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ORIGINAL ARTICLE

Factors limiting the prevention of ventilator-associated pneumonia: nursing staff perspective

Adisnay Rodríguez-Plasencia[1], Ariel José Romero-Fernández[1], Roberth Javier Erazo-Lloré[1], Nairovys Gómez-Martínez[1]

[1]Universidad Regional Autónoma de Los Andes, Ambato. Ecuador.

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ABSTRACT

Introduction: ventilator-associated pneumonia is one of the most frequent infections in intensive care units, increasing morbidity, mortality, and hospital costs.
Objective: to identify the barriers perceived by nursing staff in the prevention of ventilator-associated pneumonia in public hospitals of Ambato, Ecuador.
Methods: an observational, descriptive, and cross-sectional study was conducted, including 50 nursing professionals from four public hospitals, selected by convenience. A structured survey with 17 Likert-scale items was applied to assess compliance with preventive guidelines and perceived barriers. Data were processed using descriptive statistics, respecting bioethical principles.
Results: of the participants, 68 % were women, with ages predominantly between 20 and 30 years (58 %). Forty percent had postgraduate education, and 94 % performed assistance functions. The mean compliance with preventive guidelines was 83,2 %, with hand hygiene and the use of sterile gloves being the most frequent practices. Lower compliance was observed in verifying endotracheal cuff pressure, respiratory physiotherapy, and use of humidifiers. The main barriers reported were shortage of staff, lack of resources, absence of written protocols, and insufficient continuing education.
Conclusions: compliance with preventive measures was acceptable but limited by structural and educational constraints. Strengthening continuous training, ensuring adequate resources, and establishing institutional protocols are required to evaluate and improve nursing practice in the prevention of this condition.

Keywords: Pneumonia, Ventilator-Associated; Nursing Staff; Disease Prevention; Respiration, Artificial; Intensive Care Units.

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INTRODUCTION

Ventilator-associated pneumonia (VAP) is a complication affecting the pulmonary parenchyma of patients admitted to Intensive Care Units (ICUs), causing ventilation/perfusion disturbances that the lungs cannot compensate for.[1] This healthcare-associated infection (HAI) is diagnosed after 48 hours of endotracheal intubation and is considered highly problematic due to prolonged hospital stays, increased morbidity and mortality rates, and significant economic burden.[2,3]

VAP diagnosis relies on various criteria and scoring systems such as the Clinical Pulmonary Infection Score (CPIS) to guide treatment; however, IDSA/ATS guidelines recommend prioritizing clinical criteria.[4] VAP should be suspected when patients exhibit signs of respiratory deterioration, including purulent endotracheal secretions, leukocytosis or leukopenia, increased minute ventilation, decreased oxygenation, temperature >38°C or <36°C, and/or increased vasopressor requirements to maintain blood pressure, with or without pulmonary infiltrates.[2,5]

VAP incidence varies by country, diagnostic criteria, and ICU type. For example, North America reports 1–2,5 cases per 1,000 ventilator-days, whereas Europe reports 18,3 cases per 1,000 ventilator-days. Incidence also depends on patient comorbidities: 24,5/1,000 ventilator-days in cancer patients; 17,8 % among 511 trauma patients; and higher rates in patients with chronic obstructive pulmonary disease (COPD), likely due to prolonged invasive mechanical ventilation and impaired local and systemic defense mechanisms.[2]

VAP prevention is critical, as lethality rates reach 15,2 %, with 30- and 90-day mortality rates of 30 % and 63,7 %, respectively. Additionally, hospital stays increase by an average of 14 days, with costs exceeding $40,000 per patient.[6]

Key preventive measures include regular oral care, sedation minimization, evaluation of proton-pump inhibitors and H2-blocker use, early identification and management of dysphagia, head-of-bed elevation >30°, low tidal volume ventilation, daily spontaneous breathing trials guided by respiratory therapy, twice-daily chlorhexidine oral rinses, early mobilization, conversion from nasogastric to orogastric tubes when feasible, avoidance of gastric distension, and maintenance of endotracheal cuff pressure.[7]

Nursing professionals in ICUs play a pivotal role in HAIs, and the impact of VAP on morbidity, mortality, and healthcare costs highlights gaps in preventive practices. Understanding these gaps enhances nurses' technical and technological competencies, improving clinical performance. Therefore, this study aimed to identify barriers perceived by nursing staff in preventing VAP in public hospitals in Ambato, Ecuador.

METHODS

An observational, descriptive, and cross-sectional study was conducted in the Intensive Care Units and the Emergency Department at Hospital General Docente Ambato, Hospital General San Vicente de Paul, and Hospital General Marco Vinicio Iza. A purposive, convenience sample of 50 nursing professionals working in these areas was included. The study was carried out with staff members who met the selection criteria:

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Inclusion Criteria
- Nursing staff working in the Intensive Care Units and the Emergency Department at Hospital General Docente Ambato, Hospital General San Vicente de Paul, and Hospital General Marco Vinicio Iza.
- Staff who wish to participate in the research.

Exclusion Criteria
- Nursing staff working in other areas.
- Staff who do not wish to participate in the research.

Empirical research methods included information collection through observation and documentary analysis. Theoretical methods included the hypothetico-deductive and historical-trend approaches, along with scientific procedures of analysis-synthesis and induction-deduction.

Data were collected using a two-part survey. The first part assessed adherence to VAP prevention guidelines using 17 Likert-scale items: "Never" = 0 points, "Sometimes" = 1 point, "Always" = 2 points (maximum score: 34). Adherence was expressed as a percentage relative to the maximum possible score. Variables included: age, sex, education level, job position, ICU experience, number of ICU beds, training in mechanical ventilation and VAP prevention, guideline adherence, perceived barriers, and nursing characteristics influencing compliance.

Data were processed using epidemiological and statistical software. Summary measures included percentages and absolute/relative frequency distribution tables.

The study received approval from the institutional ethics committee. Confidentiality was maintained, and data were used solely for research purposes, adhering to the bioethical principles of the Declaration of Helsinki and applicable ethical standards.

RESULTS

Demographic characteristics of the 50 surveyed nurses from four public hospital ICUs are shown in Table 1. Most participants were women (68 %), aged 20–30 years (58 %), with postgraduate education (40 %). Nearly all (94 %) held direct care roles, 46 % had less than one year of ICU experience, 48 % worked in ICUs with fewer than 10 beds, and 66 % reported training in mechanical ventilation while 62 % reported VAP prevention training.

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Table 1. Sociodemographic characteristics of nursing staff in Intensive Care and Emergency Units.

Variable		No.	%
Sex	Male	16	32
	Female	34	68
Age	20–30 years	29	58
	31–40 years	18	36
	>40 years	3	6
Education level	Undergraduate student (rotating intern)	12	24
	Bachelor's degree	18	36
	Postgraduate	20	40
Job position	Nursing coordinator	2	4
	Nursing service leader	1	2
	Direct-care nurse	47	94
ICU/Emergency experience	<1 year	23	46
	1–5 years	20	40
	6–10 years	4	8
	>10 years	3	6
Number of ICU beds	<10	24	48
	10–15	16	32
	16–20	4	8
	>20	6	12
Received training in mechanical ventilation?	Yes	33	66
	No	17	34
Received VAP prevention training?	Yes	31	62
	No	19	38

Table 2 summarizes adherence to VAP prevention guidelines. Overall compliance was high, particularly for hand hygiene before/after patient contact, sterile glove use during open suctioning, changing ventilator circuits only when visibly soiled or malfunctioning, replacing closed-suction systems per patient (or as clinically indicated), and maintaining semi-Fowler positioning. Lower adherence was observed in endotracheal cuff pressure monitoring (at least once per shift, maintained at 20–30 cmH_2O), use of heat and moisture exchanger (HME) humidifiers, scheduled respiratory physiotherapy, and kinetic bed use.

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Table 2. Adherence to ventilator-associated pneumonia prevention guidelines**.**

Item	Never (%)	Sometimes (%)	Always (%)
Hand hygiene before patient contact	0	8	92
Glove use for every patient approach	0	34	66
Hand hygiene after patient contact	0	6	94
Use of closed-circuit suction systems	0	38	62
Replace closed-circuit suction systems per patient (or as indicated)	0	26	74
Use sterile gloves for open suctioning	0	14	86
Perform oral care at least once per shift	0	24	76
Use chlorhexidine solution for oral care	6	26	68
Use humidifiers with heat and moisture exchangers	8	38	54
Change HME humidifiers weekly or as indicated	6	28	66
Change ventilator circuit only if visibly soiled or malfunctioning	2	20	78
Check endotracheal cuff pressure ≥1x/shift and maintain at 20–30 cmH_2O	2	38	60
Perform subglottic secretion drainage via additional lumen	6	30	64
Provide scheduled respiratory physiotherapy	2	40	58
Daily sedation interruption and spontaneous breathing trials	4	44	52
Maintain semi-Fowler position	0	28	72
Use kinetic beds	10	36	54

Mean guideline adherence was 83,23 (SD = 13,54), indicating substantial implementation of VAP prevention measures in ICUs.

Table 3 shows the most frequently reported barriers to guideline adherence: nursing staff shortages, lack of university education on VAP prevention, absence of continuing education, unavailability of resources (e.g., sterile gloves, closed suction systems, kinetic beds), and lack of professional models or mentorship.

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Table 3. Barriers to adherence to VAP prevention guidelines.

Item	Disagree (%)	Undecided (%)	Agree (%)
Nursing staff shortage	14	36	50
Unavailability of resources (e.g., sterile gloves, closed suction systems, kinetic beds)	18	36	46
Hospital cost-control policies	14	58	28
Lack of written VAP prevention protocols	18	48	34
Absence of continuing VAP education	14	40	46
Insufficient university education on VAP prevention	12	40	48
Lack of professional model and mentorship	12	50	38
ICU practice not based on research evidence	16	58	26
Research findings contradict prior nursing training	14	56	30
Fear of unpredictable adverse effects on patients	12	62	26
Nurses forget evidence-based procedures	22	50	28
Nurses lack time for evidence-based procedures	26	40	34
Nurses lack necessary skills	44	42	14
Lack of patient cooperation	16	60	24
VAP prevention not considered nursing responsibility	16	48	36
Inadequate ICU physical layout	22	48	30
Inability to use VAP prevention devices	18	56	26

Notes: VAP = ventilator-associated pneumonia; ICU = Intensive Care Unit.

Table 4 presents nursing characteristics influencing guideline adherence. Higher adherence scores were observed among males (mean = 83,8), bachelor's-level nurses (84,3), those over 40 years (93,1), direct-care staff (83,4), nurses with 1–5 years of experience (84,2) or >10 years (84,3), and those working in ICUs with >20 beds (90,6).

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Table 4. Nursing characteristics influencing adherence to VAP prevention guidelines.

Variable		No.	Mean	Standard deviation
Sex	Male	16	83,8238	15,41489
	Female	34	82,9585	12,80598
Education level	Bachelor's	18	84,3139	12,56101
	Postgraduate	20	79,8525	12,74086
Age	20–30 years	29	81,2372	13,6471
	31–40 years	18	84,8044	13,76872
	>40 years	3	93,1367	6,79541
Job position	Nursing coordinator	2	85,295	20,79601
	Nursing service leader	1	70,59	-
	Direct-care nurse	47	83,4168	13,49862
ICU/Emergency experience	<1 year	23	82,6091	13,38737
	1–5 years	20	84,2645	13,87153
	6–10 years	4	80,8825	18,05322
	>10 years	3	84,3133	13,262
Number of ICU beds	<10	24	82,2308	14,90906
	10–15	16	81,6175	14,6669
	16–20	4	84,56	4,41556
	>20	6	90,685	6,00664

Notes: VAP = ventilator-associated pneumonia; ICU = Intensive Care Unit

DISCUSSION

The sociodemographic profile of this sample aligns with findings from other studies, though our inclusion of undergraduate interns rotating through ICUs and a higher proportion of postgraduate nurses distinguishes this cohort.[7]

Highly adhered-to VAP prevention practices included hand hygiene, sterile glove use for open suctioning, oral care ≥1x/shift, semi-Fowler positioning, antimicrobial oral rinses, subglottic secretion drainage, infection surveillance, enteral feeding protocols to avoid gastric distension, and changing ventilator circuits only when visibly soiled or malfunctioning—consistent with our findings.[8]

Alecrim R et al.,[9] categorized guideline adherence into three levels: insufficient, weak, and sufficient, reporting a mean adherence score of 28,6 (SD=6,3) out of 40. Similarly, Atashi V et al.,[10] found that critical care nurses demonstrated insufficient adherence to VAP prevention practices.

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Al-Sayaghi K et al.,[11] reviewed 23 studies, 11 of which evaluated VAP practice adherence among critical care nurses. Adherence levels were classified as high, insufficient, or acceptable. Only one study reported "high" adherence; four reported "insufficient" adherence; and two described "acceptable" levels. Overall, most nurses exhibited insufficient knowledge and adherence to VAP prevention practices.

Soni K et al.,[12] identified ICU work environment and hospital management as key contributors to low adherence, noting that without addressing nursing and situational barriers—such as attitudes, behaviors, self-efficacy, low motivation, peer influence, and team dynamics—improvement remains limited.

On the other hand, the majority of participants in the study by Alkhazali M et al.,[13]—59 %—agreed that the lack of educational courses on VAP prevention guidelines in their hospitals was a major obstacle to compliance with standard guidelines. More than half of the participants (56 %) considered the absence of policies and protocols in their centers to be significant barriers.

Likewise, nearly half of the participants pointed out the lack of supplies, such as kinetic beds and closed suction systems, as an important barrier. On the other hand, 23 % of participants were "strongly opposed" to considering lack of knowledge as an obstacle.[14]

Granizo Taboada WT et al.,[15] emphasized that barriers are diverse and complex, encompassing interrelated personal, environmental, and organizational factors—including nurses' knowledge, attitudes, competence, limited managerial capacity, and shortages of skilled staff and quality equipment. They recommend context-adapted VAP prevention guidelines, provision of appropriate equipment, and integration of VAP prevention into daily care bundles to raise awareness and facilitate monitoring.

Implementing a VAP prevention bundle—as Saint S et al.,[16] demonstrated—can improve outcomes. Participants confirmed that care bundles provided a structured approach to ventilated patient care, and bedside checklists were helpful in busy settings. Barriers to adoption included unit cultures that did not prioritize preventive care and the need for structured interdisciplinary approaches to sedation and weaning.[17]

CONCLUSIONS

Preventing ventilator-associated pneumonia remains a persistent challenge in intensive care units, where nursing staff play a crucial role in implementing evidence-based measures. Although adherence to core practices is generally acceptable, structural and educational barriers—including resource shortages, inadequate continuing education, and poor workflow organization—limit consistent guideline implementation. Strengthening training programs, ensuring adequate supplies, and establishing clear institutional protocols are essential to enhance clinical practice, improve patient safety, and reduce the impact of this serious complication in critical care.

Conflict of Interest

The authors declare that there is no conflict of interest.

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AJRF: Conceptualization, Data curation, Writing – original draft, Writing – review & editing.
RJELI: Data curation, Formal analysis, Investigation, Methodology, Software, Writing – original draft, Writing – review & editing. NGM: Conceptualization, Data curation, Writing – original draft, Writing – review & editing.

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