Effect of Competency Based Training Program on Nurses' Performance Regarding Endotracheal Tube Suction for Neonates on Mechanical Ventilator

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Abstract

Background: Clinical nursing competence is the capacity to apply care by integrating information, skills, attitude, beliefs, and experience. It reflects the nursing professional's feelings, ideas, and judgment. **Aim:** the study aimed to evaluate the effect of competency based training program on nurses' performance regarding endotracheal tube suction for neonates on mechanical ventilator. **Method:** A quasi-experimental design was used to conduct the study at Neonatal Intensive Care Units (NICUs) and Surgical Neonatal Intensive Care Unit "SNICU" of Benha Specialized Pediatric Hospital. The study included 70 nurses who working in the previously mentioned setting. Tools: Researchers used five tools as; a structured interviewing questionnaire, an observational checklist, nurses' attitude questionnaire, Nurse Competence Scale, and nurses' opinion questionnaire. **Results:** Less than three quarters of studied nurses had good knowledge and the most of them had competent practice post competency-based training program. Also, the majority of nurses had positive attitude post competency-based training program and there was highly statistically significant difference in nurses' competence score pre and post competency-based training program. **Conclusion:** The implementation of the competency-based training program improved nurses' performance regarding endotracheal tube suction for neonates on mechanically ventilated. **Recommendation:** Develop periodic educational and training courses for nurses working at the neonatal intensive care units regarding care of endotracheal tube suction for neonates on mechanical ventilator. Further research should be done with large sample is recommended to ensure generalization of the results.

Keywords: Competency, Training Program, Endotracheal Tube Suction, Mechanical Ventilator, Neonates, Nurses, Performance.

Introduction

Endotracheal tube suction is a critical procedure done by nurses for neonates on mechanical ventilator with endotracheal tubes to keep airways clear and lower the risk of nosocomial infections. However, this procedure has some risks including infections, lesions of the tracheal mucosa, cardiovascular disorders, hemorrhage, increase intracranial pressure, and hypoxemia **(Alessa et al., 2021).**

Inserting a tube into the trachea by passing the upper airway and laryngeal structures creates an artificial airway. All neonates with an artificial airway require endotracheal tube suctioning to remove secretions and prevent airway obstruction. The American Association for Respiratory Care (AARC) defined endotracheal tube suctioning as a component of bronchial hygiene therapy that involves the mechanical aspiration of pulmonary secretions from a neonate's artificial airway to prevent its obstruction (**Miia et al., 2020; and Wood, 2021).**

Endotracheal suctioning is done either by open or close procedures. In the open procedure, the neonates are separated from the ventilator and suctioning is carried out, while in the closed procedure the suctioning will be performed, while the neonates are connected to the mechanical ventilator. The most used procedure for suctioning for neonates is an open suction **(Javadi et al., 2020).**

Prior to suctioning of the endotracheal tube for neonates on mechanical ventilator, crucial considerations should be taken to prevent the potential complications. So, nurses should assess neonates who are on mechanical ventilator before, during and after suctioning through monitoring heart rate and rhythm, blood pressure, pulse oximetry, airway reactivity, tidal volumes, peak airway pressures, or intracranial pressure **(Arroyo-Novoa et al., 2020).**

Endotracheal tube (ETT) suctioning is one of the most common airway procedures done for neonates on mechanical ventilated newborns. There are many problems that can arise from ETT suction, such as damage to the respiratory mucosa, atelectasis, hypoxemia, decreased saturation, and ventilator-associated pneumonia, which is a major problem that can hurt babies and make them stay in the neonatal intensive care unit longer **(Schults et al., 2020).** Endotracheal suction remains

unsafe worldwide. Nurses haven't followed many of the scientific guidelines for endotracheal suctioning, probably because they don't know enough about it **(Jansson et al., 2021).**

The roles of nurses in NICUs are to observe ventilator closely and interfere to preserve ventilation and oxygenation in order to make sure that the needs of neonates are met. So, nurses should be familiar with aseptic technique which considered essential when endotracheal suctioning procedure performed to reduce the risk of infection. So, washing hands before and after suctioning with putting on apron, gloves and goggles are recommended and should be done during suctioning **(Alessa et al., 2021).**

Adequate knowledge along with the correct procedure performance is required to follow the aseptic technique which in turn prevents infection **(Savita et al., 2021).** Due to rapidly changing medical and technological advancements in today's healthcare delivery systems, nurses need to possess higher competency levels of skills, knowledge, and abilities to render safe and quality childcare **(Pascarelli, 2017).**

Competency represents the integration of knowledge, skills, values, and attitudes. Nurses' competency is a matter of concern worldwide and the complexity of assessing nurses' clinical competence has challenged educators for decades. Generic competencies are valid across different clinical contexts, whereas specific competencies are linked to specific areas of practice. Competency-based education is a outcomes-based approach to designing, implementing, assessing, and evaluating the educational programs **(Khan & Ramachandran, 2020)**.

There are two types of clinical competencies: the general and the specific competencies. The general clinical competencies include following the professional values, being able to communicate well, having good management skills, being able to work in a team, giving primary care, and taking on basic cultural traits. Some of the specific skills are knowing how to keep track of health and illness, judging the quality of nursing care, and doing things like endotracheal intubation, endotracheal tube suction, and airway management **(Ghanbari et al., 2017).**

Professional competence helps nurses perform well at work. Competence increases care skills and nursing education. Frustration and work discontent might impair nursing care when nurses don't know what they're doing. To improve nursing care, nurses must be strengthened and trained **(Karami et al., 2017).**

Significance of the Study:

Endotracheal suctioning is necessary but may cause potential risks as hypoxemia, cardiac rhythm abnormalities, trauma, and even death. So, nurses must understand these dangers and practice professionally according to best evidence. To reduce neonatal problems and risks, nurses should update their endotracheal tube suction skills **(Chen et al., 2021)**

Competency-based nursing education is an approach to designing, implementing, assessing, and evaluating nursing educational program. It does this by using a framework of competencies. The nurses' competency has a direct effect on the quality of care provided to the neonate on mechanical ventilator and decrease the cost of care. So that competency-based training Programs could be changed to help during transitions and offer help to make sure of better outcomes **(Sargeant et al., 2018).** Therefore, this study aimed to assess the effect of competency-based training program on nurse's performance regarding endotracheal tube suction for neonates on mechanical ventilator.

Aim of the Study

The aim of this study was to evaluate the effect of competency-based training program on nurse's performance regarding endotracheal tube suction for neonates on mechanical ventilator through:

1-Assessing nurses' knowledge, practice, attitude, and level of competence regarding endotracheal tube suction for neonates on mechanical ventilator.

2-Designing and implementing competency-based training program regarding endotracheal tube suction for neonates on mechanical ventilator.

3-Evaluating the effect of competency-based training program on nurses' knowledge, practice, attitude, and level of competence regarding endotracheal tube suction for neonates on mechanical ventilator.

Research Hypothesis

1. Nurses who participating in competency-based training program expected to have an improvement in their knowledge, practice, and attitude regarding endotracheal tube suction for neonates on mechanical ventilator.

2. Nurses who participating in competency-based training program expected to have high competency score regarding endotracheal tube suction for neonates on mechanical ventilator.

Subject and Methods

Methods

Research Design: A quasi-experimental design. The study extended from the beginning of January 2022 to the end of February 2022.

Research Settings: The study was conducted at Neonatal Intensive Care Units (NICUs) and Surgical Neonatal Intensive Care Unit "SNICU" of Benha Specialized Paediatric Hospital affiliated to the Egyptian Ministry of

Health and Population at Benha City, Egypt. This hospital composed of one NICU on the third floor in building "A" and Surgical Neonatal Intensive Care Unit "SNICU" on the third floor in building "B." NICU contains two rooms, the 1st room had 32 incubators, and the 2nd room had 3 incubators. SNICU contains two rooms with 12 incubators.

Subjects

1-All nurses (70) who are working at the previously mentioned setting, regardless of their characteristics, and willing to participate in the study.

2- During the study, a convenience sample of 55 neonates on mechanical ventilator was taken, with all cases available at the time.

Tools:

Data was collected through the following tools:

Tool I: Interview questionnaire:

It was designed by the researchers after reviewing the recent and relevant research. It was prepared in an Arabic language and composed of three parts:

Part I: Characteristics of the studied nurses, such as age, gender, academic qualifications, years of experience at NICU and attendance to previous training courses related to endotracheal tube suction for neonates on mechanical ventilator.

Part II: Characteristics of studied neonates: current age, gender, current weight, and gestational age.

Part III: Medical data of studied neonates as medical diagnosis, modes of mechanical ventilator, duration of connection to mechanical ventilation in days, complications occurred during connection to mechanical ventilation.

Part IV: nurses' knowledge regarding endotracheal tube suction: It encompassed of (30) multiple-choice questions and open end questions such as; definition, types, indications and contraindications of endotracheal tube suctioning, frequency of endotracheal tube suctioning, the recommended suction pressure for neonate, closed suction system and open suction system for neonates, nursing assessment prior endotracheal tube suctioning, nursing role regarding prevention of endotracheal tube suctioning complications.

Scoring system:

Each question was scored as (1) for correct answer, while (0) for incorrect. The total score ranged from 0-30. The total scores were categorized as good knowledge level if >85%, average if score 75% to 85%, and poor if score <75%.

Tool II: An observation checklist for nurses' practice

It was adapted from **(Yilmaz et al., 2022), (Mohamed & Ahmed, 2022),** It consisted of the closed and open endotracheal tube suction procedures. Each procedure includes 3 main items pre, during and after procedure. Closed endotracheal tube suction procedure included (35 steps) distributed as pre suctioning procedure (9 steps), during (19 steps) and after (7 steps). While open suction procedure included (30 steps) categorized as pre suctioning procedure (8 steps), during (15 steps) and after (7 steps).

Scoring system:

Each step was scored as (1) for done, while (0) for not done. The total scores were categorized as competent practice if scores 90% or more and incompetent if score <90%.

Tool III: Nurses' attitude regarding endotracheal tube suction. It was adapted from **Sunny & Rani (2021).** It consisted of 15 items, as nurses should assess the neonate to identify the need to suction, give priority of care for patients with accumulated secretions, think ETT suctioning is time consuming to care, ETT Suctioning is effective for thick and sticky secretions, No need to clean suction catheter with saline after procedure, oral care has a very high priority after ETT suctioning, think suctioning isn't time consuming to care, ETT Suctioning is effective for thick and sticky secretions, No need to clean suction catheter with saline after procedure, oral care has a very high priority after ETT suctioning, Do you think suctioning isn't time consuming to care, ETT Suctioning prevents hypoxemia, atelectasis and cardiac arrhythmia.

Scoring system:

Each response of nurses scored as Likert scale (agree 2), (uncertain 1), (disagree 0) for positive items and vice versa for negative item. Positive attitude if score 80% or more and Negative attitude if score < 80%.

Tool IV: Nurse Competence Scale (NCS): It was adapted from **Meretoja et al. (2004).** It included 25 steps grouped under seven main parts as helping role (4 steps), diagnostic functions (2 steps), teaching- coaching (3 steps), managing situations (7 steps), ensuring quality (3 steps), therapeutic interventions (2 steps), and work role (4 steps).

Items of the Nurse Competence Scale included:

Helping role (Planning care for ventilated neonates concerning ETT suction, Modifying the care plan according to ventilated neonates needs, Decision-making guided by ethical values, Organizing own workload and time management principles for meeting responsibilities).

Teaching – coaching (Taking proactive actions to preserve and develop my professional skills regarding endotracheal tube suction, Coaching others in duties within my responsibility area, Controlling technique for the work flow through delegating the nursing team).

Diagnostic functions (Documentation of nursing care regarding endotracheal tube suction provided to ventilated neonates, Identifying needs of neonates on mechanical ventilator undergoing endotracheal tube suction for physical support).

Managing situations (Prioritizing activities flexibly regarding endotracheal tube suction for neonates on mechanical ventilator according to changing situations, Arranging debriefing sessions for the care team according to changing situations, Promoting flexible team co-operation in rapidly changing situations, Recognizing situations posing a threat to neonates' life early, Acting appropriately in life-threatening situations for neonates on mechanical ventilator, Planning care consistently regarding endotracheal tube suction for ventilated neonates with resources available, Keeping nursing care equipment in good condition).

Therapeutic interventions (Incorporating relevant knowledge to provide optimal care regarding endotracheal tube suction for neonates on mechanical ventilator, Evaluating systematically nursing care outcomes after endotracheal tube suction for neonates on mechanical ventilator).

Ensuring quality (Familiar with hospital policy and rules, Familiar with hospital vision, mission and goals, Able to identify areas in nursing care that need further development).

Work role (Acting autonomously, Aware of the limits of own resources, Acting responsibly in terms of limited financial resources, Utilizing information technology in my work to support safe care for neonates on mechanical ventilator and improve their outcomes).

The nurses' competence level was evaluated by using Visual Analog Scale from 0 to 100 as; low competence 0-25, quite competence 25-50, competence 50-75 and very competence 75-100. The frequency with which individual items are used in clinical practice is indicated on a four-point scale (not applicable to nurse's work had score (0), used very seldom (1), used occasionally (2) and used very often (3).

Tool V: Nurses' Opinion questionnaire. It was adapted from **Mirlashari et al. (2016)** to assess nurses' opinion regarding factors affecting nurses' competency level regarding endotracheal tube suction for neonates on mechanical ventilator. It consisted of (7 items) including experience, interpersonal relationships, education level, continuous professional development, awareness of achievement for clinical nursing competency, available resources, and work environment.

Validity and Reliability:

Three experts in paediatric nursing made up a jury that looked at how the tool is clear, simple, complete, relevant, and useful. Cronbach's alpha test was used to check the reliability of every item in the tools. It was 0.79 for knowledge, 0.81 for practice and 0.85for attitude.

Ethical Considerations:

The proposal revised and approved by the Ethical Research Committee at the Faculty of Nursing, Benha University; before starting the practical work. All nurses were assured that participation in the study was voluntarily; each nurse was informed about the aim, benefits and nature of the study and each nurse had the right to withdraw from the study at any time without any rationale. The oral consent was obtained from each nurse to participate in the study. Confidentiality and anonymity of each nurse was assured through coding of all data.

Pilot Study

A pilot study was done on 10% of the study subjects, (7 nurses), to assess the study tools, regarding its clarity, simplistic and time taken to fill in. Based on the results of the pilot, study no modifications were done to the study tools. So, the nurses who were included in the pilot study were part of the study sample.

Field Work

The actual field work was carried out from the beginning of May 2022 to the end of October 2022. The researchers were available three days/week at the previously mentioned setting to collect the data by using the previously mentioned data collection tools.

Assessment Phase

At the beginning, the researchers talked to each nurse, to introduced themselves, to them as well they informed them about the purpose of the study, how long it would last, and what would be done, and also to get their verbal approval to share in the study before data collecting. Next, each nurse was asked to fill in tool one (The structured interviewing questionnaire) on their own to get the baseline data. On average, it took between 15 and 25 minutes to finish each interview with a nurse. After that, it took the researchers 10 to 15 minutes to finish the medical records of the new-borns. Then, the researchers observe nurses for 20 – 30 minutes during suctioning the endotracheal tube (Tool II). The nurses' attitude regarding endotracheal tube suctioning was filled by the studied nurses in 15-20 minutes (Tool III). Meanwhile, the researchers started to assess nurses' competence level regarding endotracheal tube suctioning by Nurse Competency Scale (Tool IV). Finally, the researchers assess factors affecting nurses' competency regarding endotracheal tube suction for neonates on mechanical ventilator as reported by the nurses (Tool V).

The researchers created an Arabic handbook about endotracheal tube suction for neonates on mechanical ventilator based on nurses needs which. identified during the pre-assessment.

The seven sessions required to complete the implementation phase (3 sessions for theory and 4 sessions for practice). A timetable that is suited for the nurse's work schedule was created to conduct the courses. It includes the time, date, place, topic, and duration of each session. Both the academic and practical components of the training sessions addressed the endotracheal tube suctioning for neonates on mechanical ventilator. The nurses were divided into 8 groups each one around 8–9 nurses for each session because it was difficult to collect all of them at once.

Each theoretical session had a time allotment between 30 and 35 minutes, while each of the three days of the practical training had a time allotment between 45 and 60 minutes. Keeping in mind that nurses would prefer straightforward language, the researchers opened each session with a summary of the data provided during the previous session and the objectives of the current one. It was taught through several methods, including small groups discussion, brainstorming, role-playing, demonstrations, and several repetitions of the same lesson as they needed. As well as educational tools used include, Power Point presentations and videos.

-The first theoretical session included: the general and the specific objectives, introduction about competency concept and its purpose, difference between competence and competency, nursing competency domains, categories of clinical competencies**,** component of nurse competencies, role of the clinical trainer in competency-based learning, and component of quality of nursing care for neonates.

- **The second theoretical session include**d definition of endotracheal tube suctioning, indications and contraindications of endotracheal tube suctioning, frequency of endotracheal tube suctioning, variables effect of the suction frequency, and how long is negative pressure applied.

-The third theoretical session included nursing assessment prior to endotracheal tube suctioning, difference between closed endotracheal tube suction system and open endotracheal tube suction system for neonates on mechanical ventilator, complications and its prevention.

-The first practical session included steps before, during and after endotracheal tube closed and open suctioning procedure and infection control measures that should be flow during the suction.

-The second practical session included steps of helping role, Steps of teaching – coaching, designed care plan to improve nursing care offer regarding endotracheal tube suction, steps for protecting neonates from unsafe or unethical care practice regarding endotracheal tube suction.

-The third practical session included steps of diagnostic functions, steps of acting in and managing life-threatening situations for neonates on mechanical ventilator during endotracheal tube suction, steps or during therapeutic interventions.

-The fourth practical session included steps of quality of nursing care application for neonates on mechanical ventilator, which including the safety measures regarding work environment that prevent harm of the neonates and staff members.

Evaluation Phase

The nurses' knowledge, practise, attitude, and level of competence were assessed immediately after the competency-based training program content was implemented. The identical data gathering methods used for the pre-test were used also during the post-tests.

Statistical Analysis

The collected data were categorized, analysed and tabulated using Statistical Package for Social Science (SPSS) computer program version 21. Numerical data were expressed as mean and standard deviation. Chi-square test was used to compare between qualitative data and t. test for quantitative data. Pearson correlation coefficient to assess the correlation between variables. A statistically significant difference was considered at p-value < 0.05 and a highly statistically significant difference was considered at p-value ≤ 0.01.

Results

Table 1 showed the nurses' characteristics; it was found that, the mean age of the studied nurses was 30.26±4.74years and the majority (92.9%) of them were females. In relation to nurses' academic qualifications more than two fifth (41.5%) of them had a technical institute of nursing certificate. Additionally, it was noticed that, more than one third (37.1%) of nurses had an experience from 5 to less than 8 years.

Figure 1 illustrated the distribution of the studied nurses according to their attendance to training courses regarding endotracheal tube suctioning. It showed that less than two thirds (60%) of nurses attended one training course about endotracheal tube suction for neonates.

Table 2 clarified neonate's personal characteristics; it was noticed that the mean age of the studied neonates was 13.75±7.24 months. In relation to gender it observed that more than half (56.4%) of the neonates were females. Additionally, it was noticed that two fifth (40.0%) of neonates weighted from 1500->2000 gm. Regarding gestational age of the neonates, it was found that; less than two thirds (65.4%) of them born before 37 weeks.

Table 3 showed distribution of neonates on mechanical ventilator according to their medical history. It was found that; less than two thirds (63.6%) of the neonates had respiratory distress syndrome. Also, more than two thirds (43.6%) of them used intermitted mandatory ventilation (IMV) mode and more than one third (36.4%) connected to mechanical ventilator for more than 15 days. In addition, less than two thirds (61.8%) of them didn't suffer from complications during their connection to the mechanical ventilator.

Table 4 revealed that nurses' total knowledge regarding endotracheal tube suctioning pre and post implementation of the competency-based training program. It was found that, less than three quarters (74.3%) of studied nurses had satisfactory knowledge level post implementation of the competency-based training program compared to 14.3% only pre-competency-based training program. Also, there

was highly statistically significant difference pre and post competency-based training program at p value (P<0.000).

Table 5 portrayed total nurses' practice regarding closed and open endotracheal tube suction pre and post competency-based training program implementation and reported that there were statistically significant differences with (P<0.000) between nurses' total practice level pre and post competency-based training program implementation. Also, according to the total practice, the current study finding revelled that, the majority (84.3%) of the studied nurses had competent practice post competency-based training program implementation compared to less than one quarter (24.3%) pre-competency-based training program. Also, there were statistically significant differences at p value = (P<0.000).

Figure 2 showed total nurses' attitude regarding endotracheal tube suction for neonates on mechanical ventilator and clarified that the majority (94.3%) of nurses had positive attitude regarding endotracheal tube suction and only 5.7% had negative attitude post implementation of the competency-based training program.

Table 6 displayed the mean scores of the studied nurses regarding total Nurse Competence Scale score pre and post competency-based training program implementation and reported that there was statistically significant difference among nurses' competency score pre and post competency-based training program with p value =(P<0.000).

Table 7 presented the correlation between nurses' total knowledge, total practice, and total attitude level regarding endotracheal tube suctioning pre and post competency-based training program. It indicated that, there was a positive correlation between the total knowledge score, total practice, and their total attitude score pre and post competency-based training program implementation.

Table 10 showed the Correlation between total Nurse Competence Scale score pre and post competency-based training program with nurses' total knowledge, total practice, and total attitude level regarding endotracheal tube suctioning pre and post competency-based training program implementation. It indicated that, there was a positive correlation between nurses' total Competence Scale score with the nurses' total knowledge score, total practice, and total attitude score pre and post competency-based training program.

Figure 3 showed factors affecting nurses' competence regarding endotracheal tube suction for neonates on mechanical ventilator as reported by the nurses and clarified that less than one quarter (22.8%) of the nurses reported that years of experience affecting their competence level regarding endotracheal tube suction.

Table 1. Distribution of the studied nurses according to their characteristics (n=70).

Nurses' characteristics	No	%
Age in years		
Less than 20	9	12.8
20-<25	18	25.7
25-<30	14	20.0
30-<35	10	14.3
35-<40	19	27.2
Mean ±SD	29.86±4.74	
Gender		
Male	5	7.1
Female	65	92.9
Academic qualifications		
Diploma of secondary nursing school	26	37.1
Technical Institute of nursing	29	41.5
Bachelor's Degree in nursing sciences	15	21.4
Years of experience		
Less than two years	8	11.4
2-<5	21	30.0
5-<8	26	37.1
8 years and more	15	21.5
Mean ±SD	5.01±2.51	

Figure 1. Distribution of the studied nurses according to their attendance to training courses regarding endotracheal tube suctioning (n=70).

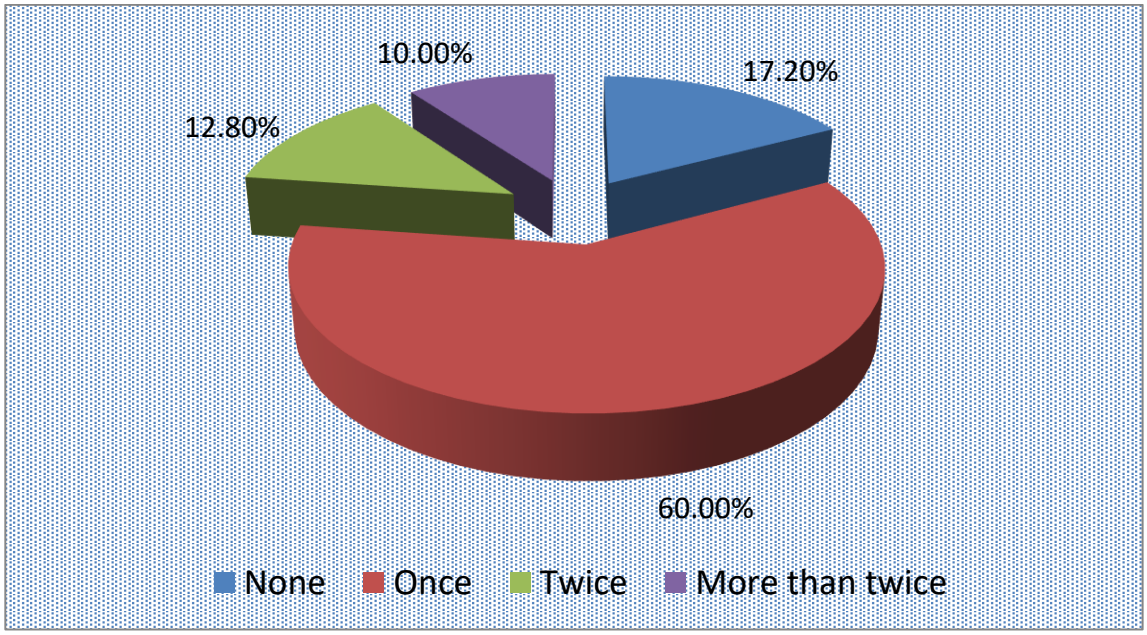


Table 2. Distribution of neonates on mechanical ventilator according to their characteristics (n=55).

Neonate's characteristics	No	%
Age in days		
1 -<7 months	8	14.5
7-< 14 months	11	20.0
14-<21 months	16	29.1
21months and more	20	36.4
Mean ±SD	13.75±7.24	
Gender		
Male	24	43.6
Female	31	56.4
Current weight in grams		
1000-<1500 g.	13	23.6
1500-<2000 g.	22	40.0
2000-<2500 g.	16	29.1
2500 g. and more	4	7.3
Mean ±SD	1784.40±410.16	
Gestational age in weeks		
<37	36	65.4
37 and more	19	34.6

Table 3. Distribution of neonates on mechanical ventilator according to their medical history (n=55).

Neonate's medical history	No	%
Medical diagnosis		
Respiratory distress syndrome	29	52.7
Meconium aspiration syndrome	4	7.3
Pneumonia	8	14.5
Tracheoesophageal fistula	6	10.9
Diaphragmatic hernia	5	9.1
Hypoxic ischemic encephalopathy	3	5.5
Modes of mechanical ventilator		
Intermitted mandatory ventilation (IMV)	24	43.6
Continues mandatory ventilation (CMV)	10	18.2
Synchronized intermittent mandatory ventilation (SIMV)	21	38.2
Duration of connection to mechanical ventilator by days		
Less than 5 days	11	20.0
5-<10 days	9	16.4
10-<15 days	15	27.2
15 days and more	20	36.4
Mean ±SD	11.36±5.92	
Complications occurred during connection to mechanical ventilator		
Yes	21	38.2
No	34	61.8

Table 4. Distribution of the nurses' total knowledge regarding endotracheal tube suctioning pre and post competency-based training program (n=70)

Items	Pre-competency-based training program (n=70)		Post competency-based training program (n=70)		X^2	P-value
	No	%	No	%		
Total knowledge level					19.25	P<0.000**
Good (≥85 %)	10	14.3	52	74.3		
Average (75 <85%)	22	31.4	11	15.7		
Poor (<75%)	38	54.3	7	10.0		

**** Statistically significant difference at p-value <0.000.**

Table 5. Distribution of the studied nurses' practice regarding endotracheal tube suctioning pre and post competency-based training program (n=70)

Practice items	Pre-competency-based training program (n=70)				Post competency-based training program (n=70)				X^2	P-value
	Competent practice		Incompetent practice		Competent practice		Incompetent practice			
	No	%	No	%	No	%	No	%		
Closed endotracheal tube suction procedure.										
Total	19	27.1	51	72.9	57	81.4	13	18.6	15.725	0.000**
Opened endotracheal tube suction procedure										
Total	15	21.4	55	78.6	61	87.1	9	12.9	19.318	0.000**
Total practice level										
Total	17	24.3	53	75.7	59	84.3	11	15.7	17.114	0.000**

**** Statistically significant difference at p-value <0.000.**

Figure 2. Total nurses' attitude regarding endotracheal tube suction pre and post competency-based training program (n=70).

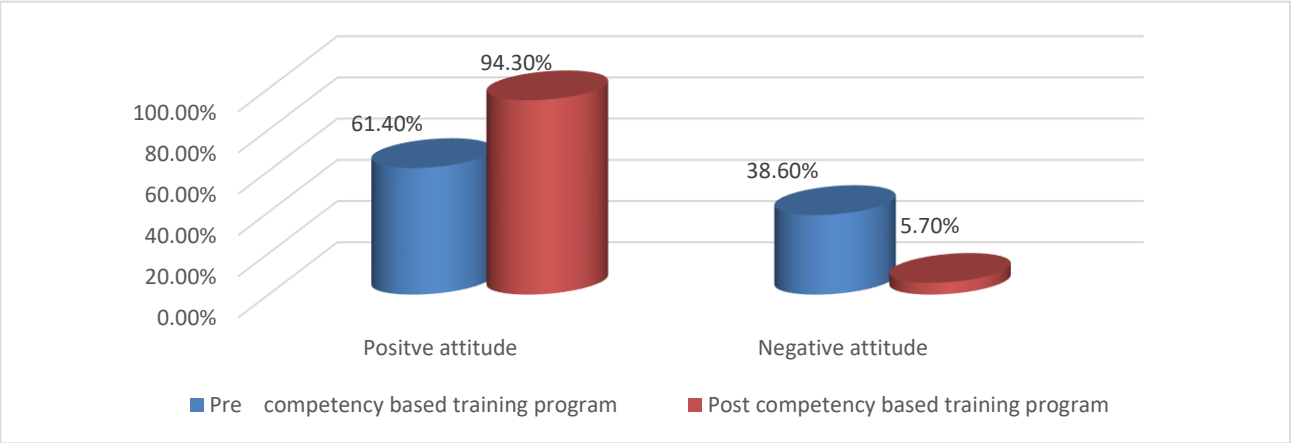


Table 6. Mean scores of the studied nurses regarding total Competence level pre and post competency-based training program (n =70)

Items	Pre-competency-based training program (n=70)	Post competency-based training program (n=70)	Paired t test	P value
	Mean ± SD	Mean ± SD		
Nurse Competence Scale				
Helping role	36.82 ± 10.17	80.66 ± 8.63	26.61	0.000**
Teaching – coaching	39.82 ± 10.69	81.71 ± 7.25	22.89	0.000**
Diagnostic functions	43.7± 6.20	93.47±4.24	54.09	0.000**
Managing situations	40.31±7.28	94.01±4.92	46.84	0.000**
Therapeutic interventions	53.23 ± 6.75	96.77±1.84	48.28	0.000**
Ensuring quality	37.76±6.67	93.84±4.57	51.32	0.000**
Work role	45.45±4.76	94.06±3.93	43.52	0.000**
Total	**42.44±7.50**	**90.64±5.54**	**41.93**	**0.000****

**** Statistically significant difference at p-value <0.000.**

Table 7. Correlation between nurses' total knowledge, total practice, and total attitude regarding endotracheal tube suctioning (n=70)

Variables		Pearson correlation coefficient					
		Pre-competency-based training program (n=70)			Post competency-based training program (n=70)		
		Total knowledge	Total practice	Total attitude	Total knowledge	Total practice	Total attitude
Total knowledge	r	1	.772	.656	1	.235	.617
	P-value		.000**	.000**		.050	.000**
Total practice	r	.772	1	.449	.235	1	.106
	P-value	.000**		.000**	.050		.381
Total attitude	r	.656	.449	1	.617	.106	1
	P-value	.000**	.000**		.000**	.381	

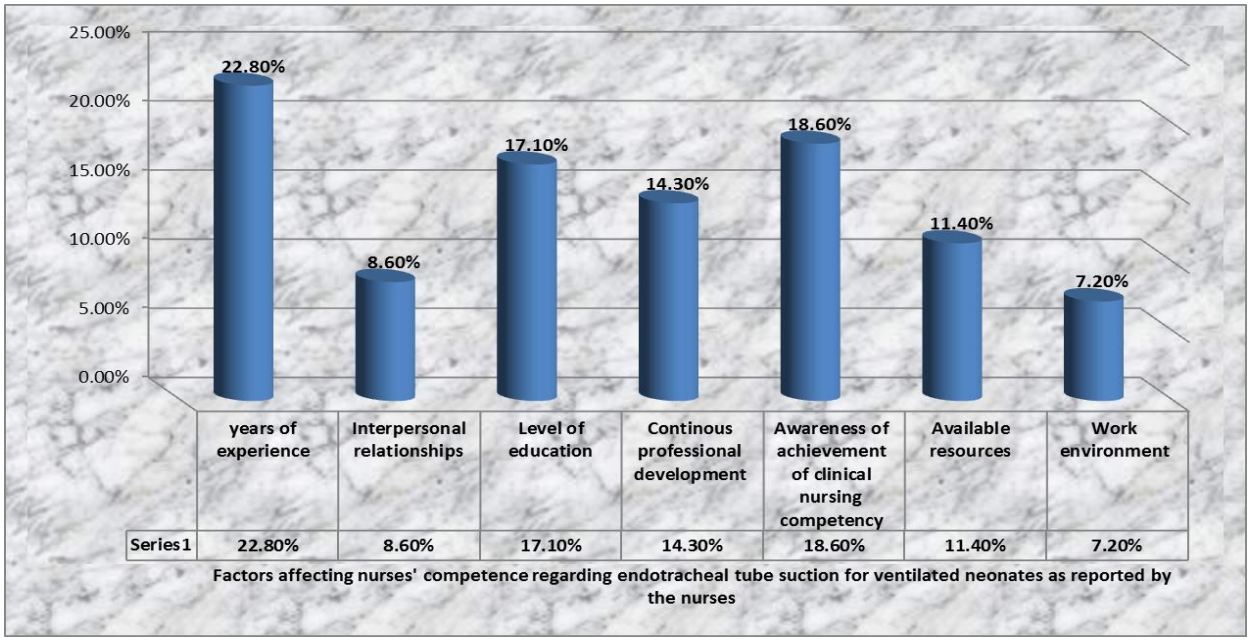
**** Correlation is significant at the 0.01 level (2- tailed).**

Table 8. Correlation between nurses' total knowledge, total practice, and total attitude with nurses' competency (n=70)

Total scores	Pearson correlation coefficient			
	Total nurse competence score preprograms(n=70)		Total nurse competence score post program(n=70)	
	r	P-value	r	P-value
Total knowledge	.119	. 327	.355	.003*
Total practice	.076	.530	.707	.000**
Total attitude	.487	.000**	.150	.214

**** Statistically significant difference at p-value <0.000. *A significant difference at P value P<0.05.**

Figure 3. Factors affecting nurses' competency regarding endotracheal tube suction as reported by the nurses (n=70).



Discussion:

One of the most frequent airway techniques used for newborns on mechanical ventilator is endotracheal tube suctioning. Nonetheless, nurses should establish and adhere to standards of nursing practice via ongoing education in the knowledge, attitude, and skills necessary for providing high-quality care **(Mohamed & Ahmed 2022).**

Competence is essential to continued education, practices, and certificated programs, especially in nursing. Nursing ethics require nurses to be competent to deliver safe, effective care. A dynamic blend of knowledge (from basic to specialty), skills (which include assessment, critical thinking, communication, time management, technical skills, teaching, and customer services), and abilities (which include caring, character, and professional presentation) all are contributed to appreciating nursing competences **(Kohrt et al., 2018)**. Therefore, the aim of the present study was to evaluate the effect of competency-based training program on nurses' performance regarding endotracheal tube suction for neonates on mechanical ventilated. This aim was achieved throughout the study findings and the research hypotheses were accepted.

Regarding the nurses' characteristics, the results of the present study revealed that, the mean age of the studied nurses was 29.86±4.74 years and most of them were females. These results may be due to increase the number of newly graduated nursing appointments by contract system to fill the deficit in the number of formal nursing. These findings were compatible with **Hendy et al., (2020)** who reported that the mean age of the studied nurses was

28 ± 8 years and the majority of them were females.

On the same context these results agreed with **Mohamed & Ahmed, (2022)** who found that, the mean age of the studied nurses was 25.10±2.614 and the majority of them were females.

In relation to nurses' academic qualifications more than two fifth of them had a technical institute of nursing. Additionally, more than one third of nurses had an experience from 5 to less than 8 years. These results were contradicted with **Ebrahimi et al. (2020)** who reported that, the average work experiences among the study sample in their study were 13.24 years and the majority had hold bachelor's degree.

Concerning attendance of the studied nurses to training courses about endotracheal tube suctioning for neonates on mechanical ventilator. The current study clarified that; less than two thirds of nurses attended one training course about endotracheal tube suction for neonates on mechanical ventilator. This finding was disagreed with the finding of study done by **El-Shahat & Kafl, (2022)**, who showed that all of the studied nurses had no previous training regarding pediatric endotracheal tube suction.

Concerning age of the studied neonates, the current study finding reveal that the mean age of the studied neonates was13.75±7.24 and more than two fifth of them were males. These findings were supported by **Hendy et al., (2020)** who reported that the mean age of the studied neonates was 12.2±7.4 and two fifth of them were males.

In relation to the medical history of the studied neonates. The current study found that; more than half of the studied neonates had respiratory distress syndrome. Also, more than one third connected to mechanical ventilator for more than 15 days. These findings were parallel to **Rocha, (2018)** who found that less than half of neonates in their study diagnosed with respiratory distress syndrome and more than one third connected to mechanical ventilator for more than 15 days. Moreover, **Bos & Ware (2022)** added that; respiratory distress syndrome is a common clinical syndrome that affects newborns and involves the activation of multiple and interacting pathways of inflammation and injury both in the lung and systematically. Mechanical ventilation could contribute to a cycle of lung inflammation and injury.

Concerning to nurses' total knowledge regarding endotracheal tube suctioning pre and post competency-based training program. It was found that, less than two thirds of studied nurses had satisfactory level of knowledge post competency-based training program with statistically significant difference pre and post competency-based training program. This result represents the importance of conduction the competency-based training program for nurses to update their knowledge. These findings were supported by **Schults et al., (2020),** who stated that, unsatisfactory level of knowledge about scientific evidence for the safe and efficient accomplishment of endotracheal suctions is one of the main causes of morbidity and mortality among neonates who had endotracheal tube. So that, there is a need for continuous training for nurses to be oriented and up to date about the care of patients in the critical care settings.

On the same line, these findings were similar to **Schults et al., (2021)** who found a significant improvement in all items of knowledge among the studied nurses after implementation of the endotracheal suction training intervention.

In the same context, these findings agreed with the results of the study done by **El-shahat & Kafl, (2022),** who found that, there were statistically significant improvement regarding nurses' knowledge level about endotracheal tube suction (ETS), preparation before ETS, procedure of ETS and evaluation after ETS post implementation of the recommended evidence-based training.

Concerning to total nurses' practice regarding closed endotracheal tube suction pre and post competency-based training program, the current study reported that, there were statistically significant differences between nurses' total practice level pre and post competency-based training program. Implementation. Also, the current study results were congruent with the results of the study done by **Khanjari, et al. (2019)**, who cleared that, the mean score of practice for nurses post competency-based training program implementation was increased compared to pre training program with statistically significant difference.

In relation to the total nurses' practice regarding opened endotracheal tube suction pre and post competency based training program implementation, the current study reported that, there were statistically significant differences between nurses' total practice level pre and post competency based training program .This finding supported by **El-Shahat & Kafl, (2022)**, who reported that; there were statistical significant improvement in nurses' practice regarding to the preparation, procedure and post procedure of the endotracheal tube suction post competency based training program implementation regarding to the recommended evidence based training compared with pre training assessment Furthermore, **Laura et al., (2021)** who reported that, regular in-service education program is required for nurses to keep them qualified to achieve positive outcomes.

Concerning nurses' total practice regarding endotracheal tube suction pre and post competency-based training program. It was found that, the majority of the studied nurses had competent practice post implementation of the competency-based training program compared to less than one quarter of nurse's pre-competency-based training program with statistically significant differences. From the researcher point of view nurses' practice improved after implementation of the competency-based training program for nurses. These

results were in agreement with **Abouzaj, (2019)** who reported that the adoption of the competency-based approach in training of nurses is a real opportunity to improve their capacities of awardees in order to prepare them to fully accomplish their professional roles effectively.

In addition, the present study findings were parallel to **Imanipour et al. (2021)** who concluded that, competency-based education enhance the clinical performance of the health care providers among the intervention group compared with that of the control group.

In the same context the current study results were similar to **Azizian et al., (2020)** who showed that, in the pretest the nurses' practice regarding endotracheal tube suctioning was unsatisfactory. So, application of the guidelines leads to improvement in their performance regarding this procedure post training implementation.

The present study showed that the majority of the studied nurses had positive attitude regarding endotracheal tube suction post competency-based training program. This finding indicates the positive effect of the competency-based training program. On the same line **Sunny &Rani (2021)** reported that most nurses respond correctly with the attitude questionnaire.

The current study clarified that, there was a positive correlation between total nurses knowledge score, total practice score and attitude pre and post competency based training program implementation. From the researchers' point of view these findings emphasize on the fact that, the level of practice influenced by the level of knowledge and without correct and sufficient knowledge, the nurses' practices become more hazardous and inefficient. These results were consistent with **Ebrahimi et al., (2020)** who reported that, there was a significant positive relation between nurses' knowledge and practice after the intervention and emphasized that nurses' performance improved by education. Also, **Mirlashari et al., (2016)** found a direct statistically significant correlation between the level of clinical competence among nurses.

The present study portrayed that, there were statistically significant differences between nurses' competency score pre and post competency-based training program. These findings supported by **Mirlashari et al., (2016)** who clarified that, the highest levels of competence were related to critical thinking researchers attitude, interpersonal relation, and the lowest level was related to the training and mentoring.

Concerning to factors affecting nurses' competence regarding endotracheal tube suction for neonates on mechanical ventilator as reported by the nurses. The current study clarified that, less than one quarter of nurses reported that years of experience affecting their competence regarding endotracheal tube suction. From the researchers' point of view, the years of experience of nurses, affecting on nurses' competence so, nurses who attending the training program increase their competency level and successful performing their professional roll. Also, the nurses who manage ETT suctioning process also, provide a more qualified nursing care. These results were supported by **Abo Jeesh et al., (2021)** who stated that years of experience had a great effect on nurses' practice.

In addition, **Mirlashari et al., (2016)** concluded that, who are interest in nursing, career status, neonatal are the rigorous theoretical and practical training courses, as well the extra hours spent should be considered to ensure clinical competence among the neonatal intensive care nurses.

Conclusion

Based on the findings of the current study; it can be concluded that; the implementation of competency-based training program improved the nurses' performance and competency level regarding endotracheal tube suction for neonates on mechanical ventilator compared to pre implementing of the program, which revealed the effectiveness of the competency-based training program on nurses' performance.

Recommendations

1. Integrate competency-based training program for neonatal nurses at NICU should be done.
2. Develop and apply periodic educational and training courses for nurses working with neonate at neonate intensive care units to improve nurses' performance regarding endotracheal tube suction.
3. Further research's including larger sample are recommended to ensure generalization of the finding.
4. Conducting the study in different settings in Egypt to generalize the results of the study and raise the level of competency of nursing care regarding endotracheal tube suction is recommended.

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