Original Article

Effectiveness of an Educational Intervention on Knowledge and Practice of Staff Nurses on Prevention of Ventilator Associated Pneumonia among Neonates in Neonatal Intensive Care Unit

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Abstract

Background: Ventilator Associated Pneumonia accounts for 6.8 - 32.2 % of all Healthcare Associated Infections (HAIs) among neonates and is a major complication in neonates on mechanical ventilation. Educational interventions for nurses have shown substantial reduction in VAP rates.
Aim: The aim of the study was to assess the effectiveness of an educational intervention on the knowledge and practice of the staff nurses regarding prevention of VAP among neonates in Neonatal Intensive Care Unit (NICU).
Methodology: This quasi-experimental one group pre-test post-test study was conducted among 50 staff nurses of the NICU of a tertiary care hospital who have been selected using non-probability purposive sampling technique. Data were collected before and ten days after the implementation of the educational intervention using a demographic proforma, a structured knowledge questionnaire on and an observational checklist on prevention of VAP. The study protocol was approved by the Institutional Ethical Committee (IEC). Analysis of data was done using SPSS 16.0 with descriptive and inferential statistics (percentage, mean, parametric and non-parametric tests of significance).
Results: The mean knowledge score of the participants had increased from 21.44±3.06 (pre-test) to 30.26±2.46 (post-test) and the median score for practice prior to the intervention was 21 (interquartile range, Q1=20, Q3=22.5) and after the intervention it was 24 (interquartile range, Q1=23, Q3=25). The educational intervention was found to be effective in terms of improvement in the knowledge ($t= -17.238$, $p<0.001$) and practice ($z= -6.180$, $p<0.001$) of the staff nurses as evidenced by statistically significant differences in the pre-test and post-test knowledge and practice scores of the staff nurses.
Conclusion: Education of the staff nurses is essential to handle a new born in Neonatal Intensive Care Unit (NICU) and to prevent complications related to the ventilator.

Keywords: Knowledge, practice, educational intervention, nurses, Neonatal Intensive Care Unit, Ventilator Associated Pneumonia (VAP).

Introduction: Ventilator Associated Pneumonia (VAP) is a serious complication in neonates on mechanical ventilation and accounts for 6.8 - 32.2 % of Health-Care Associated Infections (HAIs) among neonates. It has a large impact on neonatal morbidity, survival, hospital costs and duration of neonatal intensive care unit (NICU) stay. In developing countries the reported rates were significantly higher, ranging from 16.1 to 89 episodes of VAP per 1,000 ventilator days (Afjeh, S.A., Sabzehei, M.K., Karimi, A., Shiva, F., Shamshiri, A.R., 2012). The Center for Disease Control and Prevention (CDC) defines ventilator-associated pneumonia (VAP) as an episode of pneumonia in a patient who requires a device to assist or control respiration through a

tracheostomy or endotracheal tube within 48 hours before the onset of the infection (Centres for Disease Control and Prevention, 2017). It is characterized by a new or a progressive pulmonary infiltrate, fever, leucocytosis and purulent tracheo-bronchial secretions (Munro, et al., 2006**)**.Unfortunately, few studies have focused on neonates, particularly those with a low or very low birth weight. The incidence of neonatal VAP is difficult to be correctly determined, because it is difficult to differentiate between new or progressive radiographic infiltrates due to neonatal pneumonia or due to exacerbation of bronchopulmonary dysplasia and frequent episodes of atelectasis (Al-Alaiyan & Binmanee, 2017).

The prevention of Ventilator Associated Pneumonia (VAP) among intensive care patients is a major clinical challenge. Throughout empirical observation, nurses' lack of knowledge may be a barrier to adhere to evidenced based guidelines for preventing VAP and translating evidence based findings into consistently delivered care at the bedside remains a challenge. However, many studies have shown that, educational interventions, staff development programmes and multi –educational intervention programmes led to a substantial reduction of Ventilator Associated Pneumonia (Ali, 2013).

In a cross-sectional study conducted in Turkey to find the nurses' knowledge on evidence based VAP prevention guidelines, poor knowledge of nurses regarding VAP preventive guidelines was noted therefore the need of educational programmes to enhance the knowledge of the staff nurses regarding evidence based guidelines was recommended (Korhan, Hakverdioglu, Parlar, & Uzelli, 2014**)**. A significant reduction in the VAP rates as well as crude mortality rate after the implementation of the educational program (40.5% vs. 24%; $p<0.001$) and (12.3% vs. 8.7%; $p<0.001$) respectively was reported in a study done in Thailand, (Danchaivijitr, Assanasen, Apisarnthanarak, Judaeng, & Pumsuwan, 2005).

Jansson, Kaariainen, & Kyngas (2014), in their review, to explain the existing literature on the effectiveness of the educational programs in preventing Ventilator Associated Pneumonia (VAP) concluded that education of the critical care personnel plays an important role in terms of patient safety and quality care. Jacob, D'Souza, & John, (2014) in their study to assess the effectiveness of a self -instructional module on knowledge of the staff nurses regarding prevention of nosocomial infection in Neonatal Intensive Care Unit (NICU) showed that the knowledge of the staff nurses before providing the Self Instructional Module was not satisfactory (mean knowledge score percentage= 54.33%). However, after the administration of the self-instructional module, increase in the post-test knowledge scores was seen (mean knowledge score percentage=98.66%). The percentage of increase in knowledge was 44.33%.

Neonatal VAP surveillance is not a routine practice in the selected NICU of the tertiary care centre. However, the NICU had approximately 20-30 intubated cases on mechanical ventilator per month. So, measuring the knowledge and practice of the registered nurses with regard to prevention of VAP among neonates was possible and regarded as beneficial for the unit in terms of improving the quality of care of ventilated neonates and prevention of VAP which is a Hospital Acquired Infection.

As the nurses are engaged in the continuous care of ventilated neonates in NICU for 24 hours, adequate knowledge and practice of VAP prevention strategies will help to decrease the VAP burden in the neonatal ICU (NICU). Neonates are not small adults and are very delicate to handle. Thus, the nurses providing care at the NICU should be equipped with thorough knowledge and possess effective skills for preventing VAP. With this view in mind, this study was conducted to find out if there will be any significant difference in the knowledge and practice of the staff nurses of NICU regarding prevention of VAP in neonates after the implementation of the educational intervention, thus contributing to the sensitization of the registered nurses for routine assessments for VAP findings among the intubated neonates on mechanical ventilator.

Testing of Hypothesis

The study was designed to test two hypotheses at 0.05 level of significance.

H_1: There will be a significant difference between pre-test and post-test knowledge scores of staff nurses regarding prevention of VAP among neonates in a selected NICU of a tertiary care hospital, Udupi, Karnataka.

H_2: There will be significant difference in the pre-test and post-test practice scores of the

staff nurses in the selected NICU of a tertiary care hospital, Udupi, Karnataka.

Methodology

This study adopted one group pre-test post-test pre-experimental design. The setting chosen for the present study is a Level IIIA Neonatal Intensive Care Unit (NICU) of a tertiary care hospital, Karnataka, under accreditation by the National Neonatal Forum of India. Fifty staff nurses were selected using non-probability purposive sampling technique. Inclusion criteria were the staff nurses who were present at the time of data collection, willing to participate in the study, registered as Diploma, B.Sc. or M.Sc. in Nursing and involved in the care of ventilated neonates (direct patient care allocation).

Data Collection Tools: Researcher developed demographic proforma, structured knowledge questionnaire and observational checklist on VAP prevention were used for data collection. The demographic proforma consisted of items like age (in years), professional education, religion, work experience as a critical care nurse, attended previous training on VAP, source and time of previous training if attended, average number of neonates allotted for care per shift, awareness of presence of regular in-service education on VAP and its prevention (frequency of in-service education) and awareness of the availability of an organisational policy on VAP. The structured knowledge questionnaire consisted of 34 multiple choice items with one correct answer for each. Each correct answer carries one mark and zero for the wrong answer. The knowledge score was classified arbitrarily as "Good", "Average" and "Poor" with scores ranging from 27-34, 20-26 and <20 respectively. The observational checklist consisted of 33 items each with a score of 1 and 0 for "Yes" and "No" respectively. The total score of the checklist was 33. The practice scores were classified arbitrarily as "Satisfactory (≥70%)" and "Unsatisfactory (<70%)". The validity of the tools was ensured by giving to six experts. The Scale Content Validity Index (SCVI) of the demographic proforma, structured knowledge questionnaire and observational checklist was 1, 0.98 and 0.99 respectively. The tools were pre-tested among 5 staff nurses and found appropriate for use. Reliability of the tools was found to be 0.76 (knowledge questionnaire) and 1 (observational checklist) using split half method and inter-rater reliability tests respectively

Educational intervention: The central objective of the educational intervention was to enable the participants to gain adequate knowledge on Ventilator Associated Pneumonia (VAP) and its prevention as well as to enable them to apply the knowledge into practice to prevent VAP in NICU. To achieve the central objective, the educational sessions covered topics such as epidemiology of VAP among neonates, meaning and definition of VAP, risk factors for development of VAP, pathogenesis of VAP, brief description of mechanical ventilation in neonates and VAP preventive strategies based on Centres of Disease Control and Prevention (CDC) guidelines including early detection of signs and symptoms of VAP.

Ethical Consideration: Permission was obtained from the Institutional Ethics Committee (IEC no.753/2017) and registered under Clinical Trial Registry of India (CTRI) (Reg.no CTRI/2017/12/010875) following which the study was conducted from 29 December 2017 to 20 February 2018. Informed consent was obtained from each participant after explaining the participant information sheet before data collection.

Data Collection procedure: The pre-test data collection began from 29 December 2017 to 10 January 2018 by administering the demographic proforma and the knowledge questionnaire to the staff nurses and observation of the practices of individual staff nurse while taking care of the ventilated neonate. Observation of the practices was done on a one to one basis throughout the participant's duty hours. Each participant was observed only once. On completion of pre-test data collection of all fifty participants, the educational sessions were conducted. The sessions were given from 10 January 2018 to 18 January 2018 in the NICU classroom. The classes were taken based on the time convenient to the participants without compromising care of the babies in NICU, usually once in every shift. Each class was for a minimum duration of one hour. Once all the participants had been given the educational intervention, the post-test was conducted after 10 days of receiving the educational intervention i.e., from 20 January 2018 to 20 February 2018 by using the same knowledge questionnaire and observational checklist.

Statistical analysis: Data were analysed using SPSS version 16.0. Frequency and percentage of

pre-test and post-test knowledge and practice scores were calculated. Paired t-test and Wilcoxon sign rank test were computed to find the effectiveness of the educational intervention. The associations between the variables were computed by means of Pearson Chi-Square test (χ^2) as well as Fisher's exact test where appropriate. A p value of <0.05 (95% confidence interval) was considered statistically significant.

Results

The results of the study can be explained under the following main headings as follows:

Description of sample characteristics: The data obtained from the demographic proforma showed that 88% of the participants (44 out of 50) were between the age group of 23-34 years (23 and 46 years were minimum and maximum age respectively), 28(56%) were Diploma holders in Nursing, 20(40%) were B.Sc. Nursing degree holders and 2(4%) were M.Sc. Nursing degree holders. Majority of the participants had 1-10 years (84%) years of work experience as a critical care nurse. Only 3(6%) had previous training on prevention of VAP in CNE classes which were held 6 months before, 47(94%) were allotted 3 babies for care per shift. According to 10% (5) of the participants there is regular in-service education on prevention of VAP and 3 (6%) out of 5 participants said in-service education on prevention of VAP use to be held once in every 6 months and 2 (4%) said it use to be held once a year, 22 (44%) were not aware of the nonexistence of an organisational policy on VAP and its prevention in NICU, 16(32%) were aware that there is no policy on VAP and its prevention in NICU and 12(24%) were not sure of the presence of organisational policy. **(Table 1).**

Table 1: Frequency and Percentage Distribution of sample characteristics. N=50

Participant characteristics	***Frequency***	***Percentage(%)***
Age(years)		
23-33	44	88
34-47	6	12
Professional Education		
Diploma in Nursing	28	56
B.Sc. Nursing	20	40
M.Sc. Nursing	2	4
Religion		
Christian	17	34
Hindu	33	66
Muslim	0	0
Others	0	0
Work Experience		
<1 year	4	8
1-10 years	42	84
11-26 years	4	8
Previous Training on VAP		
Yes	3	6
No	47	94
Where was previous training on VAP done?		
CNE Class	3	6
Not attended	47	94
When was previous training done?		
6 months back	3	6
Not attended	47	94
Babies allotted for care per shift/nurse		
1	0	0
2	3	6
3	47	94
4	0	0
Do you have regular in-service		

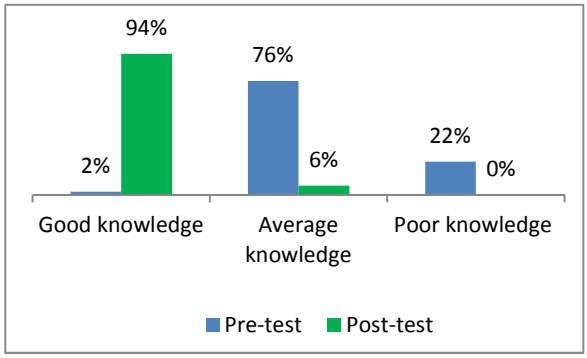
education on prevention of VAP?		
Yes	5	10
No	45	90
Frequency of in-service education on prevention of VAP		
No	45	90
Once in 6 months	3	6
Once in a year	2	4
Awareness of availability of organisational policy on VAP		
Yes	22	44
No	16	32
Not sure	12	24

Description of knowledge level of the participants: The mean knowledge score of the participants had increased from 21.44±3.06 to 30.26±2.46. The maximum and minimum pre-test knowledge scores were 30 and 13 respectively and that of the post-test were 34 and 24 respectively **(Table 2)**. Out of 50 participants, only 1 (2%) had good knowledge, 38 (76%) had average knowledge and 11 (22%) had poor knowledge in the pre-test. Whereas the post test results show improvement in knowledge of the participants accounting to 47 (94%) having good knowledge and 3(6%) average knowledge. **(Figure 1)**

Table 2: Mean, Standard Deviation, Maximum and Minimum scores of pre-test and post-test Knowledge scores

	Mean ± Standard Deviation	Maximum score (34)	Minimum score (0)
Pre test	21.44±3.06	30	13
Post test	30.26±2.46	34	24

Figure 1. Bar diagram depicting the percentage distribution of pre-test and post-test knowledge scores of the staff nurses on prevention of VAP in neonates. *N=50*



*Description of practices of the participants***:** According to the scores in the observational checklist, practice has been categorised into satisfactory (≥70%) and unsatisfactory (<70%). With the help of descriptive statistics, the frequency and percentage distribution of the participants' pre-test and post-test practice scores have been identified as depicted (**Table 3).** The median score prior to the intervention was 21 (interquartile range, Q1=20, Q3=22.5) and after the intervention it was 24 (interquartile range, Q1=23, Q3=25) **(Table 4)**

Detailed analysis in terms of frequency and percentage of each observation in the checklist showed that there was increase in the post test practice of keeping the head end elevated between 15-30^{o}, decontaminating respiratory equipment with germicidal wipes, draining of tubing condensation away from patient without opening circuit routinely before care and before position changes, meticulous hand hygiene before and after oral care, after contact with any source of microorganisms and after removing gloves, meticulous hand hygiene before and after suctioning the ET tube and after touching potentially contaminated objects, inhibition of saline lavage prior to suctioning, suctioning as clinically needed and suctioning oral cavity after oral care and mouth before nose, suctioning using a negative suction pressure of <100 mm of Hg, assessing feeding tube placement before each feed

or after every two feeds, providing tube feeding with head of bed elevated between 15-30^{o}, washing hands before and after contact with the neonate. **(Table 5)**

However, certain areas of practice which needs further improvement included routine provision of [developmentally appropriate] oral care very three to four hours, following tongue cues and avoid gagging infant during oral care, recognizing and informing physician of infant readiness to trial off the ventilator, enhancing use of minimally invasive ventilator support techniques, checking for aspirates before feeding (unless contra-indicated) and documenting the same with date and time. With regard to the documentation of the care given it was found that there was no documentation for HOB (head of bed) elevation and oral care. However, documentation was done appropriately for suctioning, ventilator and warmer maintenance. It was also noted that among 50 participants, only 10 routinely practiced checking of aspirates before feeding but none of them documented after checking the aspirates. **(Table 5)**

Table 3: Frequency and percentage distribution of the pre-test and post-test practice scores

N=50

Practice (Maximum score 33)	Pre test		Post Test	
	Frequency	Percentage	Frequency	Percentage
Satisfactory (≥70%)	12	24	49	98
Unsatisfactory (<70%)	38	76	1	2

Table 4: Description based on pre-test and post-test practice scores.

N=50

VAP Prevention practices	Maximum score (33)	Minimum score (0)	Mean ± SD	Median	Inter Quartile Range(Q1-Q3)
Pre test	25	15	20.94±1.93	21	20, 22.5
Post test	30	21	24.50±1.53	24	23, 25

Table 5: Item-wise frequency and percentage distribution of practice scores on prevention of VAP in neonates

N=50

Practice items	*Pre test*				*Post test*			
	Yes		*No*		*Yes*		*No*	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Head end elevation	35	70	15	30	46	92	4	8
Changes resuscitation bags	0	0	50	100	0	0	50	100
Decontamination of respiratory equipment	30	60	20	40	39	78	11	22
Drain tubing condensation away from patient.	5	10	45	90	26	52	24	48

Routinely provides [developmentally appropriate] oral care	0	0	50	100	5	10	45	90
Follows tongue cues and avoids gagging infant during oral care.	0	0	50	100	5	10	45	90
Meticulous hand hygiene before and after oral care, after contact with any source of microorganisms and after removing gloves.	21	42	29	58	34	68	16	32
Single use of products such as sponge applicator or gauze for every swab into mouth.	50	100	0	0	50	100	0	0
Meticulous hand hygiene before and after suctioning the ETT and after touching potentially contaminated objects.	21	42	29	58	35	70	15	30
Does not performing saline lavage prior to suctioning.	47	94	3	6	48	96	2	4
Suction as clinically needed and oral cavity after oral care and mouth before nose.	27	54	23	46	44	88	6	12
Suctioning performed using pressure of <100 mm of Hg	33	66	17	34	49	98	1	2
Recognizes and informs physician of infant readiness to trial off the ventilator	0	0	50	100	2	4	48	96
Enhances use of minimally invasive ventilator support techniques.	0	0	50	100	2	4	48	96
Assess feeding tube placement before each feed or after every two feeds	16	32	34	68	45	90	5	10
Checks for aspirates and documents the same with date and time.	10	20	40	80	14	28	36	72
Provides tube feeding with head of bed elevated between 15-30^{o}	35	70	15	30	47	94	3	6
Adequate amount of sterile water is used in humidifiers	45	90	5	10	50	100	0	0
Washes hands before and after contact with the neonate	18	36	32	64	30	60	20	40
Washes hands after contact with body fluids and patient articles.	48	96	2	4	50	100	0	0

Effectiveness of the educational intervention: The intervention was effective in terms of improving the knowledge as well as practice of the staff nurses on prevention of VAP among neonates.

The normality of the data on knowledge scores was tested using Shapiro Wilk test and the data

were found to be normally distributed. So, using Paired t-test, the effectiveness of the educational intervention on the knowledge of the staff nurses was tested and it was found that there was a significant difference in the knowledge of the nurses after the intervention(t= -17.238, p<0.01) **(Table 6)**. Thus, the stated research hypothesis 1 was accepted.

Normality of the data related to the practice scores was tested using Shapiro Wilk test and the data were not found to be normally distributed. So, using Wilcoxon sign rank test the effectiveness of the educational intervention on practice of the staff nurses regarding VAP prevention was analysed and it showed that there was a significant difference in the practice scores of the nurses after the intervention (z= -6.180, p<0.01) **(Table 7)**. Thus, hypothesis 2 was accepted suggesting the improvement in VAP preventive practices among the staff nurses of NICU.

Table 6: **Paired t-test values computed between the pre-test and post-test knowledge scores**

N=50

Total scores Maximum score 34 Minimum score 0	Mean	Standard Deviation	Paired t-test value (t)	p- value
Pre test	21.44	3.058	-17.238	0.001
Post test	30.26	2.456		

*p<0.05

Table 7: Wilcoxon's sign rank values computed between pre-test and post-test practice scores

N=50

Total scores Maximum score 33 Minimum score 0	Median	Inter-quartile range(Q1-Q3)	Wilcoxon Sign Rank value(z)	p- value
Pre test	21	20-22.5	-6.180	0.001
Post test	24	23-25.0		

*p<0.05

Associations of study variables with demographic variables: The study findings highlighted an absence of a significant association between pre-test knowledge level and age, professional education, years of work experience as a critical care nurse, previous training of the staff nurses on VAP and its prevention and number of babies allotted for care to staff nurses per shift (p>0.01) as measured using Chi-square test of association. The pre-test practices of the nurses were found to be associated with the age of the participants (χ^2*=6.805, p=0.024)*. However, no significant association between the pre-test practice of the nurses and the demographic variables as well as between pre-test knowledge and practice of the participants was noted in the study findings.

to assess its impact on the knowledge and practice of the staff nurses of a Neonatal Intensive Care Unit (NICU). The study findings revealed that majority 38(76%) of the participants had average knowledge, 11(22%) had poor knowledge and only1(2%) had good knowledge on VAP prevention among neonates prior to the educational intervention with a mean score of *21.44±3.06 (Maximum score 30 and minimum 13).* Similar to our study findings, El-Khatib, Husari, & Bou-Khalil, (2010) who aimed to assess their knowledge on evidenced based VAP prevention guidelines reported inadequate knowledge of all the 41 nurses who were recruited for the study having a mean percentage score of 71.8% ± 10.6. Ali, (2013) also reported unsatisfactory knowledge scores (mean= 7.46 ± 2.37) of the nurses and non-adherence to ventilator associated pneumonia bundle practices by the nurses. (mean = 8.62 ± 7.9 out of 29).

Discussion: In this study an educational intervention on prevention of VAP among neonates was designed

The practices adopted by majority of the nurses 38 (76%) to prevent VAP among neonates in NICU prior to the intervention were found to be unsatisfactory. Only 12(24%) had satisfactory practice scores. The median score prior to the intervention was 21 (interquartile range, Q1=20,

Q3=22.5). Heyland, Cook, & Dodek, (2002) reported similar findings in which it was found that the existing practices among the hospitals to prevent VAP were not sufficient to prevent VAP among the patients. Another supporting study by Sierra, Benítez, León, & Rello, (2005**)** also showed that VAP prevention strategies differed among the ICUs and were not as per the evidenced based recommendations and guidelines. An observational cross sectional study conducted by Gonclaves, Brasil, Ribeiro, & Tipple from October 2010 to January 2011 in Brazil focusing on nursing actions for the prevention of Ventilator Association Pneumonia showed that most of the procedures like bronchial hygiene, mouth care, head of bed elevation, handling mechanical ventilator circuit were not followed by the nurses.

With regard to the effectiveness of the educational intervention on the knowledge and practice of the staff nurses on prevention of VAP in neonates, the present study findings showed improvement in the knowledge and practice scores of the nurses after the educational sessions($p<0.01$ at 0.05 level of significance). In the study of Meherali, Parpio, Ali, & Javed, (2011) to investigate the effectiveness of a teaching module on nurses' knowledge to practice evidence based guidelines for the prevention of VAP, the post-tests scores were better than the pre-test scores although there was a decrease in the post-test scores conducted after 4 weeks of the intervention as compared to post-test conducted immediately after the intervention (pre-test= 7.8±2.9, post-test 1=10.8±2.0 & post-test 2= 9.8±2.1). Gatell, et al.(2012) had conducted their study to assess the impact of a training session on knowledge of the nurses working in a 16 bedded medical surgical ICU in Spain and it reported that the training programme had a significant effect on the knowledge of the staff nurses as the post-test knowledge scores were higher than the pre-test scores (17·87±2·69 versus 15·91±2·68; p=0·002). Yuvaraja, Sivakumar, & Balasubramanian, (2016) found a significant increase in knowledge level ($p<0.01$) of the critical care nurses after the implementation of a teaching module on International Nosocomial Infection Control (INICC) guidelines. In the study of Danchaivijitr, Assanasen, Apisarnthanarak, Judaeng, & Pumsuwan, (2005), the educational intervention on modifiable risk factors in preventing VAP among ventilated patients had a significant effect in reduction of VAP rates among ventilated patients and hence it can be used as an intervention in VAP reduction in the hospitals. The implementation of a multi-dimensional educational program which included infection control bundle interventions, education, process and outcome evaluation, VAP rates feedback, feedback of infection control practices performance in Pediatric Intensive Care Units (PICU) of five developing countries showed reduction in VAP rate by 31% after the intervention. VAP rate was 11.7 per 1000 ventilator days before the implementation of the program and 8.1 per 1000 ventilator days after the intervention (Rosenthal, et al., 2012)**.**

With regard to the documentation of the care given being provided to the ventilated neonates it was found that there was no documentation for HOB (head of bed) elevation and oral care. Morinec, Iacaboni, & Molley, (2012) also reported lack of documentation of oral care, repositioning, HOB elevation, suctioning method, suctioning two hourly cuff checks, circuit changes and condensation removal by majority of the participants inspite of rountinely performing these interevntions among the ventilated patients.

Thus, the results of the present study indicated that the educational intervention was effective in terms of improvement in the knowledge and practice of the staff nurses on prevention of VAP among neonates.

Study limitations

The study was done with a small sample size (50), so the findings of the study cannot be generalised and limited only to the population under study. Also practice may differ according to hospital policy. The study was time bound, one participant was observed only once which causes a restriction in the generalisation of their practice. It was conducted in one setting only hence there was possibility of contamination within the study samples. The chances of extraneous variables like internet, help from senior staff nurses, etc. influencing the participants' knowledge and practice were more.

Conclusion

This study aimed to improve the knowledge and practice of the staff nurses working in NICU of the selected tertiary hospital on prevention of VAP in neonates by an educational intervention. The main strategies used in this study were assessing the pre-test knowledge and giving the educational intervention in order to improve the knowledge and practice on prevention of VAP in neonates. It was found that the knowledge and practice of the staff nurses were improved after the educational intervention.

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