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Knowledge and practice of nurses working in adult intensive care units regarding prevention of ventilator associated pneumonia

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Abstract

Introduction: Ventilator-associated pneumonia (VAP) is one of the most serious hospital-acquired pneumonia which is a leading cause of mortality and morbidity. Prevention of VAP is critically dependent on knowledge and practice of Intensive Care Unit (ICU) nurses. Only adequate knowledge does not ensure good practice. Thus, the study aimed to find out the level of knowledge and practice of nurses regarding prevention of VAP.

Method: A descriptive cross-sectional study was conducted from February to July 2025 in the adult ICUs of Patan Hospital after obtaining ethical approval. Enumerative sampling included 69 nurses for knowledge assessment and 47 for practice observation. Data were collected in two phases. At first, practice was observed using checklist, followed by knowledge assessment using a self-structured questionnaire. Data were analyzed using SPSS 25, and the fisher exact test was applied to examine the association between knowledge and practice.

Result: Among 69 nurses, 38(55.10%) had good level of knowledge, 28(40.60%) average, and three (4.30%) poor level of knowledge. Among 47 nurses, 23(48.94%) demonstrated good level of practice and 24(51.06%) average level of practice. There was no significant association between knowledge and practice ($p=0.56$).

Conclusion: More than half of nurses had good knowledge and less than half had good practice on VAP prevention. This study highlights a persistent gap between nurses' knowledge and practice in VAP prevention. Despite adequate knowledge, practices were not consistently applied. The findings highlight the need for continuous training, supportive regular supervision, and a work environment that promotes adherence to VAP prevention protocols.

Keywords: Intensive Care Unit; Knowledge; Nurses; Practice; Ventilator-Associated Pneumonia



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Introduction

Ventilator-associated pneumonia (VAP) is one of the most serious hospital-acquired infections and a leading cause of morbidity and mortality in Intensive Care Units (ICUs), with more than 50% of mortality attributable to VAP.^{1,2,3} It is, however, preventable through quality care, where nurses play a central role by implementing evidence-based interventions that reduce its incidence.^{1,4}

Studies from different countries highlight variable knowledge and practice levels. In Ethiopia, 48.04% had good and 51.96% had poor knowledge.⁵ In Saudi Arabia, 40.8% had adequate knowledge and 52.6% satisfactory performance.³ In Pakistan, mean knowledge and practice scores were 50.46% and 60.8%, respectively.⁶ In India, 75.93% had average, 22.22% good, and 1.85% poor knowledge, while 94.44% had average and 5.55% good practice.² In Nepal, 49.1% of nurses had high knowledge,⁷ while another study showed most had moderate knowledge but unsatisfactory practice.⁸ Similarly, only 3.0% demonstrated good knowledge.⁹

Prevention of VAP is critically dependent on both knowledge and practice of ICU nurses.⁴ However, in our context, practice-based observational studies are scarce, and existing evidence suggests that adequate knowledge does not always ensure good practice. Therefore, this study aimed to assess the level of knowledge and practice of nurses regarding prevention of VAP.

Method

A descriptive cross-sectional study was conducted from Feb to Jul 2025 at adult ICUs of Patan Hospital, a major Teaching Hospital in Lalitpur, Nepal. Ethical approval was obtained from the Institutional Review Committee (IRC) of Patan Academy of Health Sciences (PAHS) (Ref: nrs2412171973).

Sample size was calculated using odd ratio. Calculated sample size was 86. However, the total population of nurses working in the designated units was only 76, so we used an enumerative sampling technique which was 76, but three resigned from the job and three were on maternity leave and one refused to participate, so the study included 69 nurses.

Knowledge was assessed among all 69 nurses, while practice was observed among 47 nurses (68% of the total sample), based on a previous similar study in India.² Nursing in-charges, nurses on long leave, and those unwilling to participate were excluded. A self-structured self-administered questionnaire and an observational checklist were developed based on literature review. The tool comprised three parts: Part I (Socio-Demographic Information), Part II (Observational Checklist to assess nurses' practices

regarding prevention of VAP), and Part III (Knowledge-Based Questionnaire with multiple-choice questions regarding prevention of VAP). The checklist and questionnaire were validated by an ICU nursing supervisor, a microbiologist, and a pulmonologist of PAHS using the Content Validity Index (CVI), achieving a CVI score >0.91. Pretesting was conducted among 10% of the sample (n=8) using simple random sampling via a random sampling app.

Due to the small pre-test sample, internal consistency reliability was not calculated, and only face validity was established. The tools were found to be clear and understandable for observers, participants, and researchers, with no issues during data collection.

Knowledge was assessed using 14 multiple-choice questions, with each correct answer receiving one point (total score: 14). Incorrect responses received zero points. Level of knowledge was classified as Poor (score less than 50%), Average (score 50–75%) and Good (score more than 75%).² Practices were assessed using a 13-item observational checklist with Yes and No responses, where "Yes" received one point and "No" received zero points (total score: 13).

Level of practice was classified as Poor (score less than 50%), Average (score 50–75%), and Good (score more than 75%).² But the results showed no respondents in poor practice category and only one in the poor knowledge category. Therefore, the levels were reclassified into two groups: unsatisfactory (score less than or equal to 75%) and satisfactory (more than 75%) for the purpose of analysing the association between knowledge and practice, in alignment with categorization used in similar study.¹⁰

Data collection was conducted in two phases. In the first phase, researchers observed practices related to VAP prevention using an observational checklist. Participants were not informed that their practices were being observed to ensure unbiased behaviour.

Permission was obtained from the administration and ward in-charges of different ICUs, while consent from participants was taken after observation; samples from those who refused were excluded. Observation was done during morning shifts, with 2-3 nurses observed per shift, and the observer's identity was kept confidential.

After completing the observations, the second phase of data collection commenced. In this phase, participants' knowledge was assessed. The purpose and objectives of the study were explained, including the prior observation of their practices without their knowledge. Verbal and written consent were obtained from those who voluntarily agreed to participate. A self-administered questionnaire, took respondents approximately 10-15 minutes to complete. They

completed the questionnaire during their free time, and the researcher collected it on the same day.

Result

Out of 69 respondents, 33(47.83%) held a Bachelor of Nursing (BN/BNS) qualification, while only one respondent (1.45%) had completed a Master of Nursing (MN) degree. Most of the respondents were staff nurses, with only one serving as a senior staff nurse. Regarding work experience, 38(55.07%) had between one to five years of experience, while 11(15.9%) respondents had more than 10 years of experience. In terms of working area, 33(47.8%) were working in the medical ICU, followed by six nurses (8.69%) from the surgical ICU. Most of the respondents 57(82.61%), were employed on a contract basis. Additionally, 43(62.3%) had received basic orientation training on infection prevention, Table 1.

Table 1. Socio-demographic characteristics of study participants (N=69)

Demographic variables		n(%)
Professional qualification	PCL Nursing	6(8.70%)
	BN/BNS Nursing	33(47.83%)
	BSC nursing	29(42.03%)
	Master in Nursing	1(1.45%)
Designation (Post)	Staff nurse	64(92.75%)
	Senior staff nurse	1(1.45%)
	Nursing officer	4(5.80%)
Working experience (in years)	<12 months	2(2.90%)
	1-5	38(55.07%)
	6-10	18(26.09%)
	>10	11(15.94%)
Working unit	Medical ICU	33(47.83%)
	Neuro surgical ICU	22(31.88%)
	Cardiac ICU	8(11.59%)
	Surgical ICU	6(8.70%)
Job status	Permanent	12(17.39%)
	Contract	57(82.61%)
IP training	Basic orientation	43(62.32%)
	1-day basic IPC training	8(11.59%)
	3months	1(1.45%)
	No training	17(24.64%)

Among the participants, 38(55.10%) nurses demonstrated good knowledge regarding ventilator-associated pneumonia (VAP) prevention, 28(40.60%) had average knowledge, and three (4.30%) had poor knowledge, Table 2.

Table 2. Knowledge level of nurses regarding VAP prevention (N=69)

Knowledge Level	n(%)
Good	38(55.10%)
Average	28(40.60%)
Poor	3(4.30%)

In terms of practice, 24(51.06%) nurses demonstrated average practice, 23(48.93%) had good practice, and none scored in the poor category, Table 3.

Table 3. Practice level and knowledge among practice participants regarding VAP prevention (N=47)

Category	Practice level n(%)	Knowledge level n(%)
Poor	-	1(2.13%)
Average	24(51.06%)	18(38.30%)
Good	23(48.94%)	28(59.57%)

Among the subgroup assessed for both knowledge and practice (N=47), 28(59.60%) nurses achieved good knowledge scores, 18(38.30%) had average knowledge, and one (2.12%) had poor knowledge, Table 3. However, there was no statistically significant association between respondents' level of knowledge and level of practice with $p=0.556$, Table 4.

Most of the respondents, 55(79.71%), correctly identified that VAP commonly develops in patients who have been mechanically ventilated for more than 48 hours. Likewise, 51(73.91%) of respondents answered that elevating the head of the bed helps prevent VAP. In contrast, only 26(37.68%) were aware of the recommended protocol for changing ventilator circuits. Using a heat and moisture exchanger (HME) filter can reduce the risk of VAP was known to 60(92.75%) respondents. Regarding suction techniques, 53(76.81%) identified the closed suction system as preferable for VAP prevention. The chest physiotherapy helping to lower the incidence of VAP was agreed by 64(92.75%) respondents. Similarly, 53(76.81%) were aware that identifying the specific pathogen is critical when determining the need for patient isolation in the ICU. The majority of the respondents, 64(92.75%) acknowledged the effectiveness of oral care with chlorhexidine in reducing VAP. Additionally, 46(66.67%) recognized that oral feeding tubes are recommended over nasogastric tubes in ventilated patients. With respect to endotracheal (ET) cuff management, 49(71.01%) were knowledgeable about the optimal cuff pressure range, and 52(75.36%) could identify signs of inadequate cuff pressure. Furthermore, 61(88.41%) were aware of the appropriate timing for performing subglottic suctioning in intubated patients. Likewise,

Table 4. Association between Level of Knowledge and Practice of Nurses regarding the Prevention of VAP (N=47)

Level of knowledge on VAP prevention	Level of practice on VAP prevention		Fisher's exact test p - value
	Satisfactory n(%)	Unsatisfactory n(%)	
Satisfactory	15(31.91%)	13(27.66%)	0.556
Unsatisfactory	8(17.02%)	11(23.40%)	

Table 5. Knowledge regarding Prevention of VAP (N=69)

SN	Items	Correct response n(%)	Incorrect response n(%)
1	Ventilator associated pneumonia (VAP) is most likely to occur in patients who have been on mechanical ventilation	55(79.71%)	14(20.29%)
2	Importance of head elevation	51(73.91%)	18(26.09%)
3	IPC protocol for circuits changes	26(37.68%)	43(62.32%)
4	Type of humidifier is used in ventilated patient	60(86.97%)	9(13.04%)
5	Aspiration system selected in ventilated patient	53(76.81%)	16(23.19%)
6	Knowledge regarding importance of respiratory chest physiotherapy for the prevention of VAP	64(92.75%)	5(7.25%)
7	purpose of use of oral chlorhexidine in ventilated adult patient	64(92.75%)	5(7.25%)
8	The most critical factor when deciding to isolate an infected patient within the ICU to prevent VAP	53(76.81%)	16(23.12%)
9	Recommended route of feeding tube placement to prevent VAP	46(66.67%)	23(33.33%)
10	Recommended range for ET cuff pressure to prevent VAP	49(71.01%)	20(28.98%)
11	Potential sign that the ET cuff pressure is inadequate	52(75.36%)	17(24.64%)
12	Timing for subglottic suctioning be performed in a patient with an endotracheal tube	61(88.41%)	8(11.59%)
13	Interventions associated with reducing the duration of mechanical ventilation and preventing VAP	45(65.22%)	24(34.78%)
14	Nurse's practices that can reduce the risk of cross-contamination and VAP	56(81.16%)	13(18.84%)

Table 6. Practice regarding Prevention of VAP (N=47)

SN	Practice	Yes n(%)	No n(%)
1	Perform hand hygiene before each respiratory care.	27(57.45%)	20(42.55%)
2	Perform hand hygiene after each respiratory care.	14(29.79%)	33(70.21%)
3	Perform hand hygiene after touching patients' surroundings.	21(44.68%)	26(55.32%)
4	Elevate the head of the bed to 30-45 degree but patient should not slide down patient's head.	43(91.45%)	4(8.51%)
5	Check and maintain ETT cuff pressure (25-30cm of H ₂ O)	27(57.45%)	20(42.55%)
6	Give regular oral care with chlorhexidine using suction brush or gauze moistened with mouth	44(93.62%)	3(6.38%)
7	Ensure regular aspiration of subglottic secretions	45(95.74%)	2(4.25%)
8	Use of a new sterile catheter maintaining aseptic technique for each suctioning in patients undergoing open suction.	42(89.36%)	5(10.64%)
9	Preferring orogastric tube than nasogastric tube for parenteral nutrition	21(44.68%)	26(55.32%)
10	Chest physiotherapy done	27(57.45%)	20(42.55%)
11	Position changed	45(95.74%)	2(4.25%)
12	Maintained environment and equipment cleanliness. (Perform bedside dusting using klorkleen and replace used articles)	29(61.70%)	18(38.30%)
13	Heated humidifiers or heat-moisture exchangers (HMEs) is used	45(95.74%)	2(4.25%)

45(65.22%) understood the importance of sedation vacations or daily sedation interruptions in reducing VAP risk, and the majority of respondents 56(81.16%) also had knowledge the role of environmental cleanliness in VAP prevention, Table 5.

Regarding practice, among the 47 nurses, 27(57.45%) performed hand hygiene before providing respiratory care. However, 33(70.21%) did not perform hand hygiene after respiratory care, and 26(55.32%) failed to do so after touching the patient's surroundings. The majority of nurses 43(91.45%), maintained the patient's head elevation at 30–45 degrees. Endotracheal (ET) cuff pressure was maintained by 27(57.45%) of the nurses. Chlorhexidine was used for oral care by 44(93.62%) nurses. Regular aspiration of subglottic secretions was performed by 45(95.74%)

nurses. Aseptic technique during ET suctioning was maintained in 42(89.36%) observations. For enteral nutrition, 26(55.32%) nurses used a nasogastric tube rather than an orogastric tube. Chest physiotherapy was performed by 27(57.45%) nurses. Patient repositioning was done by 45(95.74%) nurses. Environmental and equipment cleanliness was maintained by 29(61.70%) nurses. Heat moisture exchangers were used by 45(95.74%) of the nurses, Table 6.

Discussion

Findings of this study revealed that only 38(55.10%) of nurses had good level of knowledge, and 23(48.93%) demonstrated good practices on prevention of VAP. However, there was no statistically significant

association between knowledge and practice ($p=0.556$), suggesting that knowledge alone may not directly influence clinical behaviour.

These findings are consistent with a study done in India, which reported that 54% of nurses had good knowledge, and 74% demonstrated good practice and there was no significant correlation between the two.¹¹ Similarly, another study of India and Australia also found that there was no significant association between nurses' knowledge and their adherence to VAP prevention practices.^{2,12,13} In contrast, studies from China and Malaysia reported a significant positive association between knowledge of ICU nurses and their VAP prevention practices, suggesting that in some settings, improved knowledge may translate into better compliance with preventive measures.^{14,15} These differing findings across studies indicate that multiple factors such as institutional policies, supervision, workload, resource availability, attitude, motivation, and workplace culture can influence the implementation of knowledge into practice, however, these factors were not statistically tested in the cited studies, and their potential impact is inferred from infection prevention and control guidelines and prior literature, not from our study's results. Significant regional variations in knowledge levels have also been documented. In India, a study reported that 75.03% of nurses had average knowledge. Likewise, a study of Egypt's findings showed that 97.8% had moderate and only 2.2% had poor knowledge.^{2,16,17} Similarly, a study of Nepal found that 51.5% of nurses had poor knowledge regarding the prevention of VAP.⁹ In Malaysia, 66.8% of nurses were reported to have poor knowledge.¹⁵ In contrast, higher knowledge levels were found in Libya, where 57% of nurses had good knowledge, and in northwest Ethiopia, where 48% of nurses demonstrated good knowledge.^{5,18}

The present study found that 79.71% of nurses correctly recognized that VAP typically develops after 48 hours of mechanical ventilation, which reflects a strong understanding of this risk factor. This finding aligns with studies from Malaysia (98.9%) and Nepal (96.5%), but contrasts with lower awareness in Pakistan (46%).^{6,19,20} Similar variation was observed regarding head-of-bed elevation as a preventive measure, with 73.91% awareness in this study compared to 91% in Libya, 78.7% in India, 86% in Malaysia and only 42.16% in Ethiopia.^{2,5,18,19} Knowledge gaps were notable in ventilator circuit changes, as reflected by the low correct response rate. This may be attributed to variations in institutional protocols, outdated practices, and limited awareness of updated evidence-based guidelines. Only 37.68% of respondents correctly identified the recommended ventilator circuit change frequency in this study. This finding was similar to those in India (41.66%) and

Nepal (52.6%), but lower than in Pakistan (65%) and higher than in Malaysia 24.7%.^{2,6,19,20} Regarding the use of heat and moisture exchangers (HME), 86.97% responded correctly in this study, but it is consistent with findings from Turkey (84.3%) and Malaysia (56%).^{1,19} Regarding suctioning techniques, 76.81% knew the closed suction system in this study, whereas awareness was high in India (86.11%), Turkey (65.7%), and Nepal (100%), but much lower in Ethiopia (35.78%) and Libya (19%) regarding this.^{1,2,5,18,20} It may be due to the availability of the close suction. Similarly, 92.75% of respondents knew that chest physiotherapy helps prevent VAP. This finding is in line with findings from Libya (89%), Palestine (61%), Ethiopia (42.65%), and Pakistan (41.6%).^{5,6,18,21} The purpose of oral care with chlorhexidine was known by 92.8% of nurses here, whereas a study from Rupandehi, Nepal reported only 9.8% knew its use. However, another study of Nepal showed a higher percentage (98.2%) of respondents had this knowledge.^{7,20} Knowledge about appropriate endotracheal cuff pressure was found in 71.01% of respondents, which was higher than in northwest Ethiopia (44.12%).⁵

Alongside the variation in knowledge, differences in practice levels were also noted. In India and Malaysia, high levels of VAP prevention practices were reported, at 74% and 76.5% respectively.^{11,15} However, a study of India showed that 76% of nurses demonstrated unsatisfactory practices during the pre-test phase.¹⁷ Similarly, a study conducted in Saudi Arabia revealed that 47.4% of ICU nurses had unsatisfactory performance in VAP prevention.³ Among 47 nurses, only 57% performed hand hygiene before providing respiratory care. However, 70% did not do so afterward, and 55.3% failed to wash their hands after contact with patient surroundings. These findings align with findings of study done in India (13.88%) wash their hand before patient contact, 27.77% after contact, 29.16% wash their hand after contact with non-sterile surfaces and are only slightly better than some reports from eastern Saudi Arabia, 57.9%.^{2,3} Other studies done in Pakistan and China showed that hand hygiene before oral care was done by 77% and 41.7% of nurses, respectively.^{6,22} Head-of-bed elevation at 30–45 degrees was maintained by 91.45% of nurses in the present study, comparable with studies in Turkey 98%, India 97.22%, Saudi Arabia 90.1%, and Malaysia 95.7%.^{1,2,3,19} Regular aspiration of subglottic secretions was practiced by 95.74% of nurses, which was comparable to Turkey 96.1% and much higher than in India 18.05%, Saudi Arabia 47.4%, and Malaysia 25%.^{1,2,3,19}

Despite moderate-to-high knowledge levels in several key areas, the absence of a significant relationship between knowledge and observed clinical practices highlights a persistent knowledge-practice gap. This

gap may result from systemic limitations such as lack of reinforcement mechanisms, individual attitude and capacity, insufficient hands-on training, high patient-to-nurse ratio, and inadequate supervision during nursing care of patients on ventilator.

Several studies have highlighted the effectiveness of structured interventions in narrowing this gap. Roy D and Shivananda in 2021 reported significant improvements in knowledge and practice following structured training programs.¹⁷ This has emphasized the importance of simulation-based training, refresher courses, and ongoing professional development to ensure that theoretical knowledge translates into practice.

Educational qualification, ICU experience, and prior infection prevention training have been positively associated with improved knowledge and performance.^{17,21} This study supports these findings, as nurses who had received infection prevention training had higher knowledge scores. Yet, the lack of corresponding improvement in practice further emphasizes the need for institutional support, mentoring, and performance monitoring.

Even among nursing students, gaps remain. A study among final-year BSc students in Mysore, India, showed that only 8.3% had good knowledge of VAP prevention, suggesting the need to enhance infection control education in undergraduate programs.²³

In a 2024 study from Saudi Arabia, 58% of ICU nurses demonstrated moderate knowledge, while 74% had high practice levels.⁴ However, inconsistencies were again observed: 90.3% reported hand hygiene before patient contact, but only 69.9% after respiratory care, pointing to gaps between knowledge, attitude, and adherence.²⁴

Conclusion

More than half of nurses had good knowledge and less than half had good practice on VAP prevention. No statistically significant association between respondents' level of knowledge and level of practice this highlights the persistent gap between nurses' knowledge and actual clinical practices in VAP prevention, emphasizing that knowledge alone is not sufficient for ensuring quality care. Bridging this gap requires a comprehensive approach involving continuous education, hands-on training, supportive supervision, regular audits, and a work culture that promotes accountability and adherence to protocols. Key enablers include adequate staffing, access to updated guidelines, administrative support, and inter professional collaboration. Integrating VAP prevention into nursing curriculum and fostering ongoing professional development are also vital. Addressing this issue demands individual capability,

readiness, institutional commitment and leadership to ensure consistent, evidence-based care and improved patient outcomes.

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Conflict of Interest

None

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Author Contribution

Concept, design, planning: SDS; Literature review: SN, SM; Data collection/analysis: SN, SM; Draft manuscript: SN, SM; Revision of draft: SDS, SN, SM; Final manuscript: SDS, SN, SM; Accountability of the work -SDS, SN, SM.

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