

Continuing education especially for neonatal critical care nurses is a crucial part of their professional development. The current study showed that a high percentage of studied nurses did not attend training programs about suctioning. This result is consistent with **Mohamed and Ahmed, (2022)**, who stated that over 75% of nurses didn't attend training courses about suctioning. Also, **Ahmed, (2019)** apply a study about "Effect of teaching program on ICU nurse's knowledge and practice of endotracheal suctioning procedure at Omdurman military hospital" and demonstrated that more than two-thirds of the study subjects did not attend previous training about endotracheal suction. This outcome might be brought on by the overworked nature of nurses, the staffing crisis, the dearth of training opportunities, and the dearth of specialized nursing curricula.

Concerning Nurses' knowledge as well as practical knowledge related to EET suctioning, the current study revealed that only a few participants of studied nurses had satisfactory level of knowledge about neonatal suctioning before educational program implementation, compared with high percentage either immediately post, or after 3 months follow up. The results of the current study demonstrated that the educational intervention was successful in enhancing both theoretical and practical knowledge, as shown by highly statistically significant differences between program phases at  $P 0.001$ . The results of the current study agreed with those of **Heidari and Shahbazi (2017)** in their study entitled "Nurses' awareness about principles of airway suctioning, Iran" who reported that nursing staff had average and limited knowledge of endotracheal tube suctioning in newborn critical care units, but that their level of knowledge had improved after training. Also, the finding was supported by **Vinayaka & Bernet, (2016)** who conducted a study about "A study to assess the effectiveness of structured teaching program on knowledge and

practice regarding ET tube suctioning among pediatric ICU staff nurses in selected Hospital at Bangalore”, indicated that pediatric ICU staff nurses' knowledge and abilities greatly increased following a structured training program.

Furthermore, Kaur (2022), in her study titled "Effectiveness of Structured Teaching Program on Knowledge and Practices regarding Endotracheal Suctioning Among Staff Nurses Working in Intensive Care Units of Selected Hospitals of Jalandhar, Punjab," found that the experimental group had a significantly different mean knowledge score & SD between the pretest and posttest (10.72 3.252) and (18.22 3.893), respectively, than the control group, which showed no significant differences. However, Mohamed et al study's from 2022 showed that most nurses had good knowledge in the pretest as opposed to every single person in the immediate posttest and the follow-up test after three months.

Neonatal suctioning is a nursing procedure should be carried out safely and efficiently. The current study illustrated that, the total score of practice of the studied nurses regarding 5 items of neonatal suctioning (as: assessment, preparation, during procedure practice, post care practices and documentation) after implementation of an educational program the nurses' practices were improved than before with highly statistically significant differences ( $p \leq 0.001$ ). This finding was consistent with Ahmed, and Hattab, (2022) who conducted a study about "Effectiveness of an Intervention Program on Nurses' Practices toward Neonatal Intubation Suctioning Procedure at Neonatal Intensive Care Unit", Pakistan". This study shown that while nurses' practices for sucking intubation fluids were low and insufficient in the pre-test, they improved to an acceptable average level in the post-test for all procedures. Additionally, compared to the pretest, the overall mean practice score improved in both the immediate posttest and the three-month follow-up test.

As regards to the total score of the studied nurses' practice regarding neonatal suctioning, the majority of the studied nurses had an incompetent level of observed practice before the implementation of the educational program, which markedly improved to be competent level immediately after and follow up after 3 months of program implementation with a highly statistically significant difference throughout the three program phases ( $P: \leq 0.001$ ) (Table 5). The result of the present study proved the necessity of nurses' education and training on ETS. This result was

consistent with Kaur's findings from 2022, who noted that there was no significant difference between the pretest and posttest mean practices score and SD for endotracheal suctioning among staff nurses in the control group (21.30 3.518) and (21.18 3.433), respectively, while there was in the experimental group (21.66 2.677) and (28.50 3.581), respectively.

Other comparable findings were reported in the study "Suctioning: Effectiveness of Structured Training Program in Enhancing Performance Knowledge of Intensive Care Unit Nurses" by Kanwal Qaiser et al. (2020), which demonstrated a significant improvement in ICU nurses' practices following a training session. The p-value of 0.00 further supports the obvious difference between the two ratings. Additionally, according to the findings of the study done by Khanjari et al. (2019), after the educational intervention, nurses' performance scores related to endotracheal intubation suctioning in infants improved. The suction field's neonatal service quality can be enhanced through in-service training. This improvement could be explained by the positive impact of the educational program on nurses' practice. Also, it could be explained by the interest of the nurses in teaching methods used in the educational program. Also, this improvement might be as a result of active involvement of the nurses in the educational session and frequent review of their knowledge and practice by the researcher and encouraging them to take an active role in the educational program.

The results of the current study showed that there were strong positive linear connections between the investigated nurses' overall observed practice and their knowledge and practical knowledge levels prior to, immediately after, and after three months of follow-up. This indicates that the mean score immediately the following education was much higher than it was before. The results of the current study are consistent with those of Ebrahimi et al. (2020); Mohamed and Ahmed (2022); and Schults et al. (2021), who discovered a strong beneficial association between knowledge and performance following the intervention. This demonstrates the need for understanding in order to perform the newborn suctioning process.

#### **6. Conclusion:**

Based on the current study's findings, endotracheal tube suctioning knowledge and practice among nurses improved after the educational program was put in place compared to before.

### 7.Recommendations:

The following suggestions are made in light of the findings of the present study:

1. Provide in services up to date, regular training program to improve nurses' knowledge and practice regarding endotracheal tube suctioning
2. Emphasize on presence of protocol related to endotracheal tube suctioning procedure.
3. Designing a guidebook for the program's steps and the steps of the procedure about EET suctioning.
4. Repetition of this study on large sample size and on wide scales in various governorates of Egypt so that the results could be generalized and compared between Egypt and other countries.

### 8.Acknowledgement

A grant thanks to all nurses who participated in this study.

### 9.Declaration of Conflicting of Interests

The authors asserted the research, writing, and/or publication of this work were all done without any apparent conflicts of interest.

### 10.Funding

This article's research, authorship, and/or publishing were not supported financially in any way.

### 11.References

- Ahmed, A. Q., & Hattab, K. M. (2022).** Effectiveness of an Intervention Program on Nurses' Practices toward Neonatal Intubation Suctioning Procedure at Neonatal Intensive Care Unit. *Pakistan Journal of Medical & Health Sciences, 16*(05), 650-650.
- Ahmed, R. E. A. (2019).** Effect of Teaching Program on ICU Nurse's knowledge and Practice of Endotracheal Suctioning procedure at Omdurman military hospital 2019 (Doctoral dissertation)
- Blakeman, T. C., Scott, J. B., Yoder, M. A., Capellari, E., & Strickland, S. L. (2022).** AARC clinical practice guidelines: artificial airway suctioning. *Respiratory Care, 67*(2), 258-271.
- Dougherty, L.& Lister, S. (2015).** The Royal Marsden Hospital Manual of Clinical Procedures. *9th Edition. John-Wiley: Chichester.*
- Ebrahimi, H. K., Jafarnejad, S., Sohrabi, S., Abbasi, A., & Esmailian, S. (2020).** Effect

of simulation-based suction education on the knowledge and performance of pediatric intensive care unit nurses. *Journal of Critical Reviews, 7*(4), 685-694.

- Griton, M., Naud, N., Gruson, D., Bedel, A., & Boyer, A. (2021).** The risk of microaspiration during oral care in mechanically ventilated patients: A randomised cross-over study comparing two different suction protocols. *Intensive and Critical Care Nursing, 63*, 102965.
- Heidari, M., & Shahbazi, S. (2017).** Nurses' awareness about principles of airway suctioning. *Journal of clinical and diagnostic research: JCDR, 11*(8), LC17
- Kanwal Qaiser, R. N., RM, P., RN BSN, M. S. N., Yasmeen Saggi, R. N., RM, D., DWA, M., ... & Sumaira Naz Generic, B. S. N. (2020).** Endotracheal Suctioning: Effectiveness of Structured Training Program in Enhancing Performance Knowledge of Intensive Care Unit Nurses, *3*(1), 16-21
- Kaur, K. (2022).** Effectiveness of Structured Teaching Programme on knowledge and practices regarding Endotracheal Suctioning among Staff Nurses working in Intensive Care Units of Selected Hospitals of Jalandhar, Punjab, 2021. *International Journal of Nursing Education, 14*(3), 98-104.
- Khanjari, S., Bayati, N., & Haghani, H. (2019).** Effect of Training on the Performance of Nurses in the Endotracheal Suctioning of Neonates. *Iran Journal of Nursing, 32*(118), 43-53.
- LaMar, K. (2022).** Respiratory Focused Nursing Care of the Neonate. In *Manual of Neonatal Respiratory Care* (pp. 799-805). Springer, Cham.
- Mohamed, S. S., & Ahmed, S. M. (2022).** Effect of Clinical Guidelines About Endotracheal Tube Suctioning on Nurses' Knowledge and Practice at Neonatal Intensive Care Unit. *Assiut Scientific Nursing Journal, 10*(31), 190-203.
- Niaraki, S. S., Pouraboli, B., Fakhr, A. S., Mirlashari, J., & Ranjbar, H. (2022).** The Effect of Endotracheal Suctioning Using the Four-handed Care on Physiological Criteria and Behavioral Responses of the Preterm Infants: Randomized Crossover Clinical Trial. *Journal of Caring Sciences, 11*(1), 21.

**Rad, L. L., Carter, B., Curley, M. A., Copnell, B., & Tume, L. N. (2021).** Is paediatric endotracheal suctioning by nurses evidence based? An International Survey. *Nursing in critical care*, 26(5), 372-379.

**Rashwan, Z. I., Eweida, R. S., & Hamad, N. I. (2022).** Effect of minimally invasive premeasured suctioning on airway mucosal injury and suction-induced stress among mechanically ventilated neonates: A clinical challenge for nurses. *Journal of Neonatal Nursing*, 28(4), 279-285 .

**Saad, F. A. M., Ahmed, H., Rezk, N., & Kandeel, N. A. (2022).** Endotracheal Tube Nursing Care: Current Evidence. *Mansoura Nursing Journal*, 9(1), 177-187.

**Schults, J., Charles, K., Long, D., Brown, G., Copnell, B., Dargaville, P., ... & Ullman, A. (2021).** The Paediatric AirWay Suction (PAWS) appropriateness guide for

endotracheal suction interventions. *Australian Critical Care*, 35(6), 651-660

**Vinayaka, A. M., & Bernet, S. (2016).** A Study to Assess the Effectiveness of Structured Teaching Programme on Knowledge and Practice Regarding ET Tube Suctioning among Pediatric ICU Staff Nurses in Selected Hospital at Bangalore. *INTERNATIONAL EDITORIAL ADVISORY BOARD*, 8(2), 122.

**World Health Organization (WHO), (2020).** <https://www.who.int/news-room/factsheets/detail/newborns-reducing-mortality>.

**Yilmaz, İ., & Özden, D. (2021).** Evidence-based knowledge and emotional experiences of undergraduate nursing students regarding endotracheal suctioning: A cross-sectional, descriptive study. *Intensive and Critical Care Nursing*, 65, 103040.

**Table (1):** Distribution of the studied nurses according to their characteristics:

Nurses characteristics		No=60	
		No.	%
Age	20<25ys	2	3.3
	25<30ys	39	65
	30<35ys	5	8.3
	≥35ys	14	23.4
	Mean (SD)	29.58 (4.46)	
Years of experience	1< 5 years	22	36.7
	5 < 10 years	17	28.3
	10<15 years	11	18.3
	≥15 years	10	16.7
Gender	Male	6	10
	Female	54	90
Level of education	Technical nursing institute	12	20
	Bachelor degree	42	70
	Master degree	6	10
Attendance of Training Program about Suctioning	Yes	10	18.3
	No	49	81.7

**Table (2):** Total score of the studied nurses' knowledge level regarding neonatal suctioning (pre implementation of educational program, immediately post and at follow up) (n=60).

Total score	Pre-		Immediately post		Follow up(after 3 months )		Test of significance
	No.	%	No.	%	No.	%	
Total general knowledge score =(30)							
Satisfactory knowledge (<75%)	5	8.3	48	80	44	73.3	$\chi^2 = 78.74$ P-value: ≤0.001
Unsatisfactory knowledge (≥75%)	55	91.7	12	20	16	26.7	
Mean (SD)	14.96 (3.98)		25.5 (3.59)		24.36 (5.03)		F=160.79 P-value:≤0.001

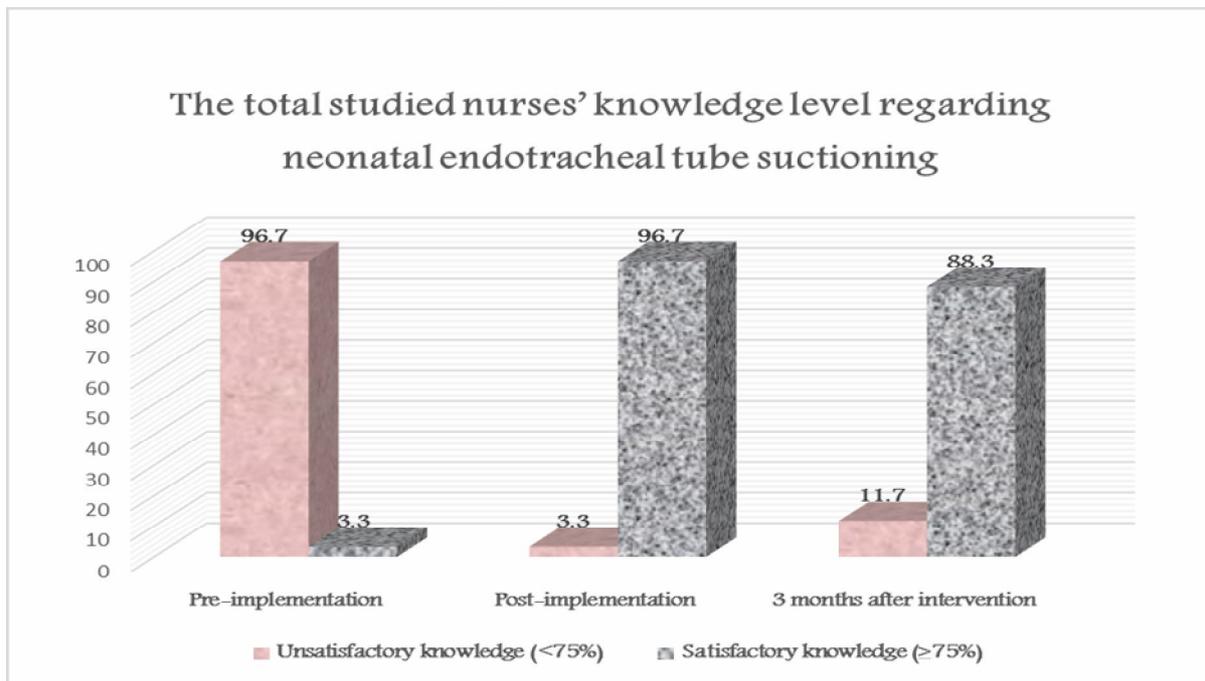
$\chi^2$ , Cochran's Q test, F: RM-ANOVA \* Significance at level P < 0.05.

## Effectiveness of Educational Program .....

**Table (3):** Total score of the studied nurses' practical knowledge regarding neonatal suctioning (pre implementation of educational program, immediately post and at follow up). (n=60)

Total score	Pre		Immediately post		Follow up (after 3 months )		Test of significance
	No.	%	No.	%	No.	%	
Total practical knowledge score =(30)							
Satisfactory knowledge (<75%)	9	15	52	86.7	48	80	$\chi^2 =66.39$ P-value: $\leq 0.001$
Unsatisfactory knowledge ( $\geq 75\%$ )	51	85	8	13.3	12	20	
Mean (SD)	17.03(4.39)		26.60(3.35)		25.55(4.53)		F=96.02 P-value: $\leq 0.001$

$\chi^2$ , Cochran's Q test, F: RM-ANOVA \* Significance at level P < 0.05.



**Figure (1)** Total score of the studied nurses' knowledge level regarding neonatal suctioning (pre implementation of educational program, immediately post and at follow up).

**Table (4):** Total score of the studied nurses' practice regarding neonatal suctioning (pre implementation of educational program, immediately post and at follow up) (N=60):

Practice categories	Pre		Immediately Post		Follow up (after 3 months)		Test of significance
	No.	%	No.	%	No.	%	
<b>Assessment (assess neonatal need for suctioning) Total Score (8)</b>							
Competent practice ( $\geq 75\%$ )	24	40	60	100	56	93.3	F=65.78 P-value= $\leq 0.001$
Incompetent practice (<75%)	36	60	0	0	4	6.7	
Mean (SD)	4.18 (2.03)		7.60 (0.80)		7.33 (1.20)		
<b>Preparation (pre procedure) Total Score (8)</b>							
Competent practice ( $\geq 75\%$ )	4	6.7	45	75	40	66.7	F=60.35 P-value= $\leq 0.001$
Incompetent practice (<75%)	56	93.3	15	25	20	33.3	
Mean (SD)	5.23 (1.72)		7.55 (0.89)		7.25 (1.25)		
<b>During procedure (implementation) Total Score (30)</b>							

Competent practice ( $\geq 75\%$ )	20	33.3	56	93.3	51	85	F=51.69 P-value= $\leq 0.001$
Incompetent practice ( $< 75\%$ )	40	66.7	4	6.7	9	15	
<b>Mean (SD)</b>	<b>21.1 (5.12)</b>		<b>28.58 (4.00)</b>		<b>27.28(5.60)</b>		
<b>Post care (post procedure)</b>				<b>Total Score (10)</b>			
Competent practice ( $\geq 75\%$ )	30	50	60	100	57	95	F=63.27 P-value= $\leq 0.001$
Incompetent practice ( $< 75\%$ )	30	50	0	0	3	5	
<b>Mean (SD)</b>	<b>7.26 (2.44)</b>		<b>10.00 (0.0)</b>		<b>9.73 (1.10)</b>		
<b>Documentation</b>				<b>Total Score (14)</b>			
Competent practice ( $\geq 75\%$ )	0	0	41	68.3	38	63.3	F=223.74 P-value= $\leq 0.001$
In Competent practice ( $< 75\%$ )	60	100	19	31.7	22	36.7	
<b>Mean (SD)</b>	<b>2.98 (1.57)</b>		<b>12.10 (2.81)</b>		<b>11.71 (3.08)</b>		

$\chi^2$ , Cochran's Q test, F: RM-ANOVA \* Significance at level P < 0.05.

**Table (5):** Total score of the studied nurses' practice regarding neonatal suctioning: (pre implementation of educational program, immediately post and at follow up). (N=60):

Total score	Pre		immediately post		follow up (after 3 months )		Test of significance
	No.	%	No.	%	No.	%	
<b>Total practice score =(70)</b>							
Competent practice ( $\geq 75\%$ )	7	11.7	56	93.3	51	85	$\chi^2=87.24$ P-value: $\leq 0.001$
In competent practice ( $< 75\%$ )	53	88.3	4	6.7	9	15	
<b>Mean (SD)</b>	<b>40.76(9.81)</b>		<b>65.83(6.83)</b>		<b>63.35(10.38)</b>		F= 173.16 P-value: $\leq 0.001$

$\chi^2$ , Cochran's Q test, F: RM-ANOVA \* Significance at level P < 0.05.

**Table (6):** Correlation between the total studied Nurses' knowledge and their practice regarding neonatal suctioning: (pre implementation of educational program, immediately post and at follow up). (N=60)

Item	The total studied Nurses' practice N=60					
	Pre		Immediately Post		Follow up (after3 months )	
	r	P	r	P	R	P
The total studied nurses' knowledge	0.355	0.005*	0.276	0.033*	0.328	0.011*
The total studied nurses' practical knowledge	0.418	$\leq 0.001$ *	0.355	0.005*	0.412	0.001*

Correlation is significant at the 0.01 level (2-tailed) \*\* Correlation is significant at the 0.05 level (2-tailed).