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EFFECTIVENESS OF NURSE-LED TRAINING PROGRAM ON EVIDENCE-BASED GUIDELINES IN THE REDUCTION OF VENTILATOR-ASSOCIATED PNEUMONIA: A SCOPING REVIEW

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Abstract

Background and Aim: Ventilator-associated pneumonia (VAP) poses a major challenge in intensive care units. The quality of nursing care has a significant influence on patient outcomes, yet the effective application of evidence-based guidelines is often inadequate in these settings. This scoping review aimed to assess the impact of training programs on evidence-based VAP prevention guidelines for nurses, focusing on their knowledge, adherence to these guidelines, barriers to implementation, and the resulting decrease in VAP rates

Methodology: The review was conducted using Arksey and O'Malley's (2005) five-stage framework and PRISMA guidelines. Searches were conducted through electronic databases, including PubMed, Google Scholar, and CINAHL, yielding 981 studies.

Study selection: The criteria for inclusion and exclusion were defined to filter and choose the pertinent studies, as illustrated in Table 1.

Data synthesis: Following the screening process, a total of 28 studies were selected for the data extraction phase of the review. A data extraction table was created, and the subsequent information was gathered from the selected studies: authors, year of publication, country, aim, study population, method, instrument—intervention, evidence-based guidelines under consideration, key findings, outcomes, and barriers to practice or compliance. The author conducted a critical analysis and review of the literature regarding the effectiveness of educational training for nurses, focusing on knowledge, compliance, practice, and the reduction of ventilator-associated pneumonia.

Conclusion: Nurses play a fundamental role in preventing ventilator-associated pneumonia in the critical care unit. The educational program was effective in the reduction of ventilator-associated pneumonia. However, needs a regular training programme for nurses and more efforts to translate research into practice in CCUs.

Keywords: Ventilator-associated pneumonia, Nosocomial infections, Critical care unit, evidence-based guidelines, knowledge, compliance, barriers.

1. INTRODUCTION:

Ventilator-associated pneumonia (VAP) refers to an infection of the lung parenchyma occurring in patients who are receiving invasive mechanical ventilation (1,2). Notwithstanding clinical guidelines, this condition remains the most common and significant complication associated with mechanical ventilation. It is classified as a general hospital-acquired infection (HAI) in critically ill patients and is associated with elevated morbidity and mortality rates. (1–3). It occurs in those who have been intubated and require mechanical ventilation for more than 48 hrs. The reported rates vary between "4.4 to 15.7 cases per 1000 ventilator days"(3). VAP affects "10 to 25% of ICU patients, and those who are intubated have a mortality rate associated with it that is 6–21 times greater (between 24 and 76%)"(3). "VAP is the second most common hospital-acquired infection and the primary cause of mortality in critically ill patients." (1,4). Its incidence is from 5 to 67%, with higher rates in "immunocompromised, surgical, and geriatric patients". The VAP risk increases by 1.5% daily and drops after the 14th day of intubation. VAP increases the length of hospital stays and medical expenses (1).Nonetheless, the diagnostic criteria significantly influence the research carried out by Anitagunahan et al, which clarified that the surveillance criteria of the National Healthcare Safety Network (NHSN) exhibit lower sensitivity compared to the Clinical Pulmonary Infection Score (CPIS) criteria. (5).

Most HAIs are preventable. In the CCU, the majority of direct care was provided to patients by nurses, whose actions influence patient outcomes by preventing and developing VAP. Evidence-based guidelines help to deliver quality nursing

care in ICUs. It was proven that if we implement evidence-based guidelines effectively, it will reduce ventilator-associated pneumonia (6). However, nurses' "knowledge and compliance with evidence-based guidelines on VAP prevention" is low to average in middle-lower income countries **[In 2024]** (7). The consistency in using these guidelines depends on several factors, such as the nurse's knowledge, barriers, and surveillance. The gap between knowledge and practice existed mainly due to the lack of nurses' training and the organization's inability to transform evidence-based research into practice (6). Despite years of research, VAP continues to be one of the most prevalent infections found in ICUs and is linked to increased mortality rates. Although extensive RCTs are needed to validate this, bundles that incorporate numerous preventive measures may yield better results (2). High-level, prospective research is advised in the future to determine the possible advantages of specific bundle components combined with evidence-based methods in lowering the incidence of VAP (8,9). This review can provide insights into potential quality enhancements aimed at decreasing VAP occurrences by examining elements related to nursing practices.\

Aim

This review aimed to investigate the research evidence concerning the impact of nursing training on evidence-based guidelines for the prevention of VAP. The specific objectives are 1) to examine the literature concerning the knowledge, practices, and adherence of nurses to evidence-based guidelines for the prevention of VAP, 2) to determine the effect of nursing training on VAP reduction, and 3) to recognize the barriers to utilizing and implementing the evidence-based guidelines for the prevention of VAP.

2. METHODS

The evaluation was carried out following Arksey and O'Malley's (2005) five-stage framework (see Appendix A). The reporting adhered to the PRISMA guidelines. Searches were executed across electronic databases such as PubMed, Google Scholar, and CINAHL to locate pertinent studies.

2.1. Criteria for Eligibility

The criteria for inclusion and exclusion were set to filter the pertinent studies, as shown in Table 1. This review included articles that were published in English. The eligibility criteria for titles, abstracts, and full-text reviews were screened by two independent reviewers. There is no disagreement between reviewers.

Table-1

Inclusion criteria	Exclusion criteria
1. Studies reporting from tertiary care hospitals 2. Studies regarding the nursing discipline on VAP prevention. 3. Studies addressing any of the training programmes about the following outcomes: use of evidence-based guidelines for VAP prevention, knowledge of evidence-based guidelines on VAP prevention, practice, and compliance with VAP prevention guidelines/bundles, barriers to implementing VAP prevention guidelines. 4. Studies including any one or combination of nursing VAP prevention bundles or guidelines. 5. Study participants were working in adult ICUs (above 18 years) 6. Study published in English 7. The studies conducted in the last 15 years	1. Studies focus on other healthcare workers. 2. Study participants were working in paediatric or neonatal ICUs 3. Studies that evaluate the individual intervention, e.g., open suctioning versus closed suctioning. 4. The research articles published in languages other than English. 5. Studies older than 15 years

3.2.Data selection

The data extraction table was created following an independent evaluation of full-text articles to gather the subsequent information from the studies included: "authors, year of publication, location, objective, sample population, methodology, tools, manipulation, evidence-based guidelines being reviewed, key results, and barriers to adherence". (Refer to Appendix B)

4. RESULTS

4.1 Identification of possible studies

A comprehensive search of electronic databases, including PubMed, Google Scholar, and CINAHL, resulted in the identification of 981 studies. 91 duplicate articles were removed. 890 articles were taken for abstract and title screening based on inclusion and exclusion criteria, and 805 articles were excluded as identified as irrelevant. We have conducted 85 studies for a comprehensive text review. Unfortunately, we are unable to access the full-text articles for 15 of these

studies. The total number of studies included in the review was 28 after the final extraction. (Fig.1. PRISMA flow diagram)

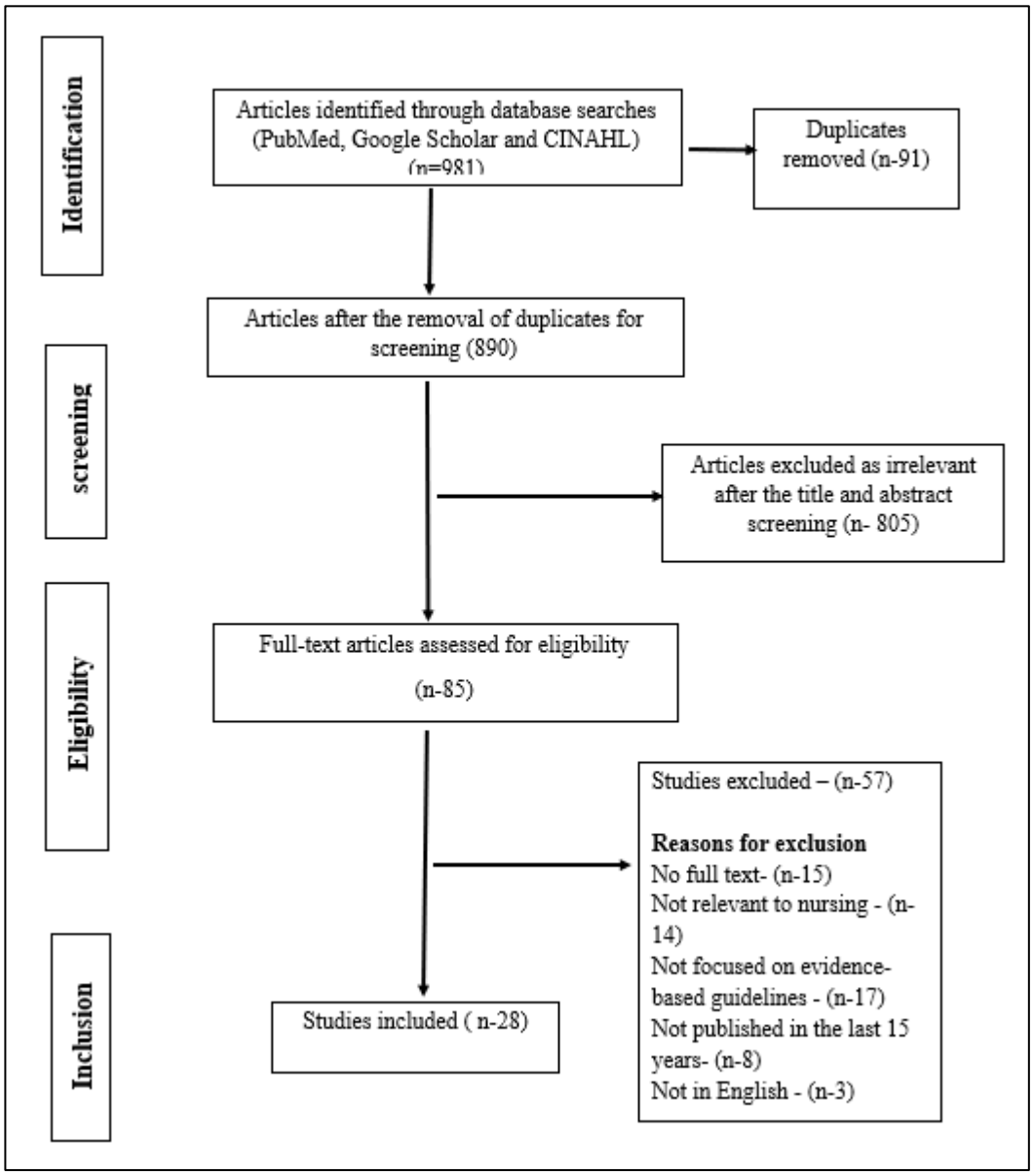

Figure:1 PRISMA Flow Diagram

4.2 Features of the included studies

Most of the studies were published in the last 7 years (60.7%). Study design of the included studies was quasi-experimental (7), RCT (4), cross-sectional survey (5), observational study (4), descriptive survey (2), correlational design (1), longitudinal study (1), and mixed cross-sectional plus descriptive survey (4). The specifics of each study can be found in Appendix B.

4.3. Concerning the guidelines based on evidence for the prevention of VAP

The majority of the studies referenced the term VAP bundles to denote a set of evidence-based nursing interventions aimed at collectively preventing VAP. Additionally, some studies referred to the VAP prevention guidelines as suggested by the Centers for Disease Control (CDC) and the Institute for Healthcare Improvement (IHI). All of the included studies mentioned that the intervention, either assessed or applied in clinical practice, was under VAP prevention bundles/guidelines. Common interventions based on evidence that were utilized across all studies included hand hygiene, oral care using chlorhexidine or a toothbrush, elevation of the head of the bed, prophylaxis for deep vein thrombosis, prophylaxis for peptic ulcers, and daily sedation breaks. Additionally, assessments for readiness to wean, removal of subglottic secretions, tracheal suctioning, adherence to aseptic techniques during suctioning, maintenance of endotracheal tube cuff pressure between 20-30 cmH2O, implementation of an early mobility program, changes to the ventilator circuit when visibly contaminated, and replacement of the heat and moisture exchanger (HME) were also part of the interventions. (8,10–32).

4.4. The training, knowledge, and adherence of nurses, Challenges to compliance, and the occurrence of VAP

Thirteen studies have provided training to ICU nurses on evidence-based guidelines for preventing VAP. Nine of these studies evaluated compliance, while three focused solely on knowledge. Additionally, eleven studies examined both knowledge and compliance. We identified seven studies that assessed the obstacles to effectively implementing evidence-based guidelines for VAP prevention. And eleven studies have given insight into the effect of VAP incidence after the educational programme for nurses.

4.5.Training of nurses

All thirteen studies have provided training to the nurses on VAP prevention in different educational methods regarding evidence-based guidelines on VAP prevention. Eight studies were given simple educational training via the lecture method with a PowerPoint presentation (8,12,15,17,22,27,28,32). Another three studies provided training through PowerPoint presentation, video, booklet, and poster (11,16,31). Majid et al. used two methods of educational intervention, face-to-face training and workshop methods, in their studies(14). The study conducted by Zolfaghari et al was given active and passive educational interventions for the nurses. Training of nurses and posters installation near every ICU bed were done in an active educational intervention group, whereas only posters installation near every ICU bed was done in a passive educational intervention group (13). In all studies educational training programme was effective in enhancing nurses' knowledge and compliance, and also impact on the reduction in VAP incidence.

4.6.VAP Incidence

The eleven studies focused on the VAP rate after the educational intervention or the Application of evidence-based intervention on VAP prevention. In seven studies VAP rate was assessed after the educational intervention, whereas in four studies VAP rate was assessed after the application of evidence-based intervention on VAP prevention. The VAP rate decreased from 39 per 1000 ventilator days to 15 per 1000 ventilator days following an educational training program for nurses focused on evidence-based guidelines for VAP prevention.(12). These results are consistent with the study conducted in Iran (2015), Lebanon (2015), Saudi Arabia (2020), Turkey (2021), and Iran (2021), where the VAP rate reduced after the educational intervention(14,15,22,28,31). However, there was no change in the VAP rate after the educational intervention, as the study was conducted in Spain, yet the late incidence of VAP was observed (9). After the application or implementation of evidence-based guidelines, the result indicates VAP rate reduction from 2.5/1000 ventilator days to 0.54(8). The results are consistent with other studies conducted in some other countries, Jordan (2017), and India (2020) (16,21). However, a study carried out in Slovenia in 2018 found no notable change in the VAP rate following the introduction of the VAP bundle; however, there was a decrease in late VAP (18).

4.7. knowledge

The nurses' knowledge was evaluated prior to and following the educational training on evidence-based guidelines for VAP prevention across ten studies. Some other studies assessed the knowledge without any educational intervention. The study conducted by Abrar Mohmmad et al(2022) in Saudi Arabia, the results revealed that 41% of nurses received a score less than 60%(fail), 35% of nurses received a score between 60% to 75% (poor knowledge), and only 24% of nurses had good knowledge (score > 75%) regarding evidence - based VAP prevention guidelines(33). A different research conducted by Getahun et al (2021) in Ethiopia revealed that 48.04% of nurses possessed good knowledge, while 51.96% exhibited poor knowledge (30). The findings of this study, which indicate a lack of knowledge among nurses about evidence-based guidelines for VAP prevention, align with similar research conducted in UA, Australia, Tanzania, Iran, and India(19,24,29,34). The research conducted by Geetanjali et al (2020) in India revealed that 75.93% of nurses possessed average knowledge, 22.22% had good knowledge, and merely 1.85% had poor knowledge concerning evidence-based guidelines for preventing VAP.(25). Other studies conducted in India concluded that nurses had average to good knowledge(35,36). However, no correlation was found between knowledge and the application of evidence-based guidelines for preventing VAP(19,36).

Most ICU nurses are not well-versed in evidence-based VAP prevention techniques. Following an academic session, nurses' mean scores on their understanding of ventilator-associated pneumonia and preventative strategies significantly improved ($p < 0.05$)(16). The results of this study are consistent with studies conducted in Spain, Malaysia, Lebanon, India, Iran, and the USA(8,11–13,15,17,27). Majid and colleagues conducted a comparison of two educational intervention methods for nurses regarding evidence-based guidelines for VAP prevention: face-to-face training and workshop approaches. The findings of this study showed that both workshops and in-person training were highly effective(14). However, the post-intervention assessment revealed a statistically significant upgrade in knowledge, except for the usage of chlorhexidine, which exhibited non-statistically significant variations between the periods of pre- and post-intervention (> 0.05), study by Khalifa EM et al(2020)(22). In general, the training of any method enhances nurses' understanding of evidence-based guidelines for preventing VAP.

4.8.Compliance .

Eight studies assessed nurses' compliance after the educational intervention, while two studies assessed compliance after VAP bundle implementation. Some of the studies evaluated the nurses' compliance without any educational intervention. The compliance was assessed through a self-reported checklist or direct observation. Nurses did not adequately adhere to the evidence-based guidelines for VAP prevention, as indicated by studies carried out in Saudi Arabia, Australia, Tanzania, India, and KSA (24,29,33,37,38). As reported by Sami Aloush et al. (2020), 45.6% of nurses exhibit insufficient compliance, 24.8% demonstrate moderate compliance, and 29.6% show sufficient compliance (26). Another study compared the compliance of nurses in private and government hospitals. The results revealed that both hospitals were poorly adherent to protocol or guidelines (35).

Most ICU nurses do not comply with or follow the guidelines for preventing VAP based on evidence. After the educational intervention, the compliance rate of nurses increased towards evidence-based VAP prevention guidelines ($p<0.001$) (25). This study agrees with the results of other studies conducted in different countries (11–15,17,18,22,27,28,32). The implementation of the VAP prevention guidelines enhances nurses' adherence from 30% to 78.9%(10). This study is consistent with a study conducted in India(23). Continuous or regular training for nurses supports compliance with VAP prevention protocols..

4.9 Barriers to practice.

The primary challenges to adhering to VAP prevention guidelines include insufficient in-service training, time constraints, absence of protocols or guidelines, a low nurse-to-patient ratio, ICUs with high bed capacity, inadequate policies, limited resources, staff shortages, lack of time, insufficient guidance, fear of adverse reactions, and pressure from senior or peer practices.(16,18,26,28,37,38). The research carried out in Tanzania by Vicent Bankanie et al (2021) indicated that the primary obstacles to the implementation of EBGs for VAP prevention included insufficient skills (96.6%), inadequate staffing (95.5%), and a deficiency in knowledge (79.3%).(29).

5. DISCUSSION

This scoping review primarily examined the impact of educational training on VAP prevention guidelines and its role in reducing VAP. It also highlighted the knowledge and compliance levels of nurses, as well as the obstacles they face in adhering to evidence-based VAP prevention guidelines. A review conducted in Canada indicates that nurses' understanding and adherence to protocols were rated as low to average, primarily because guidelines for managing VAP were not accessible. Additionally, it highlights that the key obstacles preventing nurses from complying with these guidelines for VAP prevention include insufficient audits, inadequate training, and the lack of an infection prevention and control team. However, the training or educational intervention regarding VAP prevention enhances the understanding and adherence of critical care unit nurses (8,11–13,15,17,27) and it also reduces the VAP rate in critical care units (14,15,22,28,31). Several studies indicated that there was no correlation between nurses' knowledge and their adherence to evidence-based guidelines for preventing VAP.(19,36).

The management should integrate properly to disseminate evidence-based interventions in critical care units through a regular training programme for nurses. Because nurses are the first-line defence against VAP prevention, and they are the main operators of the healthcare system. Quality nursing care of patients in the critical care unit will improve the patient's care outcome. So nurses should be trained accordingly and be involved in quality teams. And also, the management should try to overcome barriers, which were mentioned in point no.4.9. However, the management should empower the nurses to contribute towards quality improvement regarding evidence-based intervention on VAP prevention.

6. CONCLUSION:

This review evaluated the existing literature regarding the impact of a nurse-led training program on the guidelines for preventing VAP and its effectiveness in lowering the VAP rate. Additionally, it provides insights into nurses' knowledge, their compliance levels, and the obstacles they face in following VAP prevention guidelines. The knowledge and compliance were poor in many countries regarding VAP prevention guidelines. The common barriers identified include insufficient in-service training, time constraints, absence of protocols or guidelines, a low nurse-to-patient ratio, ICUs with a high bed capacity, lack of policies, inadequate resources, staff shortages, limited time, insufficient guidance, fear of adverse reactions, and pressure from senior or peer practices. The nursing education program effectively played a role in reducing VAP. However, there is a requirement for a consistent training program for nurses and increased efforts to implement research findings into practice within Critical Care Units.

limitations:

This scoping review offers a clear methodology that can be duplicated by other reviewers. Studies were excluded unless they were published in English and within the past fifteen years. To ensure consistency, only adult ICU patients and nurses were included in the study.

Implications:

Even after extensive research studies on VAP prevention, there is still a need for randomized controlled trials (RCTs). Because many studies are cross-sectional and observational, nurses should come up with more experimental and interventional studies on VAP prevention.

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10. Conflicts of interest: Nil

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Appendix A

Arksey and O'Malley's (2005) five-stage framework

Stage 1: Identifying the Research question

What is the effect of a nurse-led training programme on evidence-based guidelines in the reduction of VAP?

Stage 2: Identifying relevant studies

The search strategy was developed to identify the relevant studies and was included in the review. The search strategy consisted of search terms based on the PCC (Population, Concept, and context) framework.

Stage 3: Study selection

Studies are selected based on the eligibility criteria shown in Table 1

Stage 4: Charting the data

The data extraction table was developed, and the following information was collected from the included studies: authors, publication year, country, Aim, study population, Method, instrument—intervention, evidence-based guidelines under review, key findings, outcomes, Barriers to practice or compliance.

Stage 5: Summary and results

The result section includes the summary and findings from the analysed data throughout the review.

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Appendix B
Summary of included studies

Author, Year, and country	Aim /Purpose	Study population	Methods	Instrument	Intervention if any	Evidence-based guidelines under review	Key findings/ Outcomes	Barriers to practice/ compliance
1. Syed Z Bukhari Walee d M Hussain et. Al. 2012, Saudi Arabia(8)	To reduce the VAP incidence rate. To correlate VAP bundle compliance with VAP incidence rate	Patients on mechanical ventilators -2747	Prospective longitudinal study	checklist	Application of VAP bundle	Head-of-bed elevation; daily sedation-vacation along with a readiness-to-wean assessment; peptic ulcer disease (PUD) prophylaxis; and deep venous thrombosis (DVT) prophylaxis	The VAP rate was reduced from 2.5/1000 ventilator days to 0.54 The bundle compliance rate increased from 30% to 78.9%	N/A
2.M Rosa Jam Gatell et.al. 2012 Spain (9)	To assess the impact of training sessions on nurses' knowledge regarding VAP, compliance with VAP preventive measures, and VAP incidence	ICU nurses-58	A prospective, quasi-experimental, pre- and post-study	Questionnaire, Direct observation, Review of clinical records	Training session on VAP prevention (60 minutes), posters were displayed, and distribution of information leaflets	Use of the smallest possible nasogastric tube, controlled aspiration of subglottic secretions, endotracheal tube cuff pressure, use of oral chlorhexidine, and recording the endotracheal tube fixation number	The knowledge of nurses increased in the post-intervention period than the pre-intervention (17·87 ± 2·69 versus 15·91 ± 2·68, p = 0·002). Compliance with the following measures was better during the post-intervention period (p = 0·001): use of the smallest possible nasogastric tube, controlled aspiration of subglottic secretions and endotracheal tube cuff pressure, use of oral chlorhexidine and recording the endotracheal tube fixation number. VAP incidence remained unchanged throughout the study. However, the late incidence of VAP was observed	N/A
3.Pathmawathi Subramanian et.al. 2013 Malaysia (10)	This aimed to investigate the effects of nurse-led education on: (a) knowledge of and compliance with ventilator care bundle (VCB) practices	ICU nurses -71	Quasi experimental design	Self-constructed questionnaire, observation checklist	Nurse-led education on VAP prevention	(a) head-of-bed elevation – a semirecumbent position that could be achieved by elevating the head of the bed to an angle of 30°–45°; (b) daily sedation hold; (c) peptic ulcer disease prophylaxis using pantoprazole or ranitidine, as prescribed by the physician;	Nurse-led education significantly increased nurses' knowledge of ($t[70] = -36.19$; $p < 0.001$) and compliance with ($t[65] = -21.41$; $p < 0.001$) VCB practices. The incidence of VAP, which was 39 per 1,000 ventilator days,	N/A

Author, Year, and country	Aim /Purpose	Study population	Methods	Instrument	Intervention if any	Evidence-based guidelines under review	Key findings/ Outcomes	Barriers to practice/ compliance
	among intensive care unit (ICU) nurses; and (b) reduction in the rates of VAP post intervention.					(d) DVT prophylaxis via administration of subcutaneous heparin or enoxaparin (Clexane®) and application of antiembolism stockings such as thromboembolic deterrent stockings as prescribed; and (e) daily oral care with the help of a suction toothbrush and chlorhexidine gluconate 0.05%.	reduced to 15 per 1,000 ventilator days	
4.Mitra Zolfaghari et.al. 2014 Iran (11)	To determine the effects of passive versus active implementation of VAP guidelines on nurses' performance in critical care units.	CCU Nurses - 110	A controlled clinical trial	Observation checklist	In the passive intervention group, posters containing recommendations for the prevention of VAP were installed on the wall for each bed. In the active intervention group, in addition to poster installation, there were training sessions with feedback on nurses' performance.	VAP prevention guidelines, including the VAP bundle and other evidence-based guidelines	Nurses' performance in the active group improved significantly in comparison to the passive group, and in the passive group, it improved significantly in comparison to the control group ($P < 0.001$).	N/A
5.Majid Yazdani 2015 Iran (12,13)	To compare the effect of two methods of face-to-face training and workshop clinical guidelines in the prevention of VAP.	ICU Nurses -75	Randomized clinical trial	self-report questionnaire, knowledge questionnaire and direct observation	Face-to-face training and workshops by using clinical guidelines in the prevention of VAP	Clinical guideline for prevention of ventilator-associated pneumonia	This study demonstrated that both methods of face-to-face training and workshop were very effective. The incidence of inappropriate pressure of cuff in the tracheal tubes and tracheostomy tubes was significantly reduced after training ($p=0.001$).	N/A

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							Training the nurses is highly effective in preventing VAP, particularly for appropriate cuff pressure, suctioning, and disinfecting hands.	
6. Rashad Ismail and Eman Zahran 2015 Lebanon (13)	To assess the Effect of nurses' training on the ventilator-associated pneumonia (VAP) prevention bundle on the VAP incidence rate at a critical care unit	Patients on mechanical ventilators Critical care unit nurses	Quasi-experimental study	Structured knowledge questionnaire	Training for nurses on the VAP bundle practices	Head elevation, Thrombo-embolic and peptic ulcer prophylaxis, Daily Sedation Vacation and Daily Assessment of the Readiness to Wean, Mouthcare with chlorohexidine.	This study demonstrated that nurses' knowledge and compliance regarding the VAP prevention bundle were improved after the training program. Additionally, the training program on the VAP prevention bundle directed to nurses in CCUs dramatically decreased the incidence of VAP	N/A
7.Zeinab M Hassan and Moayad A Wahsheh 2016 Jordan (14)	To identify the level of nurses' knowledge of ventilator-associated pneumonia and prevention measures before and after an educational programme, and identify the reasons for not applying ventilator-associated pneumonia prevention measures among nurses in Jordan.	ICU nurses - 428	Pre- and post-intervention observational study.	Self-reported questionnaire	Educational programme, including PowerPoint lectures, videos, printed materials, posters, and electronic materials.	Educational module on VAP Prevention practices	The knowledge level of evidence-based strategies for preventing VAP is low among most nurses working in ICUs. Nurses showed significant improvements in mean scores on the knowledge level of ventilator-associated pneumonia and prevention measures after an educational programme ($p < 0.05$).	Lack of in-service training, Lack of time, and no protocols in the units.
8.Arjun S 2017 India (15)	To assess the knowledge and practice regarding VAE	ICU nurses - 75	Pre-test and post-test design	Structured knowledge questionnaire	Training on VAE prevention practices	VAP bundle, handwashing, suctioning, tracheostomy care	After the training, knowledge and practice were improved.	N/A

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				and observation checklist				
9.Sami M Aloush 2017 Jordan (16,17)	The purpose of this study was to assess nurses' compliance with ventilator-associated pneumonia prevention guidelines and the factors that influence their compliance.	ICU Nurses - 100	A structured observational design with a non-participant approach.	Observation checklist	Implementation of ventilator-associated pneumonia prevention guidelines	VAP prevention guidelines	The compliance of nurses was found to be unsatisfactory. Of the participants, 63% showed 'insufficient compliance'. Nurses working in units with a 1:1 nurse: patient ratio demonstrated higher compliance and had a lower rate of ventilator-associated pneumonia in comparison with their counterparts working with a 1:2 nurse: patient ratio.	Low nurse-patient ratio and large intensive care unit bed capacity
10.Ramirez-Damilig, Jeremiah 2017 (17)	To assess critical care nurses' knowledge of the evidence-based interventions contained in the CUSP 4 MVP-VAP for preventing VAEs.	71 ICU nurses	Quantitative, descriptive, and correlational study	Questionnaire		PUD prophylaxis, an early mobility program, recommends frequencies of ventilator circuit changes, tracheal suctioning, low tidal volume ventilation, and changing the HME.	The ICU nurses have the least knowledge about selective PUD prophylaxis, followed by incorporating an early mobility program for intubated patients, recommended frequencies of ventilator circuit changes, tracheal suctioning, low tidal volume ventilation, and changing the HME.	N/A
11.Sandra Burja et al, 2018, Slovenia (18)	To determine the efficacy of a VAP prevention bundle, consisting of the above-mentioned measures, by evaluating the incidence of VAP before (no-VAP-B group) and after (VAP-B group) the introduction of the bundle.	Mechanically ventilated patients no-VAP-B group, n = 55 VAP-B group, n = 74	Retrospective observational study	Observation checklist	VAP bundle	VAP bundle includes elevation of the head of the bed, oral care with chlorhexidine, subglottic suctioning, daily assessment for extubation and the need for proton-pump inhibitors, use of closed suction systems, and maintaining endotracheal cuff pressure at 25 cmH2O	No significant differences in the rates of VAP and early VAP (onset ≤7 days after intubation) were found between the two groups. However, a significant decrease in the late VAP (onset >8 days after intubation) was found in the VAP-B group compared to the no-VAP-B group (13.5% versus 30.9%, p = 0.027). Overall, our results support the use of the VAP prevention bundle in clinical practice.	N/A

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12.Sami M Aloush, 2018, Middle Eastern countries (Jordan, Egypt, and Saudi Arabia) (19)	To assess the compliance of nurses and hospitals with VAP prevention guidelines.	ICU nurses - 471	Self-reported cross-sectional survey	Questionnaire		VAP prevention guidelines	The results show that both nurses and hospitals have insufficient compliance. Previous education, experience, and academic degree were all found to affect nurses' compliance.	N/A
13.Khalifa EM and Seif Eldin AS 2020 Saudia Arabia (20)	To evaluate the effectiveness of an educational and training program of ICU nurses on their knowledge and practices regarding evidence-based guidelines for VAP prevention, to detect its impact on the incidence rate of VAP	ICU nurses -70	A quasi-experimental pre-post design, interventional study	Questionnaire and observational checklist	Training programme	Infection control guidelines and standard precautions as appropriate hand wash, using personal protective equipment, aseptic environmental techniques, cleaning, Waste management, and sterilization. oral care, Suction technique, Bed positioning, enteral feeding, cuff pressure monitoring, and optimum use of the mechanical ventilator device	There was statistically significant improvement of knowledge in the post-intervention assessment except for the use of chlorhexidine which showed non-statistically significant differences between pre and post-intervention (> 0.05). Nurses' practices regarding infection control measures and care bundle for VAP prevention showed statistically significant improvement in the post-intervention assessment (< 0.05) except for the use of clean, unsterilized gloves and chlorhexidine swabs, which were the least practiced and adopted by 4.3% and 12.9% of nurses, respectively. The VAP incidence rate was 24.86±5.19 and was reduced to 5.47.96± in the post-intervention phase	N/A
14.Dorothy Sanders-Thompson 2020 USA (6)	This project aimed to assess whether an educational intervention would increase the ICU nurses' knowledge of the	ICU nurses – 58		Questionnaire	Educational training	Definition of VAP, clinical features, pathophysiology and VAP bundle	Findings showed that nurses had an increase in knowledge following the education (M = 11.43, SD = .775) compared to nurses prior to education (M = 9.55, SD = .976), t(57) = -26.884, p < .001.	N/A

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	evidence-based intervention on VAP prevention.							
15. Monisha CK 2020 India (21)	To assess the VAE and compliance	Patients on mechanical ventilation more than 48hrs	A descriptive survey	Observational check-list, CDC's VAE surveillance algorithm	VAP bundle	Head of bed elevation >30 degrees, Daily sedation break, Deep vein thrombosis (DVT) prophylaxis, Peptic ulcer disease (PUD) prophylaxis, Oral care using tooth brush/use of chlorhexidine, and hand hygiene.	The whole sample was non-compliant with all six elements of the ventilator care bundle. However, when each bundle elements were considered separately, there was 100 percent compliance with head of bed elevation. Only 6 percent of the samples had VAEs.	N/A
16.Auxillia Madhuvu 2020 Australia (22)	To explore Australian intensive care nurses' knowledge of ventilator-associated pneumonia and self-reported adherence to evidence-based guidelines for the prevention of ventilator-associated events.		A quantitative cross-sectional online	Questionnaire		Evidence-based guidelines on VAP prevention	Lack of knowledge of evidence-based guidelines for the prevention of ventilator-associated pneumonia. There was no relationship between participants' knowledge and adherence to evidence-based guidelines (p = 0.144).	N/A
17.Sami M Aloush , Omar M Al-Rawajfa 2020 Jordan (24)	To evaluate the compliance of Jordanian nurses with ventilator-associated pneumonia prevention guidelines and the barriers to compliance.	ICU nurses -294	A descriptive, cross-sectional design	self-reported questionnaire		Ventilator-associated pneumonia prevention guidelines	According to the study compliance categories, 45.6% of the participants reported 'insufficient compliance,' 24.8% 'weak compliance,' and 29.6% 'sufficient compliance.	Lack of education, lack of policies and protocols, lack of resources, and the shortage of staff.

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18.Geetanjli Kalyan et al, 2020 India (23)	The aim of the present study is to assess the knowledge and practices of ICU nurses related to prevention of VAP	ICU nurses-108	A descriptive survey	knowledge-based questionnaire, Observational checklist.		Handwashing, oral care. Suctioning from the ETT/tracheostomy. Prepare the equipment required during suctioning. Prevention of aspiration and Endotracheal tube care, elevate the head, Cuff pressure is maintained at 20-25cm of water, assess patient for daily sedation reduction/discontinuation, assess eligibility for daily weaning trials unless contraindicated	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 the prevention of VAP. ($\chi2 = 0.14$, $p = 0.710$).	N/A
19.Rakhi Mishra, and Navita Rani 2020 India (25)	Pre-experimental one-group pretest and post-test design	ICU Nurses -30	Pre-experimental one-group pretest and post-test design	Structured knowledge questionnaire and structured observation al practice checklist	Structured Teaching Program on the care bundle of VAP prevention	VAP bundle	The mean pre-test knowledge and practice scores were 7.79 and 10.33, respectively. However, the post-test knowledge and practice scores were 24.1 and 17.16, which reveals improvement in knowledge and practice after administration of a structured teaching program.	N/A
20.Aysun Acun et al, 2021 Turkey (26)	This study aims to evaluate the efficacy of ventilator-associated event (VAE) prevention bundle practices in the intensive care unit (ICU).	ICU nurses Patients on mechanical ventilation - 38	Data were collected using the Introductory Characteristics Form Regarding the Nurse Group, Training Evaluation Form for Ventilator-Associated Event Prevention Bundle Practice, and Follow-up Form for Ventilator-Associated Event Prevention Bundle.	Interventional study	Educational training programme	Head of the bed elevation should be at an angle of 30-45 degrees Use of an oral chlorhexidine rinse Aseptic aspiration should be applied The ventilator circuits are not dirty	Bundle general compliance in the intensive care unit reached a compliance percentage of 85%. In the study. As a result, VAE prevention bundle practices, prepared in light of evidence-based guidelines, were found to reduce the rates of infection.	Many factors such as patient-nurse ratio, ICU medical conditions, shortage of medical supplies, as well as training of health professionals, are of great importance in bundle practices.

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21.Vicent Bankanie et al, 2021 Tanzania (27)	To assess the ICU nurses' knowledge, compliance, and barriers toward evidence-based guidelines for the prevention of VAP in Tanzania.	ICU nurses-116	A cross-sectional study	structured questionnaire			The lower level of knowledge and compliance implies the need for ongoing educational interventions and evaluation of the implementation of the EBGs for VAP prevention by considering the local context.	The main barriers to the implementation of EBGs for VAP prevention were lack of skills (96.6%), lack of adequate staff (95.5%), and lack of knowledge (79.3%).
22.Amare Belete Getahun et al 2021 Ethiopia (28)	This study aimed to assess the knowledge of intensive care nurses towards the prevention of ventilator-associated pneumonia.	ICU nurses-204	Cross-sectional study	structured questionnaire		VAP prevention guidelines	There are 98 (48.04%) of the participants have been found to have good knowledge and 106 (51.96%) of them are rendered poor knowledge about the overall knowledge related to the prevention of ventilator-associated pneumonia. Our study indicates that the knowledge of intensive care nurses about ventilator-associated pneu monia prevention is not sufficient.	N/A
23.Farshid Rahimi-Bashar et al, 2021 Iran (29)	To evaluate the effect of 17-ventilator care bundles and different training strategies for critical care nurses on clinical outcomes.	ICU nurses -160 1,600 adult patients (age ≥ 18 yr) who were admitted to mixed medical-surgical ICUs (> 72 hr) and received invasive ventilation (> 48 hr)	A randomized controlled triple-blinded clinical trial.	Observation checklist	Seventeen-ventilator care bundles applied by four different groups of nurses and training was given		According to the results, ICU length of stay, non-ICU length of stay, ventilator-associated pneumonia occurrence date, ventilator-associated pneumonia, and mortality rates were significantly higher in the control group compared with other groups.	N/A
24.Sameh Elha bashy, 2024,	To examine the effect of an	ICU nurses - 80	Randomised controlled trial	Evidence-based nursing	Training programme on	Evidence-based practices	The current study results revealed statistically significant differences	N/A

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Egypt (30)	adapted evidence-based nursing practice training programme on the competency level of nurses caring for mechanically ventilated patients.			competency assessment checklist	evidence-based practices		between intervention and control groups in relation to their level of competency across the three post-assessments (with p =.001). However, nurses' competency level declined over the period.	
25. Abrar Mohmmad Hashem Bokhary et al 2022 Saudi Arabia (31)	To assess critical care nurses' knowledge regarding EBGs for the prevention of VAP.	ICU nurses-100	A cross-sectional study	self-administered questionnaire		Evidence-based VAP prevention guidelines	Around 41% of the participants achieved less than 60% (fail), 35% achieved a score between 60-75% (poor knowledge), and only 24% of the participants showed satisfactory scores (≥ 75%). Non-Saudi nurses, those with a master's degree, and those with a longer duration of professional experience showed higher knowledge scores compared to others (p≤0.05).ICU nurses showed a high level of knowledge concerning basic nursing interventions. However, nurses lack knowledge concerning interventions recommended in the EBGs for the prevention of VAP.	N/A
26.Masoumeh Bagheri-Nesami, Maryam Amiri 2014 Iran (32)	To evaluate the knowledge of nurses in the intensive care unit in University hospitals of Sari.	52 ICU nurses	Descriptive research	Questionnaire		Evidence based guidelines	The average level of the nurses' knowledge about non-pharmacological preventive measures was 51.92% which was lower compared with the surveys in the other countries, highlighting the need for more educational programs in this field. Respondents had the least knowledge about the frequency of ventilator circuit changes	

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							(17.3%), the frequency of humidifier changes (3.8%) and the frequency of changes in the suction system (13.5%).	
27. Soni K.C, Raj Kumar Mehta 2018 India (35)	To assess Knowledge, Adherence and Barriers towards the Prevention of Ventilator Associated Pneumonia among Nurses	ICU nurses -136	Descriptive cross sectional study	Structured knowledge questionnaire and Structured observational checklist		VAP Bundle	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	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. Lack of time, lack of proper guidance, lack of resources,Influence from senior/peer practice, No provision of sedation scale in the ward
28.Khaled M and Sayaghi 2021 KSA (36)	To determine the compliance of critical care nurses with the ventilator-associated pneumonia prevention guidelines and the barriers faced by the nurses	ICU Nurses-283	Descriptive cross-sectional self-reported survey	self-administered questionnaire			The mean compliance score was 85.9%. More than half (54%)of the sample had a high or acceptable compliance level. The lowest compliance rate was reported for the suctioning of subglottic secretions.	The main reported barriers were the shortage of nursing staff, forgetfulness, and hospital cost control policies.