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Knowledge, Adherence and Barriers towards the Prevention of Ventilator Associated Pneumonia among Nurses

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Abstract: ***Ventilator associated pneumonia (VAP) is a common and potentially fatal complication that often encountered within intensive care units (ICU). Prevention of VAP is considered a priority among ICU nurses and measures to prevent VAP are therefore a significant component of nursing care. The study aimed at finding out the knowledge, adherence and barriers towards prevention of Ventilator associated pneumonia among nurses. A descriptive cross-sectional study was carried out among 136 nurses working in critical care units of Chitwan Medical College Teaching Hospital and College of Medical Sciences Teaching Hospital, Chitwan in which semi-structured self administered questionnaire was used. Data were statistically analyzed by using descriptive statistics and chi-square test. The study findings revealed that 14.7% of respondents had good level of knowledge and more than half (51.5%) of the respondents had low adherence towards prevention of VAP and the major barriers towards prevention of VAP were lack of VAP guidelines (70.6%), lack of guidance (72.8%), lack of training (72.8%), influence from senior/peer practice (64%), lack of time (77.2%), lack of adequate resources (100%) and inadequate staff (89.7%).There was statistically significant association between adherence status towards prevention of VAP and level of education (p<0.001) and availability of guidelines for VAP prevention (p=0.006).***

Keywords: Adherence, Barriers, K nowledge, Nurses, Ventilator Associated Pneumonia

1. Introduction

Ventilator associated pneumonia (VAP) is a form of hospital acquired infection that develops in patients receiving invasive mechanical ventilation, either through an endotracheal or tracheostomy tube, for more than 48 hours (Bouadma, Wolff & Lucet, 2012).

VAP is the second most common nosocomial infection after urinary tract infection in intensive care unit patients accounting for 20% of nosocomial infection in this population and is the leading cause of death among nosocomial infections (Augustyn, 2007). The reported incidence of VAP among patients who require invasive mechanical ventilation ranges from 10 to 65% (O'Keefe-McCarthy et al., 2008).

VAP carries a high mortality rate ranging 6% - 68% and may be as high as 74% in high risk populations, indicating a serious health hazard among ventilated patients. It is the leading cause of death, exceeding rates of death that are secondary to respiratory tract infections in non-intubated patients, central line infections, and severe sepsis (Sedwick et al., 2012).

VAP is a preventable secondary consequence of the initiation of invasive mechanical ventilation that has been linked to the quality of care provided by healthcare providers (Augustyn, 2007). Knowledge of evidence based guidelines on the prevention of VAP and adherence to them would reduce the risk of occurrence of VAP and decrease morbidity and mortality of mechanically ventilated patients in the ICU (Kim, Leal, Halevy, Gomes & Lev, 2010).

Nurses typically provide more bedside hours of care than other healthcare providers, thus their clinical practices can have a substantial impact on the prevention of VAP in mechanically ventilated patients. Routine critical care nursing interventions have been shown to reduce the incidence of VAP (Ricart, Lorente, Diaz, Kollef & Rello, 2003).

Unfortunately little is known about the degree of nursing knowledge on evidence based guidelines for the prevention of ventilator associated pneumonia and about factors that can contribute or represent barriers to their implementation. Understanding the importance of recommended practices increases the likelihood of adherence and may overcome barriers to implementation (Freire et al., 2010).

Prevention and control of VAP are dependent on education, attitudes and knowledge of nurses about VAP issues (Jordan et al., 2014). The lack of knowledge may be a barrier towards adherence to implementation of VAP bundle (El-Khatib, Zeineldine, Ayoub, Husari & Bou-Khalil, 2010).

2. Literature Survey

Yaseen and Salameh (2015) concluded that the mean of the total knowledge score among critical care nurses regarding knowledge towards adherence to VAP guidelines was 7.13 (±1.36). More experienced nurses performed significantly better than their less experienced colleagues ($p<0.05$), and mean of total knowledge score for diploma nurses was significantly lower than for Bachelor and Graduate degree nurses. The main barriers to adherence to VAP guidelines were lack of VAP courses and nursing shortages.

Ahmed and Abosamra (2015) revealed inadequate knowledge of pediatric critical care nurses regarding evidence based guidelines for prevention of ventilator associated pneumonia. There was strong correlation between years of experiences, previous training on guidelines of prevention of VAP and knowledge of nurses on the evidence based guidelines for prevention of VAP. Moreover, there was no correlation between age and knowledge of nurses on evidence based guidelines for prevention of VAP.

Jansson, Ala-Kokko, Yilpalosarri, Syrjala and Kyngas (2013) conducted a study which stated that the mean score in the knowledge towards evidence based guidelines for the prevention of VAP was 59.9%. More experienced nurses performed significantly better than their less-experienced colleagues (p = 0.029). The overall, self-reported adherence was 84.0%. The main self-reported barriers towards evidence-based guidelines were inadequate resources and disagreement with the results as well as lack of time, skills, knowledge and guidance.

Ali (2013) conducted a descriptive study revealed the unsatisfactory knowledge scores (mean= 7.46 + 2.37) and most of the nurses were not compliant with ventilator associated pneumonia bundle practices (average mean = 8.62 + 7.9 out of 29) and there was no specific protocol to follow for VAP prevention.

Said (2012) conducted a study concluded the level of knowledge scored among Intensive care (ICU) nurses at Muhimbili National Hospital. 54.2% scored excellent, 19% scored very good, 19.5% scored between good, 8.5% scored average and 1.7% scored poor. No association between knowledge and years of working experience (p- value 0.34), ICU training (p- value 0.64) and level of education (p- value 0.55). ICU nurses' practice on prevention of VAP was statistically associated with education level (p- value 0.03) but not associated with ICU training (p- value 0.53) and years of work experience (p- value 0.64).

Sedwick et al. (2012) conducted a study stated that compliance rates among nurses in critical care units was greater than 98% for prophylaxis for peptic ulcer disease and deep-vein thrombosis, interruption of sedation, and elevation of the head of the bed. The compliance rate for the oral care protocol increased from 76% to 96.8%.

3. Materials and Methods

It was a descriptive cross sectional study. The study was carried out at Chitwan Medical College Teaching Hospital and College of Medical Sciences Teaching Hospital, Bharatpur, Chitwan. The study populations were all the nurses working in critical care units of CMCTH (Medical ICU, Neonate ICU and Cardiac ICU) and CMSTH (General ICU, Medical ICU, Neurosurgery ICU, Surgery ICU, Neonate ICU and Cardiac ICU). All 136 nurses working in critical care units of Chitwan Medical College Teaching Hospital and College of Medical Sciences Teaching Hospital were selected for study sample. Approval from Chitwan Medical College- Institutional Review Board was taken prior to the study. Pretested self administered questionnaire was given to fill the answer to each respondent. Data were coded and entered in EPI 3.1 and was exported into IBM SPSS 20 version for analysis. Descriptive statistics and inferential statistics i.e. chi square was used for data analysis.

4. Results

Table 1: Socio-demographic Characteristics of the Respondents, n=136

Variables	Frequency	Percentage
Age group in completed years		
< 20	29	21.3
20-25	82	60.3
≥25	25	18.4
Mean±SD=22.7±3.05		
Level of education		
PCL nursing	90	66.2
Bachelor nursing	46	33.8
Total work experience in years		
≤ 3	125	91.9
>3	11	8.1
Present working area		
Medicine Intensive Care Unit	52	38.2
Surgery Intensive Care Unit	13	9.6
Neurosurgery Intensive Care Unit	11	8.1
Neonate Intensive Care Unit	24	17.6
Cardiac Care Unit	26	19.1
General Intensive Care Unit	10	7.4
Guidelines for VAP prevention in ward		
Yes	10	7.4
No	126	92.6

Table 1 shows that out of 136 respondents, 60.3% of respondents were between age group of 20-25 years. Regarding level of education, 66.2% of respondents had completed PCL nursing and majority of respondents (91.9%) had work experience of less than or equal to 3 years. In regards to present working area, 38.2% of the respondents were working in Medical Intensive Care Unit followed by 19.1% in Cardiac Care Unit and 7.4% of respondents were working in General Intensive Care Unit. Concerning guidelines for VAP prevention in the ward, 92.6% of respondents had no VAP guidelines in their ward and none of the respondents had taken training on VAP prevention (not shown in table).

Table 2: Respondents' Knowledge Score regarding Prevention of VAP

Knowledge towards the prevention of VAP	*Mean Score ±SD*	*Mean score Percentage*	*Range*	*Maximum possible score*
Ventilator Associated Pneumonia	6.20±2.28	56.36	1-11	11
Component of VAP bundle	2.80±1.39	46.66	0-6	6
Knowledge on VAP	**9.01±3.22**	**53.0**	**3-17**	**17**
Oral care and positioning	2.36±1.11	59.0	0-4	4
Suctioning	3.99±1.41	66.5	1-6	6
Sedation vacation and spontaneous breathing trial	1.26±0.85	63.0	0-2	2

Ventilator humidifier and cuff pressure	1.26±1.1	42.0	0-3	3
Intervention before NG feeding and medicine increasing risk of VAP	1.07±0.68	53.5	0-2	2
Knowledge on prevention of VAP	**9.96±3.55**	**58.58**	**4-17**	**17**
Total	**18.97±5.67**	**55.79**	**9-33**	**34**

Table 2 shows the mean knowledge score of respondents on prevention of VAP. The mean knowledge score of the respondents regarding Ventilator associated pneumonia (definition, causative organism, sign and symptoms, predisposing factors and component of VAP bundle) was 9.01 with 3.22 of standard deviation, 53% of mean score, range 3-17 and maximum possible score is 17. As the percent of mean score was more than 50, it was found that respondents had fair level of knowledge regarding knowledge on ventilator associated pneumonia.

The mean knowledge score of the respondents regarding prevention of ventilator associated pneumonia (oral care and positioning, suctioning, Sedation vacation and spontaneous breathing trial, Ventilator humidifier and cuff pressure, Intervention before NG feeding and medicine increasing risk of VAP) was 9.96 with standard deviation of 3.55, 58.58% of mean score, range 4-17 and maximum possible score is 17. As the percent of mean score was more than 50, it was found that respondents had fair level of knowledge regarding knowledge on prevention of ventilator associated pneumonia.

The total mean knowledge score of the respondents was 18.97 with 5.67 of standard deviation, 55.79% of mean score, range 9-33 and maximum possible score is 34. As the percent of mean score was more than 50, it was found that respondents had fair level of knowledge regarding prevention of ventilator associated pneumonia.

Table 3: Respondents' Level of Knowledge towards the Prevention of VAP

Level of knowledge	Frequency	Percentage
Good knowledge	20	14.7
Fair knowledge	64	47.1
Poor knowledge	52	38.2
Total	136	100.0

Table 3 shows that out of 136 respondents, 47.1% respondents had fair level of knowledge, 38.2% of respondents had poor level of knowledge and only 14.7% of respondents had good level of knowledge.

Table 4: Respondents' Adherence towards the Prevention of VAP

Statements	Responses				
	Never	Rarely	Sometimes	Often	Always
	n(%)	n(%)	n(%)	n(%)	n(%)
Semi-recumbent positioning of the patient	6(4.4)	6(4.4)	49(36)	38(27.9)	37(27.2)
Use of chlorhexidine solution for oral care to the patient	3(2.2)	3(2.2)	28(20.6)	31(22.8)	71(52.2)
Use of sterile gloves during ET suctioning	-	1(0.7)	26(19.1)	60(44.1)	49(36.0)
Hand hygiene after removing gloves	1(0.7)	-	2(1.5)	17(12.5)	116(85.3)
Hand hygiene before patient contact	2(1.5)	16(11.8)	98(72.1)	12(8.8)	8(5.9)
Hand hygiene after patient contact	-	-	7(5.1)	91(66.9)	38(27.9)
Hand hygiene between the patients	2(1.5)	67(49.3)	59(43.4)	4(2.9)	4(2.9)
Suctioning along with another nursing staff	-	7(5.1)	97(71.3)	22(16.2)	10(7.4)
Maintaining sterility of suction catheter until inserted into airway	1(0.7)	-	5(3.7)	90(66.2)	40(29.4)
Draining condensate that collects in ventilator circuit	20(14.7)	-	1(0.7)	3(2.2)	112(82.4)
Maintaining adequate cuff pressure in the endotracheal tube cuff using manometer	136(100)				
Providing chest physiotherapy to the patient	1(0.7)	2(1.5)	94(69.1)	35(25.7)	4(2.9)
Checking the gastric residual volume prior to feeding	-	1(0.7)	16(11.8)	77(56.6)	42(30.9)
Daily interrupting in sedation using sedation scale	113(83.1)	2(1.5)	10(7.4)	3(2.2)	8(5.9)
Performing daily assessments of readiness to wean and extubate	64(47.1)	14(10.3)	20(14.7)	10(7.4)	28(20.6)

Table 4 shows the respondents adherence towards prevention of VAP. Out of 136 respondents, 36% of respondents answered that they sometimes place the patient in semi recumbent position if not contraindicated. More than half of the respondents (52.2%) answered that they always use chlorhexidine solution for oral care. Regarding the use of sterile gloves, 44.1% of respondents answered that they often wear sterile gloves during suctioning. Regarding hand hygiene, 85.3% of respondents answered that they always perform hand hygiene after removing gloves.

Regarding hand hygiene before patient contact, 72.1% of respondents answered that they sometimes perform hand hygiene before patient contact. Regarding hand hygiene after patient contact, 66.9% of the respondents answered that they often maintain adequate hand hygiene after patient contact. Almost half of the respondents (49.3%) answered that they rarely maintain adequate hand hygiene between the patients.

Regarding suctioning along with another nursing staff, 71.3% of respondents answered that they sometimes perform suctioning along with another nursing staff. As regard to the maintaining of sterility of suction catheter, 66.2% of respondents answered that they often maintained sterility until inserted into airway.

Regarding the draining of condensate from ventilator circuit, 82.4% of respondents answered that they always drain any condensate that collects in ventilator circuit. Cent percent of the respondents answered that they never maintained adequate cuff pressure in the endotracheal tube cuff using manometer. In regards to physiotherapy, 69.1% of

respondents answered that they sometimes provide chest physiotherapy to the patient. Regarding the intervention before NG feeding, 56.6% of respondents answered that they often check the gastric residual volume prior to NG feeding. Concerning sedation vacation, 83.1% of respondents answered that they never interrupt in sedation daily using sedation scale. Regarding the daily assessment of readiness to wean and extubate, 47.1% of respondents answered that they never perform daily assessments of readiness to wean and extubate.

Table 5: Respondents' Adherence Status towards the Prevention of VAP

Adherence status	Frequency	Percentage
High adherence	66	48.5
Low adherence	70	51.5
Total	136	100

Table 5 shows that out of 136 respondents, 51.5% of respondents had low adherence towards prevention of VAP whereas 48.5% of respondents had high adherence towards prevention of VAP.

Table 6: Respondents' Barriers towards Prevention of VAP, n=136

Variables	*Frequency*	*Percentage*
Semi-recumbent positioning of patient**		
Lack of VAP guidelines	96	70.6
Considered unnecessary	14	10.3
Use of chlorhexidine solution for oral care**		
Unavailability of chlorhexidine	45	33.1
Lack of VAP guidelines	58	42.6
Considered unnecessary	2	1.5
Influence from peer practice	43	31.6
Draining of condensate that collects in the ventilator circuit**		
Lack of time	2	1.5
Lack of proper guidance	20	14.7
Considered unnecessary	2	2.2
Maintining of adequate cuff pressure in the endotracheal tube**		
Unavailability of manometer	136	100
Lack of proper guidance	6	4.4
Considered unnecessary	1	0.7
Chest physiotherapy to the patient**		
Lack of necessary equipments for chest physiotherapy	2	1.5
Incompetent in providing chest physiotherapy	82	60.3
Lack of time	105	77.2
Inadequate staff	104	76.5
Checking the gastric residual volume prior to feeding**		
Lack of time	59	43.4
Lack of guidance	5	3.7
Influence from senior/peer practice	87	64
Considered unnecessary	3	2.2
Daily interrupting in sedation **		
No provision of sedation scale in ward	121	89
Patient's discomfort	12	8.8
Lack of guidance	85	62.5
Considered unnecessary	1	0.7
Performing daily assessments of readiness to wean and extubate		
Lack of guidance	99	72.8
Lack of training	99	72.8
Considered unnecessary	3	2.2

*** Multiple answer*

Table 6 shows that out of 136 respondents, 70.6% of respondents reported lack of VAP guidelines as the barrier for not always placing the patient in semi recumbent position. Regarding the use of chlorhexidine solution for oral care, 42.6% of the respondents reported the barrier as lack of VAP guidelines.

Regarding the draining of condensate that collects in the ventilator circuit, 14.7% of respondents reported lack of proper guidance as the barrier. Cent percent of the respondents reported unavailability of manometer as the barrier for not always maintaining adequate cuff pressure of endotracheal tube.

Concerning physiotherapy, 77.2% of respondents reported lack of time as a barrier for not always providing chest physiotherapy to the patient. Regarding the barrier for not always checking the gastric residual volume prior to NG feeding, 64% of the respondents reported influence from senior/peer practice as a barrier. In regards to sedation vacation, 89% of respondents reported no provision of sedation scale in ward as a barrier for not always interrupting in sedation. Regarding the barrier for not always assessing the patient for readiness to wean and extubate, 72.8% of respondents reported lack of guidance and lack of training as a barrier.

Table 7: Respondents' Barriers on Hand Hygiene and Suctioning, n=136

Barriers	*Frequency*	*Percentage*
Hand hygiene after removing gloves**		
Unavailability of hand hygiene resources	8	5.9
Basin far from bed side	19	14
Lack of time	3	2.2
Considered unnecessary	7	5.1
Hand hygiene before patient contact**		
Unavailability of hand hygiene resources	80	58.8
Basin far from bed side	115	84.6
Lack of time	85	62.5
Considered unnecessary	1	0.7
Hand hygiene after patient contact**		
Unavailability of hand hygiene resources	53	39
Basin far from bed side	86	63.2
Lack of time	57	41.9
Hand hygiene between the patients**		
Unavailability of hand hygiene resources	85	62.5
Basin far from bed side	118	86.8
Lack of time	99	72.8
Considered unnecessary	3	2.2
Use of sterile gloves during suctioning**		
Unavailability of sterile gloves	85	62.5
Considered unnecessary	8	5.9
Lack of time	3	2.2
Suctioning along with another nursing staff**		
Inadequate staff	122	89.7
Lack of time	70	51.5
Considered unnecessary	5	3.7
Influence from senior/peer practice	91	66.9
Maintenance of sterility of suction catheter**		
Unavailability of sterile gloves	95	69.9
Lack of proper guidelines	6	4.4
Considered unnecessary	4	2.9
Influence from senior/peer practice	27	19.9

*** Multiple answer*

Table 7 shows that concerning the hand hygiene, 14%, 84.6%, 63.2% and 86.8% of the respondents reported basin far from the bed side as the barrier for not always performing hand hygiene after removing gloves, before patient contact, after patient contact and between the patients respectively.

Regarding the barrier for not always using sterile gloves during suctioning, 62.5% of respondents reported unavailability of sterile gloves as a barrier. In regards to performing suctioning along with another nursing staff, 89.7% of respondents reported barrier as inadequate staff. Regarding barriers for not always maintaining sterility of suction catheter, 69.9% of respondents reported unavailability of sterile gloves as a barrier.

Table 8: Association of Socio-demographic variables with Respondents' Level of Knowledge towards Prevention of VAP

Variable	Level of knowledge			x^2	*p* – value
	Poor	Fair	Good		
Level of education				0.97	0.61
PCL	37(41.1)	40(44.4)	13(14.4)		
Bachelor	15(32.6)	24(52.2)	7(15.2)		
Total work experience in years				1.35	0.56
≤ 3	48(40)	55(45.8)	17(14.2)		
>3	4(25)	9(56.2)	3(18.8)		

Significance level at 0.05

Table 8 shows that there was no significant statistically association between level of knowledge towards prevention of VAP with level of education (p=0.61) and total work experience (p=0.56).

Table 9: Association of Socio-demographic Variables with Respondents' Adherence Status towards Prevention of VAP

Variable	Adherence Status		x^2	*p* – value
	Adherence	Non adherence		
Level of education			12.314	< 0.001
PCL	34(37.8)	56(62.2)		
Bachelor	32(69.6)	14(30.4)		
Guidelines in ward			7.432	0.006
Yes	9(90)	1(10)		
No	57(45.2)	69(54.8)		

Significance level at 0.05

Table 9 shows that regarding level of education, there was statistically significant association between adherence status towards the prevention of VAP and level of education (p<0.001) i.e. the nurses with bachelor qualification had adherence than the nurses with PCL qualification.

Regarding the availability of guidelines for VAP prevention in the ward, there was statistically significant association between adherence status towards the prevention of VAP and availability of guidelines for VAP prevention in the ward. i.e. the nurses who have guidelines in their ward have adherence towards prevention of VAP than the nurses without guidelines in their ward (p=0.006).

5. Discussion

The findings of the study showed that the mean knowledge score was 55.79%. This findings is not supported by Ali (2013) that revealed the mean score in the knowledge test was 79.9%. This variability in findings may be due majority of respondents having professional education of diploma level, less experienced respondents, unavailability of VAP guidelines in wards and lack of training.

The findings of the study revealed that there was no statistically significant association between level of knowledge and level of education (p=0.516) and total work experience (p=0.566). This finding is supported by Said (2012) that revealed that there was no association between knowledge and years of working experience (p- value 0.34) and level of education (p- value 0.55). Another study that doesn't support this findings is by Yaseen and Salameh (2015) that concluded more experiences collegues performed significantly better than their less experienced collegues (p= <0.05) and mean of total knowledge score for diploma nurses was significantly lower than bachelor degree.

The findings of the study revealed that 51.5% of respondents had low adherence towards prevention of VAP. This findings is not supported by Ricart et al. (2003) that showed the overall non adherence with evidence-based guidelines for preventing ventilator-associated pneumonia was 22.3%. Similarly this findings wasn't supported by Jansson et al. that showed the overall self-reported adherence was 84.0%. This variability in findings may be due to only one fourth of respondents having good level of knowledge, lack of training and unavailability of VAP guidelines in the ward.

The findings of the study revealed that there was statistically significant association between adherence towards the prevention of VAP and level of education (p<0.001) but not statistically associated with years of work experience (p=0.085). This findings is supported by Ricart et al. (2003) that revealed ICU nurses' adherence on prevention of VAP was statistically associated with education level (p- value 0.03) but not associated with years of work experience (p-value 0.64).

The findings of the study revealed that the main barriers towards prevention of VAP were lack of VAP guidelines (70.6%), lack of guidance (72.8%), lack of training (72.8%), influence from senior/peer practice (64%), lack of time (77.2%), inadequate staff (89.7%) and lack of adequate resources (100%) whereas the study by Jansson et al. (2013) revealed that the main barriers towards prevention of VAP were inadequate resources and disagreement with the results of previous studies, lack of time (14.3%), patient related barrier (14.3%), lack of skills (11.9%), guidance (7.1%), forgetfulness (7.1%) and lack of staff (4.8%).

6. Conclusion

Based on the discussion and findings of the study, conclusion has been drawn. Study shows that less than one third of the respondents have good level of knowledge. The study also shows that more than half of the respondents have low adherence towards prevention of VAP and there is statistically significant association of level of adherence with level of education and availability of guidelines on prevention of VAP in the ward. A number of barriers

towards prevention of VAP are identified. These findings point the need to upgrade nurses knowledge and reduce barriers to enhance the adherence of nurses towards prevention of VAP.

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