Original Article

Knowledge and Practices of Intensive Care Unit Nurses Related to Prevention of Ventilator Associated Pneumonia in Selected Intensive Care Units of a Tertiary Care Centre, India

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Abstract

Background: Ventilator-Associated Pneumonia (VAP) is a recognized nosocomial infection and a leading cause of high morbidity and mortality. Intensive Care Unit (ICU) nurses are in the best position to put the known evidence-based strategies into practice to prevent VAP. The aim of the present study is to assess the knowledge and practices of ICU nurses related to prevention of VAP in selected ICUs of a tertiary care centre in India (2013–2014) and to find out the association between knowledge and practices. **Materials and Methods:** A descriptive survey was conducted in the different ICUs of a tertiary care hospital in India. Purposive sampling technique was used and 108 ICU staff nurses were enrolled during the period of data collection. The tool used for data collection was a self-developed valid and reliable knowledge-based questionnaire and an observational checklist. The descriptive (frequency and percentages) and inferential (Chi-square test) statistics was used. **Results** Out of the 108 nurses enrolled in the study, 82 (75.93%) had average, 24 (22.22%) had good and only 2 (1.85%) of the ICU nurses had poor knowledge. Assessment of the practices revealed that 68 (94.44%) nurses had average and only 4 (5.55%) nurses had good practice. There was no association between the knowledge and practices of ICU nurses related to prevention of VAP. ($\chi^2 = 0.14$, $p = 0.710$). **Conclusions:** Although the nurses were having good to average knowledge scores, their practices were not associated with knowledge scores. There is a need to find out the ways that would help the nurses to adhere to good practices.

Keywords: *Cross infection, health knowledge, lung diseases, pneumonia ventilator-associated, respiratory tract infections*

Introduction

Ventilator-Associated Pneumonia (VAP) is a known nosocomial infection among the patients receiving mechanical ventilation.[1] According to National Healthcare Safety Network (NHSN), the incidence of VAP in various hospitals range from 0.0 to 4.40 per 1,000 ventilator days and the depending diagnostic criteria used the overall incidence is 5–65%.[2,3] It increases the length of hospital stay, morbidity, mortality as well as economic burden due to increased resource utilization. Fifteen to fifty percent patients having VAP die. The mortality and mortality varies with patient population and organism type.[4-7] One of the reason for VAP is the direct entry of bacterial organisms into lower respiratory tract through endotracheal tube that leads to an increased risk of pulmonary infections. Other risk factors for bacterial colonization include excessive mucus secretion and absence of the cough reflex among intubated patients. The Intensive Care Unit (ICU) nurses' provide bedside care 24 h a day; they have an integral role in the prevention, control, and treatment of hospital-acquired infections among intubated patients as they are in position to utilize known VAP prevention strategies into clinical practice. Awareness and knowledge related to VAP prevention strategies is of paramount importance for health care professionals to adhere to the best practices. Nurses knowledge should boost their own confidence for appropriate decision making and bring positive outcomes in the recovery of mechanically ventilated patients.[6]

The nurses working in critical care units are supposed to deliver high quality care

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by incorporating evidence based practices related to VAP prevention.[8] Studies have mentioned that despite having many evidence based guidelines on VAP prevention; lack of knowledge and compliance in nursing practices is a noticeable cause of VAP.[9,10] To improve patient outcome, nurses must possess adequate knowledge and follow correct practices. Keeping in view the role of nurses in the prevention of VAP and owing to lack of information about their knowledge and practices in India, the current study has been taken up with an objective to assess the knowledge and practices of intensive care nurses on prevention of VAP and to assess the association between knowledge and practice.

Materials and Methods

A descriptive cross-sectional study design was used to assess the knowledge and practices of ICU nurses related to prevention of VAP. The study was conducted at selected ICUs of a tertiary care center (Postgraduate Institute of Medical Education and Research, Chandigarh) in India in the year 2013–14. Main ICU, respiratory intensive care unit, liver intensive care unit, adult gastroenterology intensive care unit, burn ICU, neuro ICU, trauma ICU, cardiothoracic and vascular surgery intensive care unit, and cardiac care units were selected. The patients who were hemodynamically unstable and met the criteria for the need of ventilation were put on ventilator. The ventilators in use and nurse is to patient ratio were of nearly the same in all ICUs. Generally, in each shift, one bed side nurse (sister grade 2) provides care to two patients on ventilator or three patient who are stable and are not on ventilator. The data was collected only in the morning hours in the respective ICU o. In each shift, overt and non-participatory observations were made on one to one basis. In each ICU, one or two nurses, who gave consent and were looking after ventilated patients, were observed followed by assessment of knowledge. As per CDC, VAP prevention guidelines, each patient must receive a bundle of care to prevent VAP, henceforth, it is assumed that all nurses must adhere to those practice guidelines and possess appropriate knowledge.

To estimate a proportion with an approximate 95% confidence level, following formula was used $n = 4pq/d^2$ (Where n = required sample size, p = proportion of the population having the characteristic, q = 1-p and d = the degree of precision-taken as 0.05). In each ICU 35–40 nurses work, out of which 2–5 nurses are either senior or remain on leave. Thus, considering 30 nurses in each ICU, a total of 270 nurses were eligible. The proportion (p) of ICU nurses was 0.09, q = 1-0.09 = 0.91. After putting the values in the given formula, the sample size came out to be 131. Although, the purposive sampling technique was used but due to limited period of data collection a total of 108 nurses were enrolled.

Knowledge and practice based questionnaire and observation checklist were developed by using CDC guidelines and extensive review literature. The knowledge questionnaire consisted of 37 multiple choice questions (MCQs) related to prevention of VAP. Each correct response was scored as one and the maximum score was 37. The level of knowledge was classified as poor (<50%), average (50–75%), good (75–100%). The practices were assessed by observation checklist. Each correct action was scored as one and the maximum score was 45. Level of practices was classified as poor (<50%), average (50–75%), and good (75–100%). To establish validity the tool was given to nursing and medical experts. The content validity index (CVI) of tool was >0.75 and the reliability was 0.86 by split half method. The paper and pencil technique was used for knowledge assessment. During data collection, all the enrolled nurses were not assigned to provide care to the patients on ventilator, this is the reason the practices of only 72 nurses were observed. To prevent bias the practices were assessed in the morning hours, that is first 4 hours, as this was the time when nurses were performing most of the routine activities. The last one hour of morning shift was utilized to assess knowledge. The data was analyzed by using Statistical Package for the Social Sciences (SPSS) 17 produced by SPSS Inc. (a software house headquartered in Chicago and incorporated in Delaware) and now acquired by International Business Machines Corporation (IBM). The descriptive statistics include frequency and percentage and in inferential statistics include Chi-square.

Ethical considerations

In order to prevent prior guidance of practice response through the questions of knowledge initially the practices were assessed followed by knowledge. Written permission was taken from ethics committee of institute (4137, 21/3/14). After obtaining administrative permission, to reduce bias, overt and non-participatory observations of practices was done. Written informed consent was taken from every participant before observation of practices and they were also informed that their knowledge will also be assessed.

Results

Sociodemographic variables of study subjects

Out of the total study subjects, majority 85 (78.70%) were females and 80 (74.07%) were between 20 and 30 years of age. Less than half of the participants, that is, 48 (44.44%) were graduate through B.Sc Nursing and 43 (39.81%) were diploma holders through General Nursing Midwifery (GNM) course. As per ICU experience, 85 (78.70%) of participants had 2 months to 5 years, 22 (20.37%) had 5–10 years and 01 (0.90%) had 10–15 years of experience. Additionally, out of total participants only 30 (27.77%) had attended various ICU training programs.

Description of the knowledge of the ICU nurses related to VAP prevention

Majority of the participants, that is, 82 (75.93%) had average, 24 (22.22%) had good, and 2 (1.85%) had poor

knowledge regarding prevention of VAP. The mean (SD) knowledge score was 25.60 (3.73).

Item wise response of nurses regarding knowledge of VAP prevention

About 106 (98.14%) nurses could expand VAP, 72 (66.67%) were aware of causative agent and about similar number 74 (68.52%) knew its clinical features. In context to suctioning, 93 (86.11%) nurses were familiar with closed system recommendation for suctioning, 103 (95.37%) recognized it as sterile procedure, and 106 (98.15%) knew that suction catheter should be thrown after single use. About positioning of ventilated patient, 85 (78.70%) nurses were aware that head end elevation prevents VAP and 81 (75.0%) were familiar with the fact that semi-recumbent position is recommended unless contraindicated. About 99 (91.67%) of nurses recognized that over feeding a ventilated patient increases risk of aspiration. About 95 (87.96%) of nurses knew that adequate cuff pressure decreases VAP by reducing aspiration risk but only 46 (42.59%) knew that cuff pressure should be maintained at 20-25 cm of water. The other factors that were assessed are depicted in Table 1.

Description of practices of I.C.U. nurses related to VAP prevention

Out of 72, majority 68 (94.44%) of nurses had average and 4 (5.56%) had good practices related to VAP prevention. The mean (SD) practice score was 29.26 (3.01).

Item wise observed practices of I.C.U nurses related to VAP prevention

Practices related to hand washing revealed that only 11 (15.27%) nurses followed standard hand washing and majority 65 (90.27%) of the nurses used alcohol rub. During suctioning, 61 (84.72%) nurses maintained insertion of the catheter into the ETT gently by using aseptic technique and limited one attempt of suctioning to 10–15 s. Nasogastric feeding practices showed that only 22 (38.55%) performed hand hygiene and 62 (86.11%) assessed tube placement by aspiration. Practice related to prevention of aspiration showed that about 70 (97.22%) nurses did elevate the head to approximately ≥30° unless contraindicated and only 16 (22.22%) maintained the cuff pressure of 20–25 cm of water. Many other practices assessed are depicted in Table 2.

Association of knowledge and practices

Although maximum nurses had average knowledge and practice scores, still there was no significant association between the knowledge and practices [Table 3].

Discussion

The study on knowledge and practices of intensive care nurses on prevention of VAP in a tertiary care centre revealed that out of 108 nurses, majority (75.93%) of nurses had average knowledge, nearly a quarter (22.22%) had good knowledge, and only few (1.85%) scored in the category of poor knowledge. However, similar study conducted at Tanzania by Ally Tatu reported that 54.20% nurses had excellent, 16.10% had very good, 19.50% had good, 18.50% had average, and 1.70% had poor knowledge. It was also reported that even if the nurses had good to average knowledge and their practices were not in accordance with the knowledge; the same results are found in the present study.[6] In the present study, mean percentage of knowledge and practice scores were 69.18% and 65.02%, respectively. The mean (SD) knowledge scores were 25.60 (3.73) and practice scores were 29.26 (3.01). On the other hand, studies conducted by Llairdo M, *et al*. and Miia Janssonet *et al*. reported low scores of 45.10% and 59.90%, respectively.[11,12] In addition to this, consistent low knowledge score of 7.46 (2.37) have been reported by Nahla Shaaban Ali from Cairo University Hospitals. They also found that the nurses were not compliant with ventilator associated pneumonia bundle practices as the score was as low 8.62 (7.90).[10] Similar low scores of 7.80 (2.90) and 4.00 (2.00) have been reported by Salima M.M. *et al*. and Akin Korhan E *et al*., respectively.[11,13] However, high mean percentage score (78.1%) was reported by Khatib MF, *et al*.[3]

In the present study, the observation of practices revealed that majority (94.44%) of nurses had average practice scores and only few (5.55%) of the nurses were following good practices. It was found that only 13.88% nurses washed hands before patient contact, whereas 27.77% did so after patients contact. More than a quarter (29.16%) nurses washed hands after contact with non-sterile surface. As opposed to this, a Tanzania study elucidated that the percentage of hand washing before patient contact was six times (83.30%) and after patient contacts it was 2 times (66.70%) more than present study.[6] During endotracheal suctioning, more than half proportion of ICU nurses (65.27%) used sterile gloves. However, hand washing before (31.94%) and after (47.22%) suctioning was poor. Comparatively, at Tanzania ICU, large proportion of ICU nurses (83.30%) used sterile gloves and hand washing was done before and after suctioning but the maintenance of environment and equipment cleanness was poor.[6] During oral care, majority (94.44%) of ICU nurses used clean gloves. To clean patient's mouth, 54.16% nurses used 1:1 chlorhexidine mouth wash and 72.22% used clean equipment. In contrast, Ally Tatu reported that during oral care 90% of ICU nurses used clean gloves, 80% cleaned mouth using toothbrush or gauze moistened with mouth wash and 73% used clean equipment.[6] Findings of all these studies revealed that nurses scored less for both knowledge as well as practices related to VAP prevention. The poor scores can be attributed to lack of audit and feedback and lack of time to time sensitization. Most of the authors have recommended that a continuing education/training

Table 1: Item wise response of subject regarding knowledge related to VAP prevention (*n*=108)

Items	Number(%) of correct respondents
The full form of VAP* is ventilator associated pneumonia.	106 (98.15%)
The causative agent can be gram+ve and gram –ve bacteria.	72 (66.66%)
Clinical features of VAP increased tracheobronchial secretions, purulent sputum, hypoxemia, increased minute ventilation, fever, need for increased cuff pressure, crackles and decreased breath sounds.	74 (68.52%)
The recommended intubating route is oral route	102 (94.44%)
Risk of VAP is reduced with extra lumen endotracheal tube.	27 (25.0%)
System recommended for suction is closed suction system.	93 (86.11%)
Introduction of suction catheter into the endotracheal tube is a sterile procedure	103 (95.37%)
Suction catheter is disposed of immediately after single use.	106 (98.15%)
ETT** suction should be done as and when required.	74 (68.52%)
Suction should be done first of hypo pharynx.	34 (31.49%)
The preferred type of humidifier heat and moisture exchangers.	102 (94.44%)
The temperature of humidifier is maintained at 36-38ºC	42 (38.88%)
It is recommended to change humidifiers every48 hourly or when visibly soiled.	80 (74.07%)
Cleaning of respiratory and bedside equipments with antiseptic should be done once in every shift	90 (83.33%)
Head end elevation should be ranging from 30-45º to prevent VAP.	85 (78.70%)
Patient on ventilator should be positioned in (unless contraindicated) semi-recumbent position	81 (75.0%)
Kinetic bed use reduces the VAP risk.	63 (58.33%)
Wearing sterile gloves during oral and Endotracheal Tube (ETT) suctioning is must for a nurse.	60 (55.55%)
Washing hands before and after oral/ETT suctioning is necessary for a nurse while providing care to ventilated patient.	104 (96.29%)
Recommended use of a swab moistened with mouth wash (chlorhexidine 2%) and water every 6 to 8 hourly or whenever necessary.	80 (74.07%)
Stress ulcer prophylaxis utilization for a long time to a ventilated patient increases risk of VAP.	39 (36.11%)
Risk of VAP can be decreased by high nurse to patient ratio.	78 (72.22%)
Rate of VAP is decreased by continuous education to ICU*** nurses on prevention of nosocomial infection and care of patient on ventilator.	88 (81.48%)
Rate of VAP is decreased by postural drainage and chest physiotherapy.	91 (84.26%)
Rate of VAP is decreased by early weaning.	92 (85.18%)
Over feeding a ventilated patient increases risk of aspiration.	99 (91.66%)
Position of patient while feeding should be semi-Fowlers.	107 (99.07%)
Adequate cuff pressure decreases VAP by decreasing risk of aspiration.	95 (87.96%)
Cuff pressure should be maintained at 20-25 cm of water.	46 (42.59%)
Position of oral endotracheal tube should be rotated 24 hourly.	44 (40.74%)
Extubation: the unplanned one is associated with increased risk of VAP due to trauma, aspiration and reintubation.	87 (80.55%)
Frequency of ventilator circuit change, if it is Disposable should be for every new patient.	42 (38.88%)
Frequency of ventilator circuit change, if it is non disposable should be for every new patient.	45 (41.66%)
Ventilator tubing should be kept below the level of the patient.	72 (66.66%)
Condenser should be emptied when visibly soiled.	81 (75.0%)
Solution being used in ICU for cleaning the suction tubing is sop and plain water.	66 (61.11%)
Increased sedation increases the risk of VAP.	54 (50.0%)

*VAP: Ventilator Associated Pneumonia, **ETT: Endotracheal Tube, ***ICU: Intensive Care Unit

program for health care professionals using evidence-based strategies and guidelines on infection and VAP prevention is the need of time.[6,7,12] We also recommend the same along with regular audit and feedback.

Although nurses had good to average knowledge and average practices regarding VAP prevention still there was no association between knowledge and practices (p = 0.710). Although these findings are consistent with the findings from the studies conducted at other parts of the world,[6,10-13] the practices were poor as compare to the knowledge, which is unsatisfactory. This also reflects that nurses either do not have access to latest evidence based information or they do not update themselves. In order to reduce incidence of VAP, the nurses those who are the back bone of any intensive care unit, must adhere to excellent practices that is consistent with knowledge. To improve quality of care and reduce VAP, the practices definitely need improvement. Having only average to good knowledge and not practicing the standards will further compromise the

Table 2: Observed Practices of I.C.U nurses related to VAP prevention (*n*=72)

Items	Number (%) of subjects following correct practices
Hand washing	11 (15.27%)
Standard hand washing	
Dry hands	29 (40.27%)
Hand washing before patient contact	10 (13.88%)
Hand washing after patient contact	20 (27.77%)
After contact with non-sterile surface	21 (29.16%)
Use of alcohol rub	65 (90.27%)
Oral care	7 (9.72%)
Hand washing before oral care	
Positioning the patient in side lying position along with the head end side of the bed lowered. If lowering the patient's head is impossible then turn to one side	36 (50.0%)
Prepared 1:1 solution of chlorhexidine (0.12%-2%) mouth wash	39 (54.16%)
Put on clean gloves	68 (94.44%)
Clean mouth using prepared solution of mouthwash	55 (76.38%)
Suction secretions as they accumulate, if necessary	69 (95.83%)
Ensuring patient's comfort. Set aside the basin, and arid around the client's mouth with towel	51 (70.83%)
Clean equipment and return to proper place	52 (72.22%)
Hand washing after oral care	24 (33.33%)
Suctioning from the ETT*/tracheostomy	
Prepare equipments required during suctioning	69 (95.83%)
Portable or wall suction machine with tubing, collection receptacle, and suction pressure.	
Sterile normal saline or water	
Sterile suction catheter (12-18 Fr for adults, 8-10 Fr for children and 5-8 Fr for infants)	
Sterile gloves	
AMBU bag	
Perform hand hygiene	23 (31.94%)
Position the patient in lateral position facing the nurse	41 (56.94%)
Set the pressure on the suction gauze (adult 100-120 mm of Hg, child 95-110mm of Hg, infant 50-95 mm of Hg)	65 (90.27%)
Wear sterile gloves.	47 (65.27%)
With sterile gloved hand pick up the catheter and attach it to the suction unit.	48 (66.66%)
Test the pressure of the suction machine.	60 (83.33%)
Insert the catheter into the ETT gently by using aseptic technique and perform suctioning for 10-15 sec	61 (84.72%)
Rinse and flush the catheter with saline.	71 (98.61%)
Relubricate the catheter; repeat suctioning until the air passage is clear.	71 (98.61%)
Allow sufficient time between each suction for ventilation and oxygenation.	70 (97.22%)
Discard suction tube immediately after one single use.	71 (98.61%)
Hand washing after suctioning.	34 (47.22%)
Nasogastric tube feed	
Prepare equipment	68 (94.44%)
Correct type and amount of feeding solution	
50 ml catheter tip syringe	
Position the client to a fowlers position. (If contraindicated, a slightly elevated right side lying position is given)	65 (90.27%)
Perform hand hygiene.	22 (38.55%)
Assess tube placement by aspiration	62 (86.11%)
Remove the plunger from the syringe and connect the syringe to a pinched or clamped nasogastric tube	70 (97.20%)
Add the feeding to the syringe barrel.	69 (95.80%)
Permit the feeding to flow in slowly at the prescribed rate	69 (95.80%)
Assess the client for discomfort	62 (86.11%)
Position the patient in slightly elevated right side lying position	26 (36.10%)

Contd...

Table 2: Contd...

Items	Number (%) of subjects following correct practices
Prevention of aspiration and	
Endotracheal tube care	70 (97.22%)
1. Elevate the head of approximately , equal to or greater than 30 degrees unless contraindicated	
Cuff pressure is maintained at 20-25cm of water	16 (22.22%)
The rate and volume of enteral feeding is adjusted to avoid gastric distension and so reduces the risk of aspiration	56 (77.77%)
Subglottic oropharyngeal secretions are drained using a specialized endotracheal tube	13 (18.05%)
Rotational movement of the patient on specialized beds to improve the drainage of respiratory secretions like rotational therapy or continuous lateral rotational therapy	6 (8.33%)
Rotate position of oral endotracheal tube 24 hourly	48 (66.66%)
Assess patient for daily sedation reduction/discontinuation	67 (93.05%)
Assess eligibility for daily weaning trials unless contraindicated	12 (16.66%)

*ETT: Endotracheal Tube

Table 3: Association between the knowledge and practice (n=72)

Knowledge score	Practice score		χ^2 (df)*p
	23-34	35-45	
19-28	56	3	14 (1) 0.710
29-37	12	1	

*p<0.05 is statistically significant, χ^2 Chi-square, df: Degree of freedom

care. Limitation of the present study includes inability to ensure calculated sample size due to limited period of data collection. The study was delimited to ICU's of a tertiary care hospital of north India.

Conclusion

Majority of ICU nurses had average knowledge and practice scores with poor association. On reviewing and comparing the findings, it is concluded that there is an urgent need to identify the strategies, tools, and techniques to improve knowledge and practice to ensure the quality of care in order to prevent VAP. Quality improvement studies are required to be taken up to improve the practices. In this study, compliance to hand hygiene was also found to be very poor. In order to improve hand hygiene, low to moderate efficacy strategies recommended based on a systematic review published in Cochrane can be utilised during quality improvement projects.[14] This in return will help to reduce VAP and other hospital acquired infections. Additionally, the hospital administration need to find out ways to make nurses more aware of the latest VAP prevention guidelines, evidence based information and must ensure the adherence of same in clinical practices.

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Conflicts of interest

Nothing to declare.

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