

Effectiveness of an Educational Program on Nurses' Knowledge Toward Prevention of Neonatal Mechanical Ventilator-Associated Pneumonia

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ABSTRACT

Background: Responsibility of preventive strategies and newborns care on mechanical ventilation lie with nurse. Nurses are one of the main resources in health care that directly influence patient health care. Since nurses are always with patients and look after them, they have a positive effect on newborns' ventilation care and prevention of side effects. Therefore, it is expected that they play an important role in the prevention of ventilator-associated pneumonia.

Objective(s): To evaluate the effectiveness of an educational program on nurses' knowledge toward prevention of neonatal mechanical ventilator-associated pneumonia.

Methodology: A quasi-experimental study design for study and control group is carried out evaluation the effectiveness of an educational program on nurse's knowledge toward neonatal mechanical ventilator -associated pneumonia, the study is carried out through the application of pre-test, post-test 1 and post-test 2 approach for the study and control groups. The period of the study was initiated from 26 December 2022 to 31 March 2023. A non-probability "purposive" sample was selected from Medical City in Baghdad City had been consisting of 50 Nurses. The size of sample is 50 nurses divided into two groups each one consisting of 25 nurses as the study group and 25 nurses as the control group. The study was exposed to an educational program while the control group was not exposed to the program. The data was obtained by the researcher utilizing a constructive knowledge questionnaire, which was then responded to through interviews with closed-ended structured questions. During the morning and evening shifts, the nurses were tested on their knowledge. Each nurse was given about (10-15) minutes to complete the test. The data of the present study were analyzed through the use of the Statistical Package of Social Sciences (SPSS) version (26).

Results: the findings present that analysis of RM-ANOVA test indicates that educational program was highly effective on nurses' knowledge among the study group evidenced by high significance associated with "Greenhouse-Geisser" correction at p-value=0.001 and the Eta squared that indicate large size effect. It is clear from descriptive data that the noticeable increase of mean score on nurses' knowledge during post-test 1 and 2 that indicate the effectiveness of educational program.

Conclusion: Regarding "concepts about prevention of neonatal ventilator-associated pneumonia" domain, nurses showed good level of knowledge after posttest. The educational program is effective and produced the desired improvement in nursing knowledge about Prevention of Neonatal Ventilator-associated Pneumonia.

Recommendations: The educational program is recommended to be applied in other health care facilities to optimize nurses' base of knowledge and practice. Updating the Prevention of Neonatal Ventilator- associated Pneumonia standards and guidelines regularly to achieve the best health care quality possible in the Iraqi hospitals.

Keywords: Effectiveness, Educational, Program, Nurses, Knowledge, prevention, neonatal, mechanical ventilator-associated pneumonia.

INTRODUCTION

Newborns are prone to nosocomial infections due to immune deficiency and skin and mucosal membrane vulnerable to infections. It occurs more in newborns on mechanical ventilation by tracheal intubation, compared to those on mechanical ventilation by continuous positive airway pressure (CPAP) (1).

Mechanical ventilation is commonly used in neonatal intensive care units (NICUs), although it saves the life of many newborns, if inappropriately used it could cause some complications. One of the most common complications is ventilator-associated pneumonia (VAP). Pneumonia is the inflammation of the lung, due to biological agents which are community-acquired or nosocomial (2).

Responsibility of preventive strategies and newborns care on mechanical ventilation lie with nurse. Nurses are one of the main resources in health care that directly influence patient health care. Since nurses are always with patients and look after them, they have a positive effect on newborns' ventilation care and prevention of side effects. Therefore, it is expected that they play an important role in the prevention of VAP (3).

NICU nurses play an important role in VAP prevention in newborns undergoing mechanical ventilation by applying acquired knowledge. They should be aware of possible complications so that they can take preventive measures. Nurses are at the central point of efforts to promote the quality of care in hospitals. They are key contributors to the care of patients and help other personnel to promote quality of care. Recently, many studies have reported on the epidemiology of VAP and its preventive methods; however, there is little information regarding nurses' performance level in VAP prevention, and authors are not able to find any research on this issue. Therefore, the assessment of nurses' compliance with standards for the prevention of VAP can improve their performance and provide clinical guidelines (4).

The findings of very recent a study conducted on nurses working in the NICU showed that NICU staff needed more and specialized knowledge about their duties. The need for the provision of training to all types of nurses and in different wards is necessary and essential; however, the training of ICU nurses is more prominent and vital due to the complexity of care, importance of their role in preventing complications during hospitalization in the NICU, and higher probability of the complications and vulnerability of patients admitted to the NICU (5).

The Center for Disease Control and Prevention (CDC) has defined VAP as a nosocomial infection in patients requiring mechanical ventilation for at least 48 hours. The VAP is the second most common nosocomial infection in NICUs leading to prolonged hospitalization, increase in medical costs, antibiotic use, prolonged mechanical ventilation, and morbidity rates (6).

This condition is a common and severe complication among NICU patients, and its treatment costs 30,000 US dollars for each affected newborn. The CDC recommends some criteria for diagnosing VAP in patients younger than one year. This includes worsening gas exchange with at least three signs: unstable temperature with unknown cause, increased respiratory secretions, purulent sputum, abnormal white blood cell count, signs of respiratory distress, and abnormal heart rate (7).

The VAP can be prevented and its incidence is expected to decrease to a third of the initial incidence rate if health care workers take some measures in their practice, such as assessment of readiness to extubate, prevention of unplanned extubation and reintubation, using noninvasive forms of ventilation when feasible, proper hand hygiene, wearing gloves before coming into contact with secretions, using separate suction catheters for tracheal and mouth suctioning, avoiding disruption of the ventilation circuit, oral hygiene and wiping the oral cavity with normal saline, avoiding normal saline instillation with ETT suctioning, suctioning the ETT only when secretions are visible or there is a change in breath sounds or respiratory status, prevention of aspiration by elevation of the head of the bed 30-45 degrees, avoiding abdominal distention and severe sedation, and excessive drugs to prevent drug resistance (8)(9).

The costs of these nosocomial infections are substantial, for they increase the duration of hospitalization and number of diagnoses, procedures, and care. The annual cost for the five principal hospital-acquired infections (surgical site infection, central line-associated bloodstream infection, catheter-associated urinary tract infection, ventilator-associated pneumonia (VAP), and *Clostridium difficile* infection) is estimated at €8.9 billion; 33.7% of this cost is attributed to surgical site infections and 31.6% to ventilator-acquired pneumonia (VAP) (10)(11).

According to the US Centers for Disease Control and Prevention, all the strategies to prevent VAP include complete oral hygiene. Complete oral hygiene refers

to the practice of keeping the mouth, teeth, and gums clean and healthy to prevent disease. This oral care includes multiple procedures, from the simple application of antiseptic solution with gauze to tooth brushing. Most hospitals use gauze and an antiseptic solution for this care (12)(13)(14).

METHODOLOGY

Study Design

A quasi-experimental study design for study and control group is carried out evaluation the effectiveness of an educational program on nurse’s knowledge toward neonatal mechanical ventilator - associated pneumonia, the study is carried out through the application of pre-test, post-test 1 and post-test 2 approach for the study and control groups. The period

of the study was initiated from 26 December 2022 to 31 March 2023.

Ethical Considerations

The researcher obtained approval from all nurses and the names of the nurses was not collected. Also, the researcher explains the research and its goals for all nurses. Therefore, fully informed about their mission was obtained. The researcher told all participants that the results of the questionnaire would be utilized specifically for research purposes. Also told those that all participants are autonomous individuals have the right to refuse involvement.

Setting of the Study

The study was conducted at 3 hospitals in a Medical City.

Table 1 Distribution of Nurses who participated in the study:

No	Hospitals	Nurses		%
		Study Group	Control Group	
1	Baghdad Teaching Hospital	10	10	40
2	Privat Nursing Home	5	5	20
3	Pediatric Teaching Hospital	10	10	40
	Total	25	25	100%

Study Sample

A non-probability “purposive” sample was selected from Medical City in Baghdad City had been consisting of 50 Nurses. The size of sample is 50 nurses divided into two groups each one consisting of 25 nurses as the study group and 25 nurses as the control group. The study was exposed to an educational program while the control group was not exposed to the program.

Data Collection Methods

The data was obtained by the researcher utilizing a constructive knowledge questionnaire, which was then responded to through interviews with closed-ended structured questions. During the morning and evening shifts, the nurses were tested on their knowledge. Each nurse was given about (10-15) minutes to complete the test.

Data Analysis

The data of the present study were analyzed through the use of the Statistical Package of Social Sciences (SPSS) version (26).

RESULTS OF THE STUDY

Table 2 Assessment of Nurses’ Knowledge Concerning “Concepts about Prevention of Neonatal Ventilator-associated Pneumonia” among Study and Control Group

List	Concepts about Prevention of Neonatal Ventilator-associated Pneumonia	Study Group (N=25)						Control Group (N=25)											
		Pre-test		Post-test 1		Post-test 2		Pre-test		Post-test 1		Post-test 2							
		M	Ass.	M	Ass.	M	Ass.	M	Ass.	M	Ass.	M	Ass.						

1	Ventilator-associated pneumonia is the most common nosocomial infection due to using of ventilator in neonatal intensive care units.	1.8	Good	1.96	Good	2.00	Good	1.12	Fair	1.16	Fair	1.32	Fair
2	Ventilator devices are used in neonatal intensive care units to help the neonates who are unable to breathe naturally.	.80	Fair	2.00	Good	1.96	Good	.96	Fair	.96	Fair	1.00	Fair
3	Stay more than 48 hours on ventilator does not expose the neonate to ventilator-associated pneumonia.	.88	Fair	2.00	Good	2.00	Good	1.4	Fair	1.12	Fair	.60	Poor
4	Mechanical ventilator is an effective to life saving intervention neonate in critical condition are widely used in neonatal intensive care unit.	.80	Fair	2.00	Good	1.92	Good	.76	Fair	.80	Fair	.72	Fair
5	Ventilator associated pneumonia is a type of nosocomial infection that occur more than 48 hours after mechanical ventilation by	.80	Fair	2.00	Good	2.00	Good	.76	Fair	.76	Fair	.80	Fair

	endotracheal tube.												
6	Ventilator associated pneumonia is an inflammatory condition of the lung that effect the air sac called alveoli.	.60	Poor	2.00	Good	1.96	Good	.68	Fair	.60	Poor	.72	Fair
Total		.95	Fair	1.99	Good	1.97	Good	.94	Fair	.90	Fair	.86	Fair

M: Mean, Poor= 0 – 0.66, Fair= 0.67– 1.33, Good= 1.34 – 2

The table 2 presents the assessment of nurses’ knowledge about “Concepts about Prevention of Neonatal Ventilator- associated Pneumonia”; the findings among the study group reveal that nurses are showing fair level of knowledge during pre-test time (Mean= .95) while they show good level of knowledge

during the post-test time 1 (Mean= 1.99) and post-test time 2 (Mean= 1.97).

Among the nurses in the control group, they how fair level of knowledge during the three times of test: pre-test (Mean= .94), post-test 1 (Mean= .90), and post-test 2 (Mean= .86).

Table 3 Repeated Measure Analysis of Variance (RM-ANOVA) Test for Effectiveness of Educational Program on Nurses’ Knowledge about Prevention of Pneumonia associated with Ventilator among the Study Group (N=25)

Descriptive		Within-Subjects Effect								
Knowledge	Mean (S.D)	Source	Type III Sum of Squares	df	Mean Square	F	P-value	Sig.	Partial Eta Squared	
Pre-test	31.20 (8.010)	Time	Sphericity Assumed	51424.027	2	25712.013	1174.690	.001	H.S	.980
			Greenhouse-Geisser	51424.027	1.097	46893.633	1174.690	.001	H.S	.980
			Huynh-Feldt	51424.027	1.110	46341.647	1174.690	.001	H.S	.980
			Lower-bound	51424.027	1.000	51424.027	1174.690	.001	H.S	.980
Post-test I	87.24 (.970)	Error(Time)	Sphericity Assumed	1050.640	48	21.888				
Post-test II	86.24 (1.809)		Greenhouse-Geisser	1050.640	26.319	39.920				
			Huynh-Feldt	1050.640	26.632	39.450				
			Lower-bound	1050.640	24.000	43.777				

S.D: Standard Deviation, df: Degree of Freedom, f: F-statistics, P-value: probability value, Sig: Significance, H.S: High Significant

This table presents that analysis of RM-ANOVA test indicates that educational program was highly effective on nurses’ knowledge among the study group evidenced by high significance associated with “Greenhouse-Geisser” correction at p-value=0.001

and the Eta squared that indicate large size effect. It is clear out of descriptive data the noticeable increasing of mean score on nurses’ knowledge during post-test 1 and 2 that indicate the effectiveness of educational program.

Table 4 Repeated Measure Analysis of Variance (RM-ANOVA) Test for Effectiveness of Educational Program on Nurses’ Knowledge about Prevention of Pneumonia associated with Ventilator among the Control Group (N=25)

Descriptive		Within-Subjects Effect									
Knowledge	Mean (S.D)	Source	Type III Sum of Squares	df	Mean Square	F	P-value	Sig.	Partial Eta Squared		
Pre-test Post-test I Post-test II	27.28 (6.275) 28.32 (8.148) 28.88 (8.228)	Time	Sphericity Assumed	32.960	2	16.480	2.576	.087	N.S	.097	
			Greenhouse-Geisser	32.960	1.821	18.101	2.576	.092	N.S	.097	
			Huynh-Feldt	32.960	1.962	16.797	2.576	.088	N.S	.097	
			Lower-bound	32.960	1.000	32.960	2.576	.122	N.S	.097	
		Error(Time)	Sphericity Assumed	307.040	48	6.397					
			Greenhouse-Geisser	307.040	43.701	7.026					
			Huynh-Feldt	307.040	47.095	6.520					
		Lower-bound	307.040	24.000	12.793						

S.D: Standard Deviation, df: Degree of Freedom, f: F-statistics, P-value: probability value, Sig: Significance, H.S: High Significant

This table reveals that there is no significance has been associated with “Greenhouse-Geisser” correction and the Eta squared that indicate small size effect. The descriptive shows no differences in mean score of nurses’ knowledge in the control group during pre-test, post-test 1, and 2.

DISCUSSION

Discussion of Assessment of Nurses’ Knowledge Concerning “Concepts about Prevention of Neonatal Ventilator-associated Pneumonia” among Study and Control Group (Table 2).

Results of the assessment of nurses’ knowledge about “Concepts about Prevention of Neonatal Ventilator-associated Pneumonia”; presents that findings among the study group reveal that nurses are showing fair level of knowledge during pre-test time while they show good level of knowledge during the post-test time 1 and post-test time 2.

Among the nurses in the control group, they show fair level of knowledge during the three times of test: pre-test, post-test 1, and post-test 2.

In the same context, a recent supportive evidence is found that the nursing care related to VAP prevention

was 62.84%, while a study on nurses’ VAP prevention practices in Iran showed that 33.6% of the nurses had a relatively desirable performance and 66.4% of them had undesirable quality and the performance scores in suctioning, aspiration prevention, and oral care were 53.67%, 40.78%, and 18.87%, respectively (15)(16)(17).

In the same line with Dipanjali and his colleagues (2020) the mean knowledge score of the participants had increased. The maximum and minimum pre-test knowledge scores were 30 and 13 respectively and that of the post-test were 34 and 24 respectively. Out of 50 participants, only (2%) had good knowledge, (76%) had average knowledge and (22%) had poor knowledge in the pre-test. Whereas the post test results show improvement in knowledge of the participants accounting to (94%) having good knowledge and (6%) average knowledge (18)(19)(20).

The researcher explains that this improvement in knowledge in the study group could be attributed to the effectiveness of the intervention, which included an educational program aimed at increasing the nurses’ knowledge about the prevention of neonatal ventilator-associated pneumonia. The researcher may

also have considered the possibility that the control group did not receive the same intervention, which may have contributed to the lack of improvement in knowledge levels.

5.10. Discussion of the Effectiveness of Educational Program on Nurses' Knowledge about Prevention of Pneumonia associated with Ventilator among the Study Group and Control Group (Table 3) and (Table 4).

The data analysis indicates that the educational program was highly effective on nurses' knowledge among the study group. It is clear out of descriptive data that the noticeable increasing of mean score on nurses' knowledge during post-test 1 and 2 that indicate the effectiveness of educational program.

Results reveal that there is no significance associated with "Greenhouse-Geisser" correction and the Eta squared that indicates small size effect. The descriptive shows no differences in mean score of nurses' knowledge in the control group during pre-test, post-test 1, and 2 as shown in figure (4-2).

A study conducted in Jordan used the VAP-prevention guidelines course included 4 sessions of 2 hours per session. The first introduced mechanical ventilator management and VAP, and the remaining sessions covered the most up-to-date guidelines. The guidelines included oral care, handwashing, suction, mechanical ventilator management, patient position, prophylactic use of antibiotics, peptic ulcer prophylaxis, and deep venous thrombosis prophylaxis. The sessions took place in classrooms at the researcher's university. The educational strategies included classroom presentations, class discussion, and videotapes. The participants were provided with hard copies of the presentation's slides (21)(22).

Recent research done on ICU nurses from 5 Jordanian hospitals participated in the study. Their age was 30-37 years. There was no statistically significant difference in the baseline characteristics of the experimental group and the control group. Of the 120 nurses who began, 17 (28%) dropped out of the control group but only 1 participant dropped from the experimental group. Participants who dropped out were of different ages, years of experience, and genders (21)(23)(24).

Another study took place in Iraq by Helal and colleagues (25) found that the findings revealed that majority of nurses have high knowledge about most of the items concerning CPAP and neonatal resuscitation (26).

CONCLUSION

Regarding concepts about prevention of neonatal ventilator-associated pneumonia, nurses showed good level of knowledge after posttest. The educational program is effective and produced the desired improvement in nursing knowledge about Prevention of Neonatal Ventilator-associated Pneumonia.

RECOMMENDATIONS

The educational program is recommended to be applied in other health care facilities to optimize nurses base of knowledge and practice. Updating the Prevention of Neonatal Ventilator-associated Pneumonia standards and guidelines regularly to achieve the best health care quality possible in the Iraqi hospitals.

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