

Influence of Training Program Implementation on Nurses' Performance Regarding Neonates Invasive Mechanical Ventilation

Amina Mohamed Thabet¹, Nora Abd El Hamid Zakie², Zahra Ahmed Sayed³, Huda Shawky Mahmud⁴, and Eman Sayed Masood⁵

(1) Assistant professor of Pediatric Nursing, Faculty of Nursing, Sohag University, Egypt

(2) Assistant professor in Pediatric Nursing, Faculty of Nursing, Assuit University, Egypt

(3) Lecturer of Critical Care Nursing Faculty of Nursing, Aswan University, Egypt

(4) Lecturer in Pediatric Nursing Department, Faculty of Nursing, Helwan University, Egypt

(5) Assistant Professor of Pediatric Nursing, Faculty of Nursing, El-Minia University, Egypt

Abstract

Background: Mechanical ventilation plays an important role in reducing neonatal mortality and morbidity rate. Nurses caring for neonates on ventilator must be competent to provide an effective nursing care for such group of patients, Effective training program for nurses' will increase their quality of nursing care and improving health and wellbeing of neonates undergoing mechanical ventilation. **So, the aim of this Study** was to evaluate the influence of training program implementation on nurses' performance regarding neonates invasive mechanical ventilation. **Research Design:** A quasi-experimental design was utilized. **Study settings:** the study conducted at Neonatal Intensive Care Unit of Assuit University Children Hospital/Egypt. **Research Subject:** Convenient sample was included 59 nurses from the previously mentioned setting and 59 neonates under invasive mechanical ventilation. **Two tools were used for data collection:** tool 1; Predesigned questionnaire consisted of three parts: nurses' demographic characteristics, demographic and clinical data of neonates and nurses' knowledge about mechanical ventilation. Tool two; Observational Checklists were used pre and post program implementation **Results:** revealed that there was a statistical significant difference between nurses' performance at pretest and post program regarding the neonates with invasive mechanical ventilation **Conclusion:** Training program implementation had a significant effect on nurse's performance regarding the neonates with invasive mechanical ventilation. **Recommendation:** implementing the training program for improvement nurses' performance regarding the neonates with invasive mechanical ventilation to all nurses in all neonatal intensive care units in Egypt.

Keywords: Evidence-Based Measures, Invasive Mechanical Ventilation, Neonates, Nurses' Performance.

Introduction:

Neonatal period is accountable for 60% to 70% of neonatal mortality in latest periods occurring largely up to the 6th daytime of life actuality the important indicator for high standers of care quality introduced to newborn. Approximately 9% of all births worldwide require special or neonatal intensive critical care, so high-risk neonates require close observation by experienced qualified nurses and physicians to improve their survival and healthy life (Abou-Elsaad et al., 2017 & Pinheiro et al., 2016).

Mechanical ventilation is an invasive life support procedure with many effects on the

cardiopulmonary system. It is a life-saving intervention for critically ill newborns admitted to a neonatal intensive care unit. Between 10%-20% of all neonates admitted to NICU receive mechanical ventilation (Aurora et al., 2017).

The main reasons for spending on mechanical ventilator for neonates were immature hyaline membrane; or may after meconium aspiration, and then birth asphyxia, pneumonia, frequent intermittent apnea unresponsive to drug therapy, persistent pulmonary hypertension (PPH), poor respiration ,saturated O₂ < 85% on oxygen support , respiratory failure, defined as severe respiratory distress, and/or hypoxemic (Pao₂ <50 mmHg) hypercarbia (Paco₂ >60 mmHg)

despite CPAP pressure of 7-8 cm H₂O and general anesthesia (Acharya et al., 2015 & Srinivas et al., 2016).

Mechanical ventilation has been associated with many complications such as infections “ventilator associated pneumonia (VAP)”, lung injury, chronic lung disease also known as broncho-pulmonary dysplasia (BPD), shock, hypoglycemia, intra ventricular hemorrhage (IVH), air leak syndrome, retinopathy of prematurity (ROP), malformations of the oral cavities and skin complications (Iqbal et al., 2015).

For successful weaning and extubation to spontaneous breathing must be performed effectively; care for mechanically ventilated neonates should be adjusted properly according the disease and nutritional status of neonate. Vital signs, infection symptoms, blood gas and radiological findings of the neonates should be monitored and recorded and the weaning should be gradually when the neonate shows recovery signs and makes spontaneous respiratory efforts depending on lung maturity, infection indicators and findings, electrolyte and fluid balance, weight, age, nutritional condition and the neonate is tolerable to perform the spontaneous breathing (Güler and Ekici, 2019).

Good practice in nursing, is understood as an inseparable and interrelated set of theories, processes, techniques, and activities that are seen as the best available options for care in the area, while maintaining the consistency with knowledge, contexts, values, environments, goals and evidences in the interest of health (Brandão et al., 2019). Nurses are responsible for provide the systematic and quality improvement of nursing practice. Neonatal nurses responsible for understanding the complexities of care given to any neonate requiring mechanical ventilation to deliver safe and effective care, monitoring mechanical ventilation use and the neonate under ventilation and record those 24 hours a day to prevent potential problems or bring solutions on mechanical ventilation when necessary and support in weaning (Koy et al., 2015; & Khalafi and Nasef, 2016).

Hence, implementing training program is mainly important during the newborn period in

intensive care unit (NICU) to improvement performance of nurses that provide directly care to neonates with invasive mechanical ventilation.

Significance of the Study:

The newborn period is a highly vulnerable time for a neonate who is competing for numerous of the physiologic adjustments necessary for extra-uterine existence. The neonatal death rate reflects not only the efficiently care accessible to women during pregnancy but also the care quality measure are available to neonates throughout the first month of life. The leading reasons of death rate throughout the initial 4 weeks of life are prematurity, acute respiratory distress and congenital malformation, nearly 80% of neonates who die inside 48 hours after birth are Very Low Birth Weight (VLBW) or Extremely Low Birth Weight (ELBW), these not require only immediate diagnosis and treatment, but also continue skilled nursing care. Mechanical ventilation has become a necessity to enhance neonatal survival rate and is an essential component of neonatal intensive care units (Ahmed et al., 2014). Therefore, improving the nursing care provided to those neonates and enhancing the role of the nurse are very important.

Aim of the study:

The aim of this study was to evaluate the influence of training program implementation on nurses' performance regarding the neonates invasive mechanical ventilation., this aim was achieved through:

- Assessing the nurses' performance (knowledge and practice) regarding the neonates with invasive mechanical ventilation.
- Designing and implementing a training program for the nurses regarding the neonates with invasive mechanical ventilation.
- Evaluating the effectiveness of the training program on nurses' performance regarding the neonates with invasive mechanical ventilation.

Research Hypothesis:

Nurses who receive training program about evidence-based measures regarding the neonates with invasive mechanical ventilation:

- 1- Will have increase in their knowledge at post test compared with pre test.
- 2- Will exhibit improve in their practice at post test compared with pre test.

Subjects and Methods:**Research design**

Time series quasi experimental research design (pretest-posttest) was adopted and utilized to accept or reject research hypothesis.

Quasi-experiments are similar to randomized controlled trials in many respects, but there are many challenges in designing and conducting a quasi-experiment when internal validity threats are introduced from the absence of randomization (Matthew and Maciejewski, 2020).

Sample and sample size:

In this study, a convenient sample was included 59 nurses and 59 neonates under invasive mechanical ventilation was recruited to test the effectiveness of training program regarding the neonates with invasive ventilator. Nurses were selected neonatal intensive care unit. Randomized sample was selected by using a SPSS, to determine a sample size; a power analysis was conducted using 0.05 as the level of significance, 0.95 as the power and effect size of 0.25.

Setting

This study was conducted at neonatal intensive care unit (NICU), Assuit University Children Hospitals/Egypt. The place where the neonates receive special care, as a large number of neonates in intensive care unit need mechanical ventilation due to different conditions and high mortality rate.

Tools of data collection:

Data was collected through the following two tools:

Tool I: A predesigned Interviewing Questionnaire (pre and post-test)

It was developed by the researcher after reviewing related literature and it was written in simple Arabic language to suit the nurses' categories. It consists of the following 3 parts:

Part 1: It concerned with nurses' characteristics included their age, qualification, their years of experience, marital status and attendance of training courses.

Part 2: Demographic and clinical data of neonates on mechanical ventilation such as age on admission, gestational age at birth, birth weight, medical diagnosis, and ventilator modes.

Part 3: Nurses' knowledge about mechanical ventilation such as (definition, indications, complications, and indicators of weaning from mechanical ventilation) to measure the exact knowledge level of nurses regarding neonates mechanical ventilation, it included 20 questions.

Scoring system for knowledge of the studied nurses was calculated as the following: 2 scores were given for completely correct answer, 1 for an incompletely correct answer and 0 for do not know, the total number of questions was 20 questions and the total score were 40. According to the nurses' responses, their level of knowledge was categorized as the following: good level ($\geq 75\%$); average level ($60 < 75\%$) and poor level ($< 60\%$).

Tool II: Observational checklist for nurses, was used before and after the implementing the training program.

This tool was developed and modified by the researcher based on the current international literature. Adopted from pediatric nursing procedures manual (Taksande, 2014 & Kalia, 2015), to assess the nursing care provided to neonates with invasive mechanical ventilation. This tool was used before and after the implementation of the training program to assess the nurses' practice that introduce direct care for a ventilated neonate. It included the procedures of hand washing, axillary temperature, close system endotracheal tube suctioning, chest physiotherapy (postural drainage and chest percussion and vibration),

intravenous infusion (cannula connection and infusion steps), mouth care every four hours, eye care and positioning strategies for a neonate. (All observed items of practice were 8 procedures).

Scoring system for practice of the studied nurses was calculated as the following: completely done score 2, incompletely done score 1, and not done score 0. The total score of nurses' practice was 238 for all the nursing procedures carried out for the neonates on mechanical ventilation (119 items for the above-mentioned procedures). According to the nurses' responses, their level of nurses' practice was categorized as the following: good level ($\geq 75\%$); average level ($60 < 75\%$) and poor level ($<60\%$).

Tools' validity and reliability

The validity of the tools was tested by measuring its content validity index by five experts in the pediatric nursing field who reviewed the tool one for clarity, relevance, understanding and easiness minor modification were required.

Reliability of the tools was done to examine the internal consistency, tool 1 was ascertained with cronbach's alpha = 0.84 and tool 2 its result was 0.87.

Pilot study

A Pilot study was carried out including 10% of the studied nurses (6 nurses, and 6 neonates) to test the applicability and feasibility of the study tools. Modifications were done according to the results of the pilot study. Nurses included in the pilot study were excluded from the main study sample since some modifications were done in the form of rephrasing for some statements. The final form of the tools was then obtained and the time needed for completing each tool was also determined.

Dependent and independent variables:

A- Independent variable:

In this experimental research, the researchers manipulated the training program as an independent variable which were given to the study nurses.

B- Dependent variables:

In this research, the nurses' knowledge and performance were the dependent variables. These dependent variables were the variables that changed as predicted in the

research hypotheses in response to the independent variable (training program). The dependent variables at the pre- and post-test were compared to clarify the effect of the independent variable on dependent variables.

Methods for data collection:

The study was carried out on four phases:

1- Preparatory phase: A review of current and past, national, and international related literature in the various aspects of the problems using books, articles, periodicals, and magazines was done. This phase ended with a pilot study.

2- Planning phase: Based on the findings of the preparatory phase, training program regarding the neonates invasive mechanical ventilation was adapted.

Administrative approval was obtained from the responsible persons (directors of Assuit University Children Hospital and head of the NICU). The researchers introduced themselves to nurses at the NICU and informed them about nature and the objective of the study. Printed informed consent was achieved from them after explaining the purpose of the study prior to enrollment in the study. The researchers also were assured that the study is harmless and their participation is voluntary and they have the right to withdraw from the study at any time without giving any reason. They were also assured that, anonymity and confidentiality will be guaranteed, as well the collected data will be used for the research purpose only. Ethics, values, culture and beliefs were respected. The training program was done by the researches.

After that, the researchers prepared the training places, teaching aids and media (pictures, handouts). This was followed by arranging for the teaching and training schedule based on the subjects of training program regarding neonates invasive mechanical ventilation, a number of nursing staff involved, time convenience, shifts as well as the resources accessible, also planned with them the teaching and training sessions for both theoretical, practical and the nurses were distributed into small groups, each group contains 3 to 5 nurses. Each group of nurses chooses the best time for receiving the teaching sessions whenever they have minimal workload.

3- Implementation phase:

Teaching and training sessions were implemented during the nurses' official working hours. There were a total of 12 sessions. The number of nurses in each session ranged from 3- 5 nurses. The period of each meeting was 30 – 45 minutes, including ten minutes for conversation and feedback. Every session frequently initiated with a summary of what has been educated during the previous sessions and the aims of the innovative subjects. Feedback and reinforcement of teaching were achieved according to the nurses' needs to ensure their understanding.

The study comprised of a voluntary questionnaire distributed to the nurses to evaluate their knowledge regarding neonates invasive mechanical ventilation before a series of educational sessions. Evidence based care with several different methods of information delivery was used: information posted on a PowerPoint presentation, and an evidence brochure.

Indirect observation for nursing practice regarding neonates on mechanical ventilation

was done individually for each nurse. The time needed for observing each nurse ranged from 1- 2 hours. From 1 to 2 nurses were observed per day.

This study was carried out through a period of six months from the beginning of July to the end of December 2020.

4- Evaluation phase: The same tools were used immediately post implementation of the training program for all studied nurses as an indicator to determine the level of improvement.

Statistical design and Data analysis

Data entry and data analysis were done using SPSS version 19 (Statistical Package for Social Science). Data were presented as a number, percentage, mean and standard deviation. Chi-square test was used to compare qualitative variables. Pearson correlation was done to measure the correlation between quantitative variables. P-value was considered statistically significant when $P < 0.05$.

Result:

Table 1: Percentage distribution of the studied nurses regarding their characteristics in (n=59).

Items	Total number	
	No = 59	100%
Age: (years)		
< 30	37	62.7
≥ 30	22	37.3
Mean ± SD	28.44 ± 5.31	
Residence:		
Rural	43	72.9
Urban	16	27.1
Marital status:		
Single	22	37.3
Married	37	62.7
Years of experience:		
Mean ± SD	9.15 ± 6.61	
Attending training courses regarding mechanical ventilation?		
Yes	1	1.7
No	58	98.3

Table 1, revealed that less than two thirds (62.7%) of the nurses' age were less than 30 years with a mean age of 28.44 ± 5.31 . More than two thirds (72.9%) of them were from rural areas, and the vast majority (98.3%) of them didn't attend a training program regarding the care of neonates with invasive mechanical ventilation.

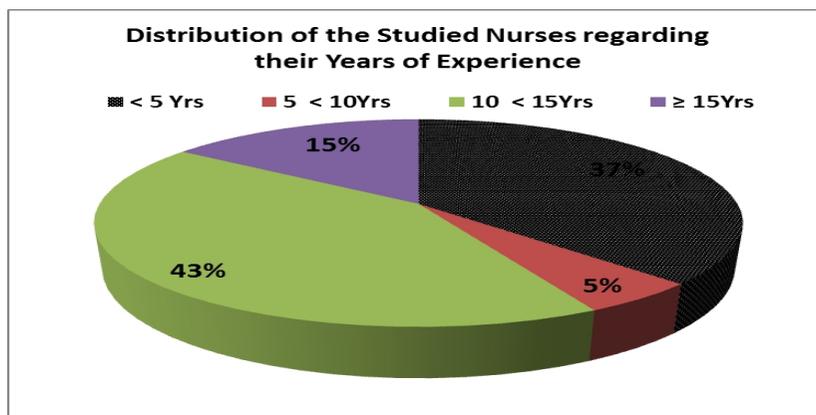


Figure 1: Percentage distribution of the studied nurses regarding their years of Experience (n = 59)

Figure 1, illustrated that nearly half of the studied nurses (43%) were 10 < 15 years of experience in providing care for a neonates on invasive mechanical ventilation and only 5% were 5 < 10 years of experience.

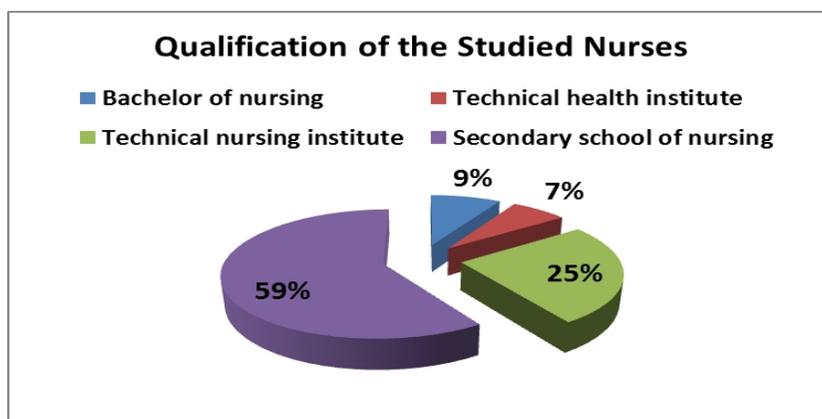


Figure 2: Distribution of studied nurses according to their qualification (n = 59).

Figure 2, showed that more than half (59%) of the studied nurses graduated from secondary school of nursing, followed by 25% were had technical nursing institute and 9% had bachelor of nursing.

Table 2: Percentage distribution of the studied neonates according to their demographic and clinical data (n=59).

Items	(n=59)	%
Age on admission/ days:		
< 3days	53	89.83
≥ 3days	6	10.17
Mean ± SD	1.5±0.2	
Gestational age at birth/ weeks:		
28 < 32	12	20.4
32 < 36	30	50.8
36 – 40	17	28.8
Mean ± SD	33.80 ± 3.07	
Birth weight/ gm.		
Mean ± SD	2420.8 ± 731.5	

Table 2, clarified that nearly half of neonates on IMV (89.83%) aged less than 3 days. More than half (50.8%) of the neonates had gestational age ranged from 32 < 36 weeks with mean \pm SD of 33.80 ± 3.07 weeks.

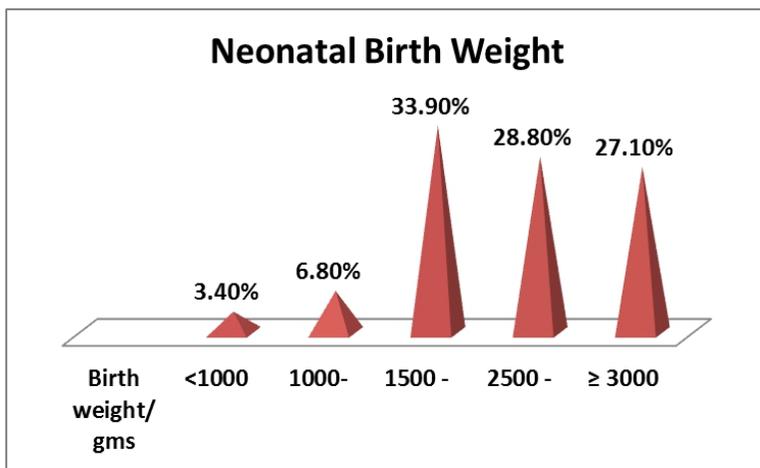


Figure 3: Distribution of neonatal with invasive mechanical ventilation according to their birth weight (n=59).

Figure 3, revealed that about one third of neonates (33.90%) were had birth weight ranged from 1500 < 2500 gm, with mean \pm SD 2420 ± 0.73 gm, followed by 28.80% were from 2500 to less than 3000 gm and only 3.40% were < 1000gm.

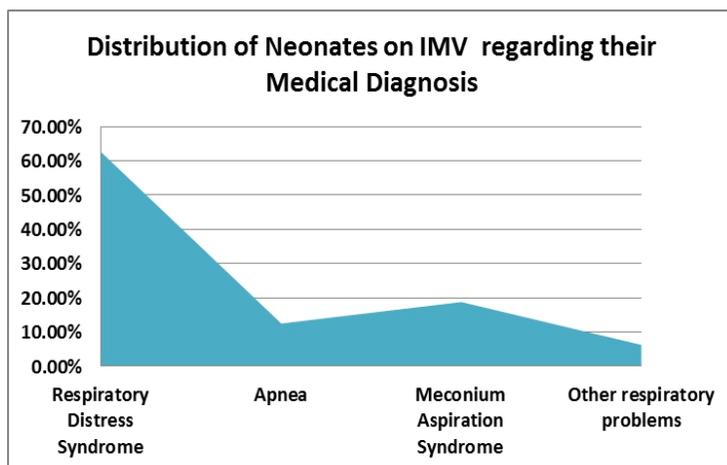


Figure 4: Distribution of neonatal with IMV According to their Medical Diagnosis (n=59).

Figure 4, illustrated that nearly two thirds (62.5%) of neonates on IMV diagnosed medically with respiratory distress syndrome, and about 20% were with meconium aspiration syndrome.

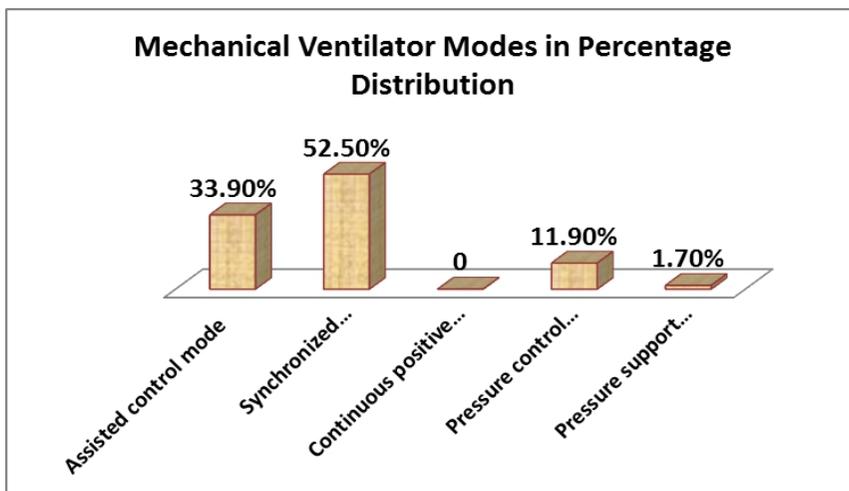


Figure (5): Distribution of IMV Modes (n=59).

Figure 5, showed that more than half of neonates (52.50%) of them were on synchronized intermittent mandatory ventilation mode.

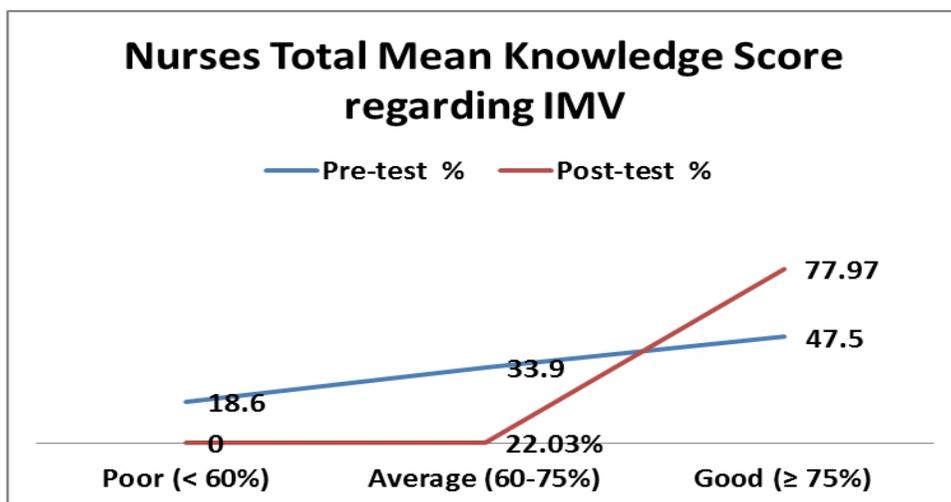


Figure 6: The nurses’ total mean score of knowledge regarding neonates invasive mechanical ventilation at pre and post-test (n=59).

Figure 6, indicated that the nurses’ total mean score of knowledge regarding neonates invasive mechanical ventilation at pre and post-test. It was found that less than half (47.5%) of the studied nurses had a good level of knowledge at the pre- test, while at the post- test, after implementing the training program, more than three quarters of them (77.97%) had a good level of knowledge with significant difference ($P = 0.0001$).

Table 3: Percentage distribution of the nurses' practice at pre and post-test regarding care provided for neonates with invasive mechanical ventilation (n=59).

Items	Completely done				Incompletely done				Not done				P-value
	Pre-test		Post-Test		Pre-test		Post-Test		Pre-test		Post-Test		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Hand washing	48	81.36	59	100	6	10.1	0	0.00	5	8.5	0	0.00	0.000*
Taking an axillary temperature	34	57.6	49	83.05	18	30.5	10	16.9	7	11.9	0	0.00	0.023*
Close system of Endotracheal tube (ET) suctioning	50	84.7	59	100	7	11.9	0	0.00	2	3.3	0	0.00	0.000*
Chest physiotherapy	34	57.6	48	81.36	18	30.5	8	13.56	7	11.9	3	5.08	0.026*
Intravenous infusion	42	71.2	51	86.44	15	25.4	7	11.86	2	3.4	0	0.00	0.028*
Mouth care	39	66.1	59	100	11	18.6	0	0.00	9	15.3	0	0.00	0.000*
Eye care	30	50.8	59	100	20	33.9	0	0.00	9	15.3	0	0.00	0.000*
The positioning strategies of the neonate	18	30.5	53	89.83	25	42.4	7	11.86	16	27.1	0	0.00	0.001*

*Statistically significant differences at p. value<0.05

Table 3, showed percentage distribution of the nurses' practice at pre and post-test regarding care provided for neonates with invasive mechanical ventilation. It was found that before implementing the training program the majority of nurses (84.7%) practice completely endotracheal tube suctioning, followed by hand washing (81.36%), followed by Intravenous infusion (71.2%). Nearly half of nurses (42.4%) incompletely practice the positioning of the neonate, and more than one third of them (33.9%) incompletely practice neonates' eye care. While after implementing the training program, all the nurses (100.0%) practice completely hand washing, endotracheal tube suctioning, mouth care, and eye care. There were statistical significance differences related to nurses' practice regarding care provided for neonates on invasive mechanical ventilation at the pre and post.

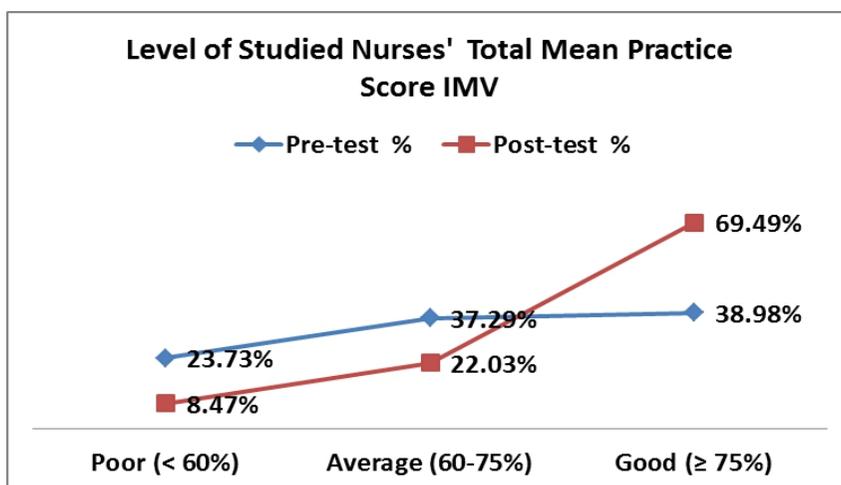


Figure 7: level of studied nurses' total mean score practice provided for neonates on mechanical ventilation in pre and post training program implementation.

Figure 7, indicated that the total levels of nurses' practice regarding nursing care provided for neonates on mechanical ventilation. It was found that more than one third (38.98%) of the studied nurses had a good level of practice at the pre-test, while at the post-test, more than two thirds of them (69.49%) had a good level of practice with highly statistical significance difference ($P = 0.0001$).

Table 4: Comparison between the nurses' total mean knowledge and practice scores Provided For neonates on invasive mechanical ventilation in pre and post evidence-based measures implementation (n=59).

Items	Total Mean Score Knowledge		Total Mean Score Practice	
	Pre-test	Post-test	Pre-test	Post-test
Total Mean± SD	17.12±1.74	33.34± 1.6	185.59 ± 20.35	221± 11.56
χ² test	664.27		39.50	
P – Value	0.0001*		<0.001	

*Statistically significant differences at p. value<0.05

Table 4, revealed that, there were statistical significance between total mean knowledge score and total mean practice score in pre and post training program implementation p-value = (0.0001 and <0.001) respectively.

Table 5: The relation between total nurses' level of knowledge and their demographic characteristics. (n=59).

Items	Knowledge level						P-value
	Poor		Average		Good		
	No.	%	No.	%	No.	%	
Age: (years)							0.209
< 30	9	24.3	10	27.1	18	48.6	
≥ 30	2	9.0	10	45.5	10	45.5	
Residence:							0.018*
Rural	9	20.9	10	23.3	24	55.8	
Urban	2	12.5	10	62.5	4	25.0	
Marital status:							0.144
Single	5	22.7	4	18.2	13	59.1	
Ever-married	6	16.2	16	43.3	15	40.5	
Qualifications:							0.034*
Bachelor/ nursing institute	8	33.4	5	20.8	11	45.8	
Secondary school of nursing	3	8.5	15	42.9	17	48.6	
Years of experience:							0.036*
< 10	8	32.0	5	20.0	12	48.0	
≥ 10	3	8.8	15	44.1	16	47.1	

*Statistically significant differences at p. value<0.05

Table 4, showed that the relation between total nurses' level of knowledge and their demographic characteristics. A statistically significant relation was found between total score of the studied nurses' level of knowledge and their demographic characteristics related to residence, qualifications and years of experience ($P<0.018$, $P<0.034$ and $P<0.036$) respectively. On the other hand, no statistically significant relation was found regarding their age and marital status ($P=0.209$ and $P= 0.144$) respectively.

Table 6: The relation between total nurses' level of practice and their demographic characteristics (n=59).

Items	practice level						P-value
	Poor		Average		Good		
	No.	%	No.	%	No.	%	
Age: (years)							0.094
< 30	12	32.5	11	29.7	14	37.8	
≥ 30	2	9.1	11	50.0	9	40.9	
Residence:							0.105
Rural	13	30.2	16	37.2	14	32.6	
Urban	1	6.2	6	37.6	9	56.2	
Marital status:							0.034*
Single	9	40.9	8	36.4	5	22.7	
Ever-married	5	13.6	14	37.8	18	48.6	
Qualifications:							0.012*
Bachelor/ nursing institute	10	41.7	9	37.5	5	20.8	
Secondary school of nursing	4	11.5	13	37.1	18	51.4	
Years of experience:							0.011*
< 10	10	40.0	10	40.0	5	20.0	
≥ 10	4	11.8	12	35.3	18	52.9	

*Statistically significant differences at p . value < 0.05

Table 5, clarified the relation between total nurses' level of practice and their demographic characteristics. As shown in this table a statistically significant relation was found between total score of the studied nurses' level of practice and their demographic characteristics related to marital status, qualifications and years of experience ($P < 0.034$, $P < 0.012$ and $P < 0.011$) respectively. However, no statistically significant relation was found regarding age and residence ($P = 0.094$ and $P = 0.105$).

Table 7: Correlation between nurses' total mean score of knowledge and total mean score of practice at the pre and post training program implementation.

Nurses' Total Mean Score Practices	Nurses' Total Mean Score Knowledge	
	Pre	Post
	R	R
	0.372	0.632
<i>P</i> – Value	0.003	0.0001*

*Statistically significant differences at p . value < 0.05

Table 7, demonstrated that, after implementing the training program, there was moderate correlation ($r = 0.677$) and highly statistically significant difference between the total mean score of the studied nurses' level of knowledge and their practice ($p = 0.000$).

Discussion

Nurses introduce direct health care for neonates connected to the mechanical ventilation face numerous challenges. Proficiency and effectively care are important

parts in providing safe and professional nursing care to improve the quality of nursing care provided for them in order to increase the survival rate for these neonates, reduce morbidity and mortality rates. They also must offer a harmless setting for these neonates in

the NICU and control the infection regulator rules and policies (**Rocha et al., 2018**). So this study aimed to evaluate the influence of training program implementation on nurses' performance regarding the neonates invasive mechanical ventilation.

Regarding demographic data of the studied nurses, the result of the current study showed that less than two thirds of the nurses' age was < 30 years with Mean \pm SD 28.44 \pm 5.3, this result was similar to a study by **Aziz and Abdul-Hamza, (2017)** who carried study entitled "Assessment of nursing care in neonatal respiratory distress" and founded that the age group of nurses were between 20 > 30 years. As regard the residence of the studied nurses, the result of the present study showed that less than three quarters of the studied nurses were from rural areas. This result disagrees with **Aziz and Abdul-Hamza, (2017)** who found that the majority of the studied nurses were living in urban areas.

The current study also revealed that more than half of the studied nurses had secondary school nursing diploma, this result was in accordance with **Abdel-Fattah et al., (2018)** who carried study about "quality of nurses' performance regarding parenteral nutrition at neonatal intensive care units" and indicated that more than half of the studied nurses had diploma of nursing. This finding disagreed with **Loutfy et al., (2014)** who carried study entitled "quality of nursing care provided for preterm infants suffering from respiratory distress syndrome" and founded that the majority of the studied nurses had bachelor degree of nursing. This may be due to the fact that nursing secondary school provides the community with large number of diploma nurses graduates than other agencies such as faculties of nursing and technical institutes of nursing and mal-distribution of highly qualified nurses in Egypt.

Regarding the years of experiences of the studied nurses, the finding of the current study showed that less than half of them had experience 10 <15 years. This result disagreed with **Ahmed and Abosamra, (2015)** in their study about "knowledge of pediatric critical care nurses regarding evidence based guidelines for prevention of ventilator associated pneumonia" and founded that the

majority of study sample have period of experience less than five years.

Findings of the current study, presented that the vast majority of the studied nurses did not attend training program, this finding supported by **Elsayed et al., (2013)** who reported that all the studied nurses did not attend training program. This finding not supported by **Mansi and Aziz, (2017)** who carried study titled "evaluations of nursing care in newborn respiratory distress syndrome." who found that higher than half of the studied nurses have attended training program. This may be attributed to lack of training programs and this might affects nurses' level of knowledge and practice.

Regarding demographic and clinical data of the studied neonates connected to mechanical ventilators, the finding of current study revealed that more than 50% of the neonates had gestational age from 32-36 weeks with mean \pm SD 33.80 \pm 3.07, this finding was in the similar way with **Mohamed, (2012)** in his study about " quality of nursing care provided for neonates with mechanical ventilation " and founded that the majority of newborn's had gestational age from 32-36 weeks.

Concerning to birth weight about one third of studied neonate had birth weight from 1500 - < 2500 gm with mean \pm SD 2420 \pm 0.73 gm. This finding similar to **Ahmed et al., (2014)** who carried study about quality of nursing care for neonates with trachea-esophageal fistula and founded that all the studied neonates had birth weight from 1500 - < 2500 gm. While less than two thirds of them were diagnosed with acute respiratory distress. This finding was similar to **Mohamed et al., (2011)** in his study about predictors of mortality among neonates admitted to NICU and illustrated that the majority of neonatal admission due to acute respiratory distress syndrome.

As regards, the nurses' information around the nursing care introduced to mechanically ventilated neonate. The current study denotes that less than half of the studied subjects had a knowledge level are good before implementation of the training program; this result was dissimilar with **Ahmed et al., (2014)**

who founded that more than 50% of the studied nurses had correct knowledge regarding promoting quality of care, while this finding was agreement with **Mohammed, (2012)** who considered that, nurses had an average knowledge level related to nursing care of newborn's connected to mechanical ventilators. *These results may be attributed to the lack of continuous education and preparation prior to work or training concerning to care of such group of neonate, in addition to lack of their motivation to updating their knowledge.*

As regards, the nurses' practice related to nursing care delivered to neonates on mechanical ventilators the findings of the this study revealed that, less than one third of the studied group had a good level of practice related to hand washing. This result disagree with **Abd El Fattah et al., (2018)** who founded that more than half of nurses had a good level of practice regarding hand washing agreed with **Ahmed et al., (2014)** who stated that hand hygiene is deemed as the simplest method for control of nosocomial infections if it is done properly also it may prevent from a lot of costs and fatalities nurses done it before and after each procedure. *These findings might be due to washing hand followed routinely in all of nursing actions due to adequate and recurrent training for nurses regarding procedures of infection control at NICU.*

This study also a exposed that more than two-third of the studied group had a good level of practice after employing the training program; this finding differed with **Shahin et al., (2013)** who founded that higher than two-thirds of the studied nurses group had a poor level of total score of practice. *This finding may be due to lack of up- to- date training and experience occasionally that leads to health care errors.*

The present study revealed that there was a statistically significant relation was founded between nurses' level of knowledge and their residence, this finding agreed with **Mansi and Aziz, (2017)** who founded that there was statistically significant relation between nurses' level of knowledge and their residence. *This result may be related to of more than two-thirds of nurses were from the rural areas, this may difficult to them to access to network,*

reading or join to any educational or training program about care provided for neonates on mechanical ventilation.

The present study presented that, there was a significant relation between the studied nurses' total score of knowledge and their qualification. This finding was consistent with the finding of the study done by **Abdel-Fattah et al., (2018)** who founded that there was statistically significant relation between nurses' knowledge and qualifications, this finding disagrees with **Ahmed et al., (2014)** who reported that there was no statistically significant relation between nurses' knowledge and qualifications. *This result may be due to highest percentage of nursing staff is diploma nurses, while relatively small percentage has bachelor degree.*

The finding of the present study showed that there was a statistically significant relation between the nurses' level of knowledge and years of experience. This finding was supported by **Zaki et al., (2018)** who founded that there was a statistically significant relation between nurses' level of knowledge and years of experience. This finding contradicted with **Abdel Halim, (2013)** who stated that there was no statistical relation between nurses' level of knowledge and years of experience. *This may be explained that nurses had more and updating knowledge along years of experience.*

The current study illustrated that there was a statistically significant relation between nurses' level of practice and their qualifications. This finding in the same line with **Zaki et al., (2018)** who founded that there was a statistically significant difference between nurses' total practice score and their qualifications. *This result may be due to more than half of the studied nurses had a diploma of nursing.*

Regarding the relation between the nurses' level of practice and years of experiences, the current study showed that, there was a statistically significant relation between nurses' level of practice and years of experience, this finding goes on the same line with **Ahmed et al., (2014)** who founded that, there was a significant relation between total nurses' practice and years of experiences. This finding dissimilar with **Abou Ahmed, (2013)**

who showed that there was no relation between nurses' practice and year of experiences. *This result may be due to the year of experiences enable the nurses to master skills competently.*

There were statistical significance between total mean knowledge score and total mean practice score in pre and post evidence-based measures implementation. This finding in contrast to **Sharma R and Baheti S., (2017)** in his article about "assessment of the quality of nursing care given for high-risk neonate" who reported that there was no statistically significant correlation between total scores of nurses' level of knowledge and practice. This finding was similar to **Mohamed, (2012)** who found that there was a highly statistically significant difference between the nurses' knowledge regarding mechanical ventilation and their role in the care of neonates undergoing mechanical ventilation.

Limitation:

Interpretation of the results should acknowledge some limitation; small sample size. Future studies should try to ensure that research should be performed in a facility that will offer an adequate sample size of nurses in different places in Egyptian order to validate findings.

Conclusion:

Based on the results of the present study, it can be concluded that, implementation of training program regarding neonates invasive mechanical ventilation at neonatal intensive care units had significant effect on nurse's the performance. There were statistical significance between total mean score of knowledge and total mean score of practice at the pre and post training program implementation.

Recommendations:

Based on the results of the current study, the following recommendations are proposed:

1. Periodical training programs for nurses working at neonatal intensive care unit are mandatory for updating their knowledge and to maintain an effective practice.

2. Replication of the study on large samples in different neonatal intensive care units (NICUs) / Egypt.
3. Developing of a nursing protocol related care for neonates undergoing mechanical ventilation and implement the designed training program in all neonatal intensive care units (NICUs) / Egypt.

Implications for practice

Implementation of the evidence-based measures is effective in improvement nurses' performance regarding the neonates with invasive mechanical ventilation at NICUs so, it should be performed routinely.

Implications for neonatal research

The findings of this study infer that the majority of the nurses were had unsatisfactory performance before implementation of the evidence-based measures, thereby further researches should be conducted in future for updating their performance regarding the neonates with invasive mechanical ventilation at NICUs.

Notes

The author confirms that there is no conflict of interest and the study was not supported by any grant.

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