

Effect of Design Nursing Instruction on Mechanically Ventilated Children in Pediatric Intensive Care Units

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Abstract

Background: Mechanical ventilation is one of the most devices that are indispensable to use in Pediatric Intensive Care Units. However, all over the world many children are dying in Pediatric Intensive Care Units. Mechanical ventilation is help and supports management in the Intensive Care Unit, but it may cause a lot of threats and complications. This study **aimed** to evaluate the effect of a design nursing instruction on mechanically ventilated children in pediatric intensive care units. **Methods:** Research design: A quasi-experimental design was utilized to conduct this study. **Settings:** The study was convoyed at Pediatric Intensive Care Units at Suez Canal University Hospital and Ismailia Medical Center, Egypt. **Sample:** A convenient sample method of forty (40) nurses. **Tools:** The data was collected through a structured interview questionnaire sheet and observation to assess nurses' knowledge and practices of Mechanical ventilation. **Results:** There were statistically significant differences between the mean scores of the pre and post-test as regards nurses' knowledge and practices of mechanically ventilated children in Pediatric Intensive Care Units. **Conclusions:** Design nursing instruction has a positive outcome and improves nurses' practice regarding mechanically ventilated children's care. **Recommendations:** The current study recommended developing a written protocol for care of mechanically ventilated children and their clinical outcomes to support satisfactory knowledge, and competent practices are actually required in children's Intensive Care Units.

Key Words: Nursing instruction, Pediatric Intensive Care Units, Mechanically ventilated children.

Introduction

Seriously ill children are characterized by the presence of actual or potentially life-threatening problems. Most of these children are dependent on health care providers and technological assistance. Among these technological assistance devices in critical care units (CCUs) the mechanical ventilator assists or replaces spontaneous breathing (1). According to (2) mechanical ventilation (MV) refers to the use of life support technology that assists with the work of breathing for children who are unable to effectively oxygenate. In order to maintain enough oxygenation and ventilation until the underlying pathologic process resolves.

Mechanical ventilation (MV) is the skill of using devices to easily transport oxygen and CO₂ between the atmosphere and the alveoli with the goal of improving pulmonary gas exchange. MV is pointing to physiological and medical reasons. Physiological objectives include supporting cardiopulmonary gas exchange thereby, increasing lung volume and inhibiting the work of breathing. Therefore, the goals of MV are to prevent hypoxemia and acute respiratory acidosis, cure respiratory distress, prevent atelectasis and respiratory muscle fatigue, allow sedation and neuromuscular blockade, limit oxygen consumption, drop in the

intracranial pressure, normal chest wall, and facilitate diagnostic and therapeutic procedures with not exhaustion and collapse/recruitment ventilator resulted in lung injury (3 &4).

(5) reported that MV is one of the most common care provided in intensive care units (ICUs) in the world. It is indicated for acute respiratory failure, heart failure, and sepsis, in situations where children are not able to protect their airways, such as drug overdose, slow reversal of anesthetic agents, and neuromuscular diseases.

According to (6) two main types of ventilators are available nowadays, negative and positive pressure ventilators. Negative pressure ventilators decrease the atmospheric pressure surrounding the thorax to initiate inspiration. They in general are not necessary for the critical care environment. Positive pressure ventilators utilized a mechanical device mechanism to strongly air into the child's lungs through an endotracheal tube (ETT) or tracheostomy tube. (7) stated that while MV has good safe benefits, it results in dangerous complications, and adverse physiologic effects which may cause the long duration of MV itself, long duration of hospitalization and death.

As regards physiological risks associated with MV ventilator-associated lung injury (VALI) and nosocomial infection including ventilator-associated pneumonia (VAP). Ventilator-associated lung injury occurs through alveolar over distention and cyclic opening and closing of alveoli resulting in diffuse alveolar damage, increased permeability, pulmonary edema, cell contraction, and cytokine production. Complications can occur due to inappropriate application of mechanical ventilation. This may result in extra alveolar gas causing pneumothorax or subcutaneous emphysema due to high peak inspiratory pressures and alveolar stretch and edema formation as the result of large tidal volume (8).

Therefore, many complications can be prevented or treated rapidly through vigilant nursing care. Best practice includes the implementation of a "ventilator bundle" for all mechanically ventilated children to prevent complications and improve outcomes (9 &10).

(11) added that care for a child who is receiving MV requires extensive training and supervised practice. The child will require protection from infection, continuous monitoring of vital signs, observation for hypoventilation and hyperventilation, measurement of intake and output, and prevention of disabilities or inactivity.

Safe practice is a moral and experienced duty of health professionals. Therefore knowledge is an important part of child security management. Assessing the knowledge and practice of ICU nurses led to the introduction of appropriate education protocols in ICUs. This could raise both child safety and the individualized children caretaking protocol-directed care (12). Moreover, (13) stated that for the purpose to give good inclusive care for children while decreasing health care power the nurse must have the knowledge, practices and abilities to correctly manage children have MV. It is essential that educators, students, and nurse professionals strive to develop the data necessary to successfully manage children receiving ventilation support, proper MV education strategies at all levels to the health care providers will have a large impact on improving the quality of child intervention in such a field.

Significance of the study

Children's care on MV cannot be simplified. It needs excellent knowledge and competent practice of a complex and dynamic interaction between several ventilator variables. This knowledge and practice need to be incorporated into accurate and efficient decisions about the best skills while also avoiding ventilator-related risks (14 &15).

Moreover, MV is among the most common and dramatic ICU procedures, with about 30% (range 20%-60%) of children's Hospital Los Angeles a (PICU) supported by this technique. Mechanical ventilation is a lifesaving method for thousands of children who can't breathe on their own and is administered until the child resumes independent (spontaneous) breathing (16).

So, critical care nurses must have specialized skills and knowledge to practice efficiently in critical situations. Also, they should be able to have a competent level of care for children on the MV. Therefore, this study was conducted to evaluate the impact of a design nursing instruction on mechanically ventilated children and in pediatric intensive care units

Aim of the Study

The aim of this study was to evaluate the effect of a design nursing instruction on mechanically ventilated children in Pediatric Intensive Care Units.

This aim was being fulfilled through the following objectives:

- 1- Assessing nurses' knowledge regarding the care of mechanically ventilated children in pediatric intensive care units.
- 2- Assessing nurses' practice regarding the care of mechanically ventilated children in Pediatric Intensive Care Units.
- 3- Implementing and evaluating the effect of a design nursing instruction on mechanically ventilated children in pediatric intensive care units.

Subject and Methods

The study was portrayed under the four main designs as the following:

1. Technical design

2. Operational design
- 3- Administrative design
- 4- Statistical design

Technical design

The technical design of this study included a description of the research design, settings, subjects, and tools of data collection.

Research design:

A quasi-experimental study design was utilized for the current study.

Setting:

The study was carried out in Pediatric Intensive Care Units at the following hospitals:

1. Suez Canal University Hospitals
2. Ismailia Medical Center

Subjects:

The subject of this study was composed of:

All convenient nurses (40 nurses) at PICUs at the previously mentioned settings throughout six month period who fulfill the following criteria:

- Accept to participate in the study.
- Give direct care to mechanically ventilated children.

The tool for data collection

Two tools were utilized by the researchers to collect the necessary data.

Tool I: A structured interview questionnaire sheet

It was adopted from (17) after reviewing the related literature. It is used to assess nurses' knowledge regarding mechanical ventilator and nursing care of children on mechanical ventilator and consists of two parts:

- **Part 1:** Personal characteristics of the studied nurses such as age, sex of nurses, education level, years of experience, and attended any training program regarding the

care of children on mechanical ventilation.

- **Part 2:** Nurses' knowledge regarding mechanical ventilator and nursing care of children on mechanical ventilator including definition, causes, risk factors, indication, complications, and management of mechanical ventilator.

The Scoring system was developed by the researchers; each correct answer was scored 1 point and zero for the wrong one.

- Good \geq 80%
- Average 60-80%
- Poor < 60%

Tool II: Observational checklists for nurses' practices

It was developed by the researchers in the light of (18). The observational checklists were used to assess and evaluate the pediatric nurses' practice in all aspects of care provided to children on mechanical ventilator including preparation of ventilator, Endotracheal tube care, chest physiotherapy, Suctioning, Eye Care, mouth Care, Capillary Blood Gases (CBGs), Changing child's position, Cardiopulmonary resuscitation (C.P.R), Nasogastric tube insertion and care (Pre and post-test).

The Scoring system was developed by the researchers, each correct step done adequately was taken two points, done inadequately was taken one point, and zero points for not done.

2- Operational design:

Nursing instruction was designed and implemented through four sequential phases:

1- Preparatory phase:

- Review of recent literature related to mechanical ventilation to determine nurses' needs.
- Assessment of nurses' knowledge and practices regarding mechanically ventilated care for

children in pediatric intensive care units.

2- Planning phase:

Analysis for the pre-test to detect the nurses needs regarding the care of mechanically ventilated children.

3- Implementation phase:

General and specific objectives of the nursing instruction were designed. Implementation of educational program was entailed 5 sessions. The time of each session ranged from 30-45 minutes according to its content and nurses' responses. The instruction was implemented within 6 months and teaching sessions were conducted three days per week. Each group did not exceed 5 nurses. They were carried out using different teaching methods e.g. (lectures, demonstrations as well as group discussions). Also, various teaching media were used such as colored posters, videotapes, and handouts.

4- Evaluation phase:

Nurses' practices were evaluated by the end of the sessions as a post-test.

3. Administrative design:

A. An official permission for data collection was obtained using proper channels of communication from authorized personnel.

B. Content validity and reliability:

C. The tools were ascertained by five experts in the field from nursing and medical staff to check content validity, relevance, and comprehensiveness. Also, a reliability test was done.

C. Ethical considerations:

- The research approval was obtained from the ethical committee before starting the study.

- An oral consent was obtained from the nurses to accept to participate in the study and confidentiality of any obtained information was ensured, consent of the administrators of hospitals.

D. Pilot study

- A pilot study was carried out on 10% (4 nurses) of the study subjects to test applicability, feasibility, practicability of the tools, and then the necessary modifications were done according to the results of the pilot study. 10% of the study sample was included in the research.

3 - Statistical Design:

Data were arranged, categorized, tabulated, and analyzed using appropriate statistical tests by using Statistical Package for the Social Science (SPSS version 21) software for analysis. The analysis was conducted applying frequency tables with percentages. Data were revised, coded, and analyzed. All tests were performed at a level of significance of 5% ($P < 0.05$).

Results

Table 1 showed that more than half of the studied nurses' age was more than 30 years and less than 35 years (57.5%) and less than two-thirds of the nurses (60%) did not attend an instruction regarding the care of neonates with invasive mechanical ventilation.

Table 2 Presented the percentage distribution of the nurses' knowledge regarding mechanical ventilation in children's pre and post-test of nursing care. It's clarified that 60 % and 52.5% of nurses had information about definition and management respectively. of MV respect compared to 90% and 90.5% post-instruction. So, there were highly statistical significance differences related to nurses' knowledge regarding mechanical ventilation for children in the pre and post.

Figure 1 indicated that approximately two-thirds (60%) of the studied nurses had

bachelor's degrees of nursing, followed by 35% were graduated from secondary school of nursing (diploma) and 5% had technical nursing institute.

Figure 2 revealed that there were highly statistically significant differences between mean scores of the pre and post-knowledge scores regarding definition, causes & risk factors, indications, complications, and management of MV.

Table 3 showed the percentage distribution of the nurses' practice at pre and post-test regarding care provided for children with mechanical ventilation. It was found that before implementing the nursing instruction the majority of nurses (80%) practice eye care followed by hand washing and mouth care (75%), followed by intravenous infusion (65%), and approximately two-thirds of them (60%) completely done endotracheal tube suctioning and measurement of capillary blood gases. Nearly half of nurses (40%) completely practice the change positioning of the child. While after implementing the instruction, all the nurses (100.0%) practice completely hand washing, intravenous infusion, mouth care, and eye care. There were statistically significant differences related to nurses' practice regarding care provided for children on mechanical ventilation in the pre and post.

Figure 3 describe that more than two-thirds of children (67.25%) were on synchronized intermittent mandatory ventilation mode

Table 4 represented the mean scores of nurses' knowledge regarding nursing care of children on mechanical ventilation pre-and post-test. The mean score regarding nursing roles before, during, and after initiating of mechanical ventilation pre-test were 4.72 ± 1.03 , 4.81 ± 0.96 , and 5.73 ± 1.99 . On the other hand, the mean scores regarding nursing role before, during, and after initiating mechanical ventilation post-test were 9.81 ± 0.98 , 8.88 ± 1.05 , and 8.98 ± 0.78 . That was reflected in the implementation of nursing guidelines

proficiency on nurses' knowledge regards MV in children.

Table 5 showed 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 education level, years of experience, and attending training programs ($P < 0.017$, $P < 0.049$, and $P < 0.016$) respectively. On the other hand, no statistically significant relation was found regarding their age and respectively ($P = 0.195$).

Table 6 revealed the relation between total nurses' level of practice and their demographic characteristics. A statistically significant relation was found between the total score of the studied nurses' level of

as knowledge and their demographic characteristics related to education level, years of experience and attending training programs ($P < 0.039$, $P < 0.014$, and $P < 0.019$ respectively). On the other hand, no statistically significant relation was found regarding their age and respectively ($P = 0.345$).

Table 7 explains that there was statistical significance between the 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 8 demonstrated that after the instruction, there was practices correlation ($r = 0.376$) and highly statistically significant difference between the total score of the studied nurses' level of knowledge and their practice ($p = 0.001$).

Table 1: Socio-demographic characteristics of the nurses in PICU (n=40).

Characteristics	NO	%
Age in years		
20 < 25	5	12.5
25 < 30	8	20.0
30 < 35	23	57.5
35 ≥ 40	4	10.0
Educational level		
Diploma	14	35.0
Technical institute of nursing	2	5.0
Bachelor degree of nursing	24	60.0
Years of experience		
< 5	9	22.5
5 < 10	16	40.0
10 < 15	7	17.0
15 < 20	6	16.5
20 >	2	5.0
Attending of training programs related to MV		
Yes	16	40.0
No	24	60.0

Table 2: Percentage distribution of the nurses’ knowledge regarding mechanical ventilation in children pre and post- test of nursing care (n= 40)

Items	Pre-test		Post-Test		P-value
	%	No.	%	No.	
Definition	24	60	36	90	0.002*
Causes	20	50	35	87.5	0.005*
Risk factors	20	50	35	87.5	0.004*
Indication	18	45	30	75	0.008*
Complication	22	55	31	77.7	0.034*
Management	21	52.5	36.2	90.5	0.029*

*Statistically significant differences at p. value<0.05

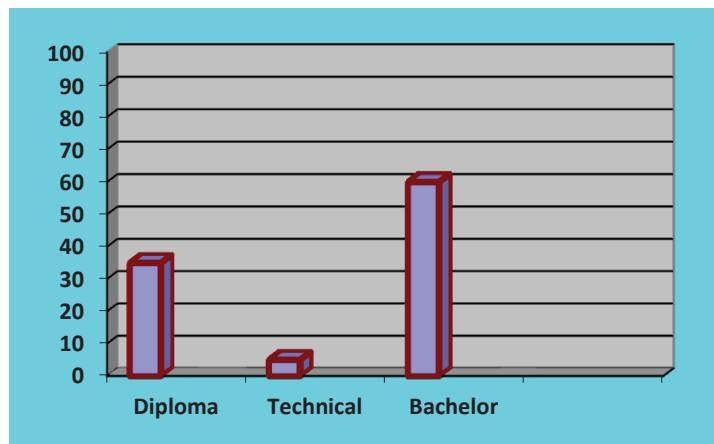


Figure 1: Distribution of studied nurses according to their qualification (n =40)

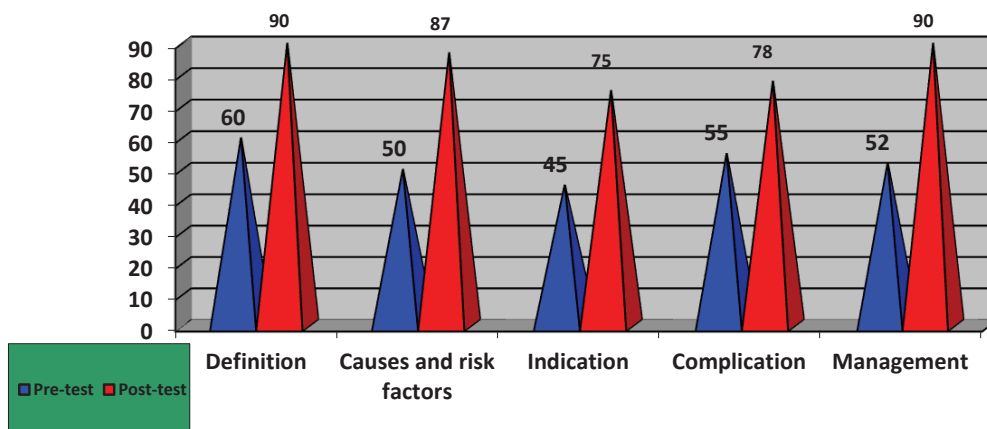


Figure 2: Total mean score of the nurses’ knowledge regarding mechanical ventilation in children pre and post-test of nursing care (n= 40)

Table 3: Percentage distribution of the nurses’ practice at pre and post-test regarding care provided for children with mechanical ventilation (n=40).

Items	Pre-test		Post-Test		P-value
	No.	%	No.	%	
Hand washing	30	75	40	100	0.000*
Taking an axillary temperature	20	50	33	83	0.024*
Preparation of ventilator	18	44	36	90	0.035*
Close system of endotracheal tube (ET) suctioning	24	60	39	99	0.000*
Chest physiotherapy	18	44	35	89	0.028*
Intravenous infusion	26	65	40	100	0.048*
Eye care	32	80	40	100	0.000*
Mouth care	30	75	40	100	0.000*
Changing child's positioning	16	40	36	90	0.001*
C.P.R	20	50	35	88	0.001*
Measurement of Capillary blood gases	24	60	32	80	0.001*
Nasogastric tube insertion	20	50	30	75	0.007*

*Statistically significant differences at p. value<0.05

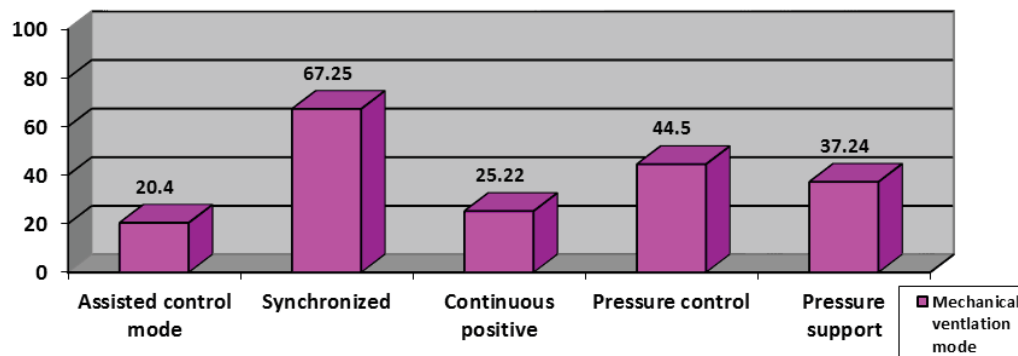


Figure 3: Percentage distribution of mechanical ventilator mode (n=40)

Table 4: Mean scores of nurses’ knowledge regarding nursing care of children on mechanical ventilation pre and post- test.

Knowledge items	Maximum score	Pre - test (N = 40) X ± SD	Post –test (N = 40) X ± SD	t-test	p-value
ing role before initiating of mechanical ventilation	15	4.72 ± 1.03	9.81 ± 0.98	-33.752	.000*
ing role during initiating of mechanical ventilation	14	.81 ± 0.96	8.88 ± 1.05	-40.853	.000*
rsing role after initiating of mechanical ventilation	12	5.73 ± 1.99	8.98 ± 0.78	-17.263	.000*
Total mean scores of nurses knowledge	20	16.47 ± 2.3	46.59 ± 2.8	-35.576	.000*

* Significance difference at nurses’ knowledge’s pre and post-test (p. value<0.05).

Table 5: The relation between total nurses’ level of knowledge and their demographic characteristics. (n=40).

Items	Knowledge Level						P-value
	Poor		Average		Good		
	No.	%	No.	%	No.	%	
Age in years							0.195
25< 30	1	2.5%	3	7.5%	4	10%	
30< 35	1	2.5%	2	5%	20	50%	
Educational level							0.017*
Diploma	2	5%	2	5%	10	25%	
Bachelor degree	2	5%	3	7.5%	19	47.5%	
Years of experience							0.049*
5 <	0	0	2	5%	7	17.5%	
From 5 to less than 10	2	5%	4	10%	12	30%	
From 10 to less than 15	0	0	3	7.5%	4	10%	
Attending of training programs							0.016*
Yes	2	5%	2	5%	12	30%	
No	1	2.5%	4	10%	19	47.5%	

*Statistically significant differences at p. value<0.05

Table 6: The relation between total nurses’ level of practice and their demographic characteristics n=40).

Items	practice Level						P-value
	Poor		Average		Good		
	No.	%	No.	%	No.	%	
Age in years							0.345
25< 30	0	0	4	10%	4	10%	
30< 35	2	5%	2	5%	19	47.5%	
Educational level							0.039*
Diploma	2	5%	2	5%	10	25%	
Bachelor degree	3	7.5%	3	7.5%	18	45%	
Years of experience							

5 <	2	5%	2	5%	5	12.5%	0.014*
From 5 to less than 10	3	7.5%	5	12.5%	16	40%	
From 10 to less than 15	0	0	3	7.5%	4	10%	
Attending of training programs							0.019*
Yes	2	5%	2	5%	12	30%	
No	0	0	3	7.5%	21	52.5%	

*Statistically significant differences at p. value<0.05

Table 7: Comparison between the nurses’ total mean knowledge and practice scores Provided For children on mechanical ventilation in pre and post- test (n=40).

Items	Total Mean Score Knowledge		Total Mean Score Practice	
	Pre-test	Post-test	Pre-test	Post-test
Total Mean± SD	13.42±1.94	55.33± 2.75	194.59 ± 22.45	451± 36.32
X₂ test	763.37		49.55	
P – Value	0.0001*		<0.001	

*Statistically significant differences at p. value<0.05

Table 8: Correlation between nurses' total score of knowledge and total score of practice at the pre and post-test program.

Items	Pre- test		Post- test	
	R	P-value	R	P-value
Total knowledge score	0.445*	0.008	0.376*	0.0001
Total practice score				

*Statistically significant differences at p. value<0.05

Discussion

Mechanical Ventilation is a cornerstone for treating children in PICU with multiple diagnoses, it aims to relieve child distress, protect the airway, reduce work of breathing and prevent hypoxemia and hypercapnia. Mechanical ventilation has been produced to relieve distress associated with respiratory failure. In some cases, non-invasive ventilation is not tolerated by patients due to gastric insufflation and mask pressure. So, invasive ventilation will be the substitute (19).Children's hospitalizations in the Intensive Care Unit (PICU) are stressful experiences for the children and their families. The support of pediatric nurses

is necessary to control and reduce stress and infection. And nurse–parent support may play a role in effective stress management and make a positive contribution to the health of the family. Most children admitted to PICU require assistance with breathing via a mechanical ventilator. Mechanical ventilation is the transition from ventilator support to spontaneous breathing (20&21). So, this study aimed to evaluate the influence of nursing instruction on children ventilation. According to characteristics data of the studied nurses, the result of the current study clarified that more than half of the nurses' age was 30 < 35 years, this result

was similar to a study by (22) who carried out study entitled effect of implementing a training program for nurses on prevention of pediatric ventilator-associated pneumonia were between 30 to 35 years and contrast with (23) who have study about the impact of nursing guidelines on nurses' knowledge and performance regarding prevention of ventilator-associated pneumonia in neonates, he was found that the majority of the nurse in their study less than 25 years old. However, in the present study there was no significant difference between the control and study for nurses' age, this result is supported by (24) study.

The current study also revealed that two-thirds of the studied nurses had Bachelor's degrees in nursing. This result is not similar to (25) who carried study entitled effect of training program implementation on nurse's performance regarding neonates invasive mechanical ventilation and found that more than half of the studied nurses had secondary school nursing diploma, This finding disagreed with (26) 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 the large number of diploma nurses graduates than other agencies such as faculties of nursing and technical institutes of nursing and maldistribution of highly qualified nurses in Egypt.

Regarding the years of experience of the studied nurses, the finding of the current study showed that less than half of them had any experience of 5 <10 years. This result was in accordance with (21) who carried study entitled effect of implementing a training program for nurses on prevention of pediatric

ventilator-associated pneumonia, (27) in their study about " knowledge of pediatric critical care nurses regarding evidence-based guidelines for the prevention of ventilator-associated pneumonia" disagreed and found that the majority of nurses have a period of experience less than five years. The current study also revealed that more than half of the studied nurses did not attend the training program, this finding was supported by (28) in their study about knowledge of pediatric critical care nurses regarding evidence-based guidelines for the prevention of ventilator - associated pneumonia, who found that the majority of nurses did not attend any training program and this finding disagreement with (29) 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. This may be attributed to a lack of training. These results may be attributed to the no continuous education and preparation prior to work or training concerning to care of children, in addition to the lack of their need to update their knowledge. Knowledge and practices are considered the backbone of the prevention of nosocomial infections, especially in children. The goal of continuous education in nursing is to improve knowledge and practice to support the quality of care (22). However, the current study results showed that there were highly statistically significant differences between the nurses' practice of hand washing during pre and post-test of nursing care provided for children with mechanical ventilation and found that, all studied groups had a good level of practice related to hand washing. This result disagrees with (30) who found that more than half of nurses had a good level of practice regarding hand washing and agreed with (31) who stated that hand

washing is a simple 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 hands followed routinely in all of the nursing actions due to adequate and recurrent training for nurses regarding procedures of infection control at NICU.

Furthermore, there were highly statistically significant differences between the mean scores of nurses' knowledge regarding the nursing role of children on mechanical ventilation in the pre and post-test. (32) Added that, the finding of the current study was presented statistical significant differences between mean scores of nurses' knowledge regarding Mechanical Ventilation in children pre and post- test of nursing care about definition, causes and risk factors, indications, clinical pictures, complication and management. (33) reflected that the nursing educational program had an improvement on the nurse's performance regarding the care of mechanically ventilated children in Pediatric Intensive Care Units. This finding differed from (34) who found that higher than two-thirds of the studied nurses group had a poor level of the 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. Concerning the Percentage distribution of mechanical ventilator mode, this study showed that the majority were on synchronized intermittent mandatory ventilation mode with the same line of (35). This may be difficult for the nurses to access or join to any educational or training program about the care provided for children on mechanical ventilation in ICU.

In relation to the level of nurses' total knowledge regarding mechanical ventilation for children in pre and post,

the result of the current study clarified that, the high number of study sample had poor knowledge scores in the pre-test. The present study presented that, there was no significant relationship between the studied nurses' total score of knowledge. On the other hand, there were improvements in nurses' Knowledge scores in the post-test, in comparison to the pre-test with highly statistically significant differences. This may be due to no more nursing training about mechanical ventilation for children in PICU. The knowledge shortage has reflected obstacles to nursing care of children on mechanical ventilation in PICU as a reference available at any time for nurses, to be aware of the importance of the nursing role, and its management. This result was supported by (36), who stated an improvement in the knowledge and practice of nurses after the program. Meanwhile, these results may be due to lack of training courses, lack of equipment, sources and work overload which in turn affect nurses' knowledge and practice.

According to the nurses' total mean score of knowledge, the current study showed that, the total mean score of nurses' knowledge in the pre-test was (13.42 ± 1.94). On other hand, the post-test total mean scores were improved to (55.33 ± 2.75). This result was consistent with the finding of the study done by (37) who reported that the nurses' performance was improved after the program. This finding is not the same as (21) who noticed that there was no statistically significant relationship between nurses' knowledge and performance after the instruction. *This result may be due to the* highest percentage of nursing staff being diploma nurses, while a relatively small percentage has bachelor's degrees. While, the nurses' total mean practice scores found that the total mean score of nurses'

practice in the pre-test was (194.59 ± 22.45). On other hand, the post- test total mean scores were improved to (451 ± 36.32). This result was agree with the finding of the study done by (23) who noticed that there was no statistically significant relation between nurses' practice after the program. It was noticed that the nurses' knowledge and practice were improved post-test. It reflects the educational program for the nurse's performance regarding mechanical ventilation for children in ICU. Moreover, the finding of the present study showed that there was a statistically significant relationship between the nurses' level of knowledge and level of education, years of experience and attending training programs. This finding was supported by (38). In spite of this finding contradicted (39) who stated that there was no statistical relation between nurses' level of knowledge and level of education, years of experience, and attending training programs. *This may be explained that nurses had more and updating knowledge along with their demographic characteristics.* The current study illustrated that there was a statistically significant relationship between nurses' level of practice and their demographic characteristics. This finding is in the same line as (24) who found 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.* This finding dissimilar from (40) who found that there was no relationship between nurses' practice and year of experiences. *This result may be due to the years of experience enabling the nurses to master skills competently.* There was statistical significance between total knowledge score and total practice score in pre and post. This finding in contrast to (33) in their article about

"assessment of the quality of nursing care given for high-risk neonates" who reported that there was no statistically significant correlation between total scores of nurses' level of knowledge and practice. This finding was similar to (41) who found that there was a highly statistically significant difference between the nurses' knowledge regarding mechanical ventilation and their role in the care of children undergoing mechanical ventilation.

Meanwhile, reference to the Correlation of nurses' total knowledge and their total practices of mechanical ventilation in pre and post-test, the recent study reflected that there were highly statistically differences among nurses' total knowledge and total practices for nurses' performance. These results were known as it is perhaps leading to a decrease of opportunity for continuous training and education program in the hospital to improve the nurses' practice and maybe also due to lack of equipment, shortage of staff, and close observation and reinforcement as well as the nurses were workoverloaded.

Finally, continuous education programs are designed to improve the quality of care for nurses and narrow the cavity between scientific knowledge and actual nurses' performance (42). Therefore, the current study had improvement of nurses' total knowledge and practice for mechanical ventilation on children in PICU.

Conclusion

Based on the findings of the current study, it was concluded that nurses' performance regarding the care of mechanically ventilated children in pediatric intensive care units (PICU) was improved after the education training program. There was statistical significance between the total mean score of knowledge and the total mean score of

practice in the post-training program than in the pre-test.

Recommendations

1- Periodical training programs for nurses working at PICU for updating their knowledge and maintain an effective practice.

2- Encourage nursing staff orientation at PICUs would include training and education on policies and strategies for MV in children.

3- Developing a nursing protocol related to care for children on mechanical ventilation and producing the designed training program in PICUs in Egypt.

4- Future studies should be conducted to improve nurses' knowledge and performance regarding MV in children was recommended.

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