



Effectiveness of Multifaceted Bundle Interventions on Selected Outcomes Variables of Ventilator Associated Problems, Knowledge and Compliance of Bundle Care Among Nursing Professionals in Intensive Care Unit at Selected Hospital, Jaipur City, Rajasthan

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KEYWORDS

Multifaceted Bundle Intervention, Ventilator Associated Problem, Compliance of Bundle Care, Nursing Professionals

ABSTRACT:

Introduction: Pneumonia is an acute lung inflammation often diagnosed through chest x-rays. Ventilator-associated pneumonia (VAP) occurs in ICU patients on mechanical ventilation, with diagnosis challenging due to varied pathogens. Lung ultrasound and respiratory sampling are emerging diagnostic tools.

Methodology: This study aimed to evaluate the effectiveness of multifaceted bundle interventions on selected outcomes variables of ventilator associated problems among nursing professionals in intensive care unit at selected tertiary care hospital, Jaipur city. Additionally, it sought to examine the association of knowledge and compliance of bundle care regarding ventilator associated problems among nursing professionals with their selected demographic variables. Utilizing a quantitative evaluative research approach, a pre experimental one group pre test & post test research design was adopted. Samples were selected the convenient sampling techniques. Data were collected from 40 nursing professionals by using structured knowledge questionnaire and checklist.

Result: The multifaceted bundle intervention significantly enhanced the knowledge of nursing professionals regarding ventilator-associated pneumonia (VAP). Statistical analysis showed substantial improvements in knowledge areas, such as general information on VAP and VAP bundle care, with t-values of 5.30 and 5.90, respectively, both well above the tabulated value at a 0.05 significance level. Similarly, compliance with various aspects of bundle care also improved, particularly in ventilator care measures, endotracheal suctioning, oral care, extubation and weaning trials, and DVT prophylaxis, with t-values exceeding the critical value. However, the intervention was not effective in improving compliance in infection control measures, patient positioning, and peptic ulcer prophylaxis, where t-values were below the critical value.

Conclusion: Overall, the intervention proved beneficial in enhancing both knowledge and compliance among nursing professionals, particularly in areas critical to VAP prevention and management.

INTRODUCTION

Pneumonia is an acute inflammation of the lungs triggered by infection, with diagnosis primarily based on chest x-ray and clinical symptoms. The etiology, clinical presentation, treatment, and prognosis of pneumonia vary depending on whether the infection is bacterial, mycobacterial, viral, fungal, or parasitic, and whether it occurs in the community or hospital setting.

This distinction is crucial for tailoring appropriate management strategies.¹

Ventilator-associated pneumonia (VAP), a specific type of pneumonia, arises in patients receiving mechanical ventilation in intensive care units (ICUs). VAP typically develops after at least 48 hours of mechanical ventilation and significantly impacts patient outcomes, leading to longer ICU stays and an elevated mortality rate of 20–30%.² Accurate diagnosis of VAP remains



challenging, often relying on new radiographic infiltrates combined with clinical criteria such as fever, abnormal white blood cell counts, purulent airway secretions, and impaired gas exchange. Postmortem studies have shown that these criteria have a sensitivity and specificity of around 70%.³

Recent advancements in VAP diagnosis include bedside lung ultrasound and molecular point-of-care tests of respiratory secretions. Lung ultrasound offers a non-invasive, real-time assessment of pulmonary infiltrates and can be used to monitor treatment responses, though its role in patient-centered outcomes is still under evaluation. Molecular tests aid in identifying specific pathogens, potentially guiding more targeted therapies.⁴ The microbiological landscape of VAP differs from that of community-acquired pneumonia (CAP). While viruses and fungi are rare causes of VAP in immunocompetent individuals, resistant bacteria are prominent pathogens in VAP, necessitating careful antibiotic stewardship. The variability in diagnostic practices across hospitals highlights the ongoing need for standardized, effective diagnostic and management protocols for VAP.⁵

NEED OF THE STUDY

Ventilator-associated pneumonia (VAP) is a major hospital-acquired infection affecting ICU patients on mechanical ventilation. The risk of developing VAP is approximately 1.5% per day, decreasing to less than 0.5% per day after 14 days of mechanical ventilation. VAP extends hospitalization by an average of seven days and is classified into early-onset (less than five days) and late-onset (five days or more). Pathogens typically enter the lungs via oropharyngeal colonization from exogenous sources such as contaminated hands, healthcare attire, and medical instruments, ultimately compromising host defenses.⁶

Globally, the prevalence of VAP is around 15.6%, with regional variations: 13.5% in the United States, 19.4% in Europe, 13.8% in Latin America, and 16.0% in Asia Pacific. Mortality rates for VAP patients range from 16% to 94%, compared to 0.2% to 51% for non-VAP patients. In Rajasthan, India, VAP incidence dropped from 80% to 61.2% after implementing preventive measures, with an overall compliance rate of 88.5% for VAP bundles. The estimated incidence of VAP in

Rajasthan is 10.2%, with a mortality rate between 15% and 50%.⁷

Hospitalized ventilated patients with VAP face a 46% mortality rate, compared to 32% for those without VAP. In India, VAP affects 9-27% of intubated patients, significantly increasing mortality risk. Preventing VAP can save an estimated ₹14,000 per patient. Annually, VAP results in around 4,000 cases, 230 deaths, 17,000 ICU days, and ₹46 million in healthcare costs. Common pathogens include *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, *Haemophilus influenzae*, and *Acinetobacter* species.⁸

AIM OF THE STUDY

The main aim of the study is to evaluate the effectiveness of multifaceted bundle interventions on selected outcomes variables of ventilator associated problems, knowledge and compliance of bundle care among nursing professionals in intensive care unit at selected hospital, Jaipur city, Rajasthan.

OBJECTIVES

- To assess the level of knowledge of bundle care regarding ventilator associated problems among nursing professionals.
- To assess the level of compliance of bundle care regarding ventilator associated problems among nursing professionals.
- To evaluate the effectiveness of multifaceted bundle interventions on knowledge and compliance of bundle care regarding ventilator associated problems among nursing professionals.
- To find out the association of knowledge and compliance of bundle care regarding ventilator associated problems among nursing professionals with their selected demographic variables.

METHODOLOGY

This study aimed to evaluate the effectiveness of multifaceted bundle interventions on selected outcomes variables of ventilator associated problems among



nursing professionals in intensive care unit at selected hospital, Jaipur city. Additionally, it sought to examine the association of knowledge and compliance of bundle care regarding ventilator associated problems among nursing professionals with their selected demographic variables. Utilizing a quantitative evaluative research

approach, a pre experimental one group pre test & post test research design was adopted. Samples were selected the convenient sampling techniques. Data were collected from 40 nursing professionals by using structured knowledge questionnaire and checklist

RESULT

Description of Demographic characteristics of The Nursing Professionals

Table no. 1: Frequency and percentage distribution of nursing professional as per demographic variables

S. No.	Variables	Frequency	Percentage
1.	Age		
	20 – 25 years	12	30%
	26 – 30 year	18	45%
	31 – 35 years	6	15%
	36 and above	4	10%
2.	Gender		
	Male	18	45%
	Female	22	55%
	Transgender	00	00%
3.	Professional Qualification		
	GNM	9	22.5%
	Basic B.Sc. Nursing	15	37.5%
	Post basic B.Sc. Nursing	12	30%
	M.Sc. Nursing	4	10%
4.	Working Experience		
	0 – 5 year	12	30%
	6 – 10 years	13	32.5%
	11 – 15 years	11	27.5%
	More than 15 years	4	10%
5.	Area of Work		
	Medical ICU	8	20%
	Surgical ICU	12	30%
	Neuro ICU	9	22.5%
	HDU	11	27.5%
6.	Any Special Training Programme		
	Yes	19	47.5%
	No	21	52.%

The table no. 1 show that majority 18 (45%) nursing professional were from the 26 – 30 years, 22 (55%) were female, 15 (37.5%) were have completed Basic B.Sc. Nursing, 13 (32.5%) were have 6 – 10 years of

experience, 12 (30%) were have experience of surgical ward and 21 (52%) have not any special training programme.



Effectiveness of Multifaceted Bundle Intervention on Knowledge Regarding Ventilator Associated Problems

Table No. 2: Mean, median, SD of knowledge level

S. No.	Knowledge	Pre test			Post test			Mean Difference	df	t value	p value
		Mean	Median	SD	Mean	Median	SD				
1.	Questions related to general information regarding ventilator associated pneumonia	6.15	7	2.03	8.15	8	1.61	2	39	5.30	0.001
2.	Questions related to VAP bundle care	9.42	9	2.57	12.27	12.5	1.70	2.85	39	5.90	0.000
Overall		15.57	16	3.30	20.42	21	2.74	4.85	399	7.15	0.000

The table no. 2 presents the results of an intervention aimed at improving knowledge about ventilator-associated pneumonia (VAP) and VAP bundle care.

Before the intervention, participants had a mean score of 6.15 (SD = 2.03) on general information regarding VAP, which improved significantly to a mean score of 8.15 (SD = 1.61) post-intervention. This improvement is statistically significant with a mean difference of 2.00, a t-value of 5.30, and a p-value of 0.001. This suggests that the intervention had a substantial positive impact on participants' understanding of general VAP information.

Similarly, knowledge about VAP bundle care also saw a significant enhancement. Prior to the intervention, the mean score was 9.42 (SD = 2.57), which increased to 12.27 (SD = 1.70) after the intervention. The mean

difference here was 2.85, with a t-value of 5.90 and a p-value of 0.000. This indicates that the intervention effectively improved knowledge about VAP bundle care.

Overall, participants' combined knowledge scores on both general VAP information and VAP bundle care increased from a mean of 15.57 (SD = 3.30) before the intervention to a mean of 20.42 (SD = 2.74) after the intervention. The mean difference of 4.85, with a t-value of 7.15 and a p-value of 0.000, underscores a significant overall improvement in knowledge.

These results demonstrate that the intervention was effective in enhancing participants' understanding of both general VAP information and specific VAP bundle care practices, as reflected by the statistically significant improvements in all areas measured.

Effectiveness of Multifaceted Bundle Intervention on Compliance of Bundle Care Regarding Ventilator Associated Problems

Table No. 3: Mean, median, SD of compliance of bundle care

S. No.	Compliance level	Pre test			Post test			Mean Difference	df	t value	p value
		Mean	Median	SD	Mean	Median	SD				
1.	Infection control measures	2.65	3	0.86	3.17	3	1.27	0.52	39	2.21	0.18
2.	Patient positioning	0.52	1	0.50	0.72	1	0.45	0.2	39	2.08	0.25



3.	Ventilator care measures	2.42	2	1.29	3.65	4	1.09	1.25	39	4.47	0.000
4.	Endotracheal Suctioning care	4.8	5	1.57	6.97	7	1.44	2.17	39	6.71	0.000
5.	Oral care	0.77	1	0.78	1.65	2	0.53	0.88	39	6.19	0.000
6.	Peptic ulcer prophylaxis	1.47	1	0.96	1.9	2	1.08	0.43	39	2.00	0.09
7.	Extubation and Weaning trials	0.95	1	0.74	2	2	0.64	1.05	39	3.92	0.000
8.	DVT prophylaxis	0.42	0	0.50	0.67	1	0.47	0.25	39	2.50	0.004
Total		13.97	14	2.10	20.22	20	2.34	6.25	39	13.64	0.000

The table no. 3 summarizes the changes in compliance with various care measures before and after an intervention aimed at improving adherence to best practices for ventilator-associated pneumonia (VAP) prevention.

Infection Control Measures showed a slight increase from a mean score of 2.65 (SD = 0.86) to 3.17 (SD = 1.27), but the mean difference of 0.52, with a t-value of 2.21 and a p-value of 0.18, was not statistically significant. This indicates that the intervention did not significantly impact compliance with infection control measures.

Patient Positioning improved from a mean score of 0.52 (SD = 0.50) to 0.72 (SD = 0.45), with a mean difference of 0.20. The t-value of 2.08 and p-value of 0.25 suggest that this improvement was not statistically significant either.

Ventilator Care Measures saw a notable increase from a mean score of 2.42 (SD = 1.29) to 3.65 (SD = 1.09). The mean difference of 1.25, with a t-value of 4.47 and a p-value of 0.000, indicates a significant improvement in compliance.

Endotracheal Suctioning Care improved substantially from a mean score of 4.80 (SD = 1.57) to 6.97 (SD = 1.44). The mean difference of 2.17, with a t-value of 6.71 and a p-value of 0.000, shows a significant increase in compliance.

Oral Care compliance increased from a mean of 0.77 (SD = 0.78) to 1.65 (SD = 0.53), with a mean difference of 0.88. The t-value of 6.19 and p-value of 0.000 reflect a significant improvement.

Peptic Ulcer Prophylaxis compliance went from a mean score of 1.47 (SD = 0.96) to 1.90 (SD = 1.08), with a mean difference of 0.43. However, the t-value of 2.00 and p-value of 0.09 indicate that this change was not statistically significant.

Extubation and Weaning Trials showed a significant increase from a mean score of 0.95 (SD = 0.74) to 2.00 (SD = 0.64). The mean difference of 1.05, with a t-value of 3.92 and p-value of 0.000, demonstrates a notable improvement.

DVT Prophylaxis also improved significantly, with scores rising from a mean of 0.42 (SD = 0.50) to 0.67 (SD = 0.47). The mean difference of 0.25, with a t-value of 2.50 and p-value of 0.004, shows a statistically significant increase.

Overall, the total compliance score increased from a mean of 13.97 (SD = 2.10) to 20.22 (SD = 2.34), with a mean difference of 6.25, t-value of 13.64, and p-value of 0.000. This significant improvement underscores the effectiveness of the intervention in enhancing overall compliance with VAP prevention measures.

DISCUSSION

The study assessed the effectiveness of a multifaceted bundle intervention on nursing professionals' knowledge of ventilator-associated problems using a structured questionnaire. Results indicated significant improvements in knowledge post-intervention. For general information on ventilator-associated pneumonia, the mean score increased from 6.15 to 8.15, with a t-value of 5.30 (p = 0.001). Knowledge of VAP bundle care also improved, with mean scores rising



from 9.42 to 12.27, and a t-value of 5.90 ($p = 0.000$). Overall, the intervention increased the mean knowledge score from 15.57 to 20.42, with a t-value of 7.15 ($p = 0.000$), confirming the intervention's effectiveness in enhancing nursing professionals' knowledge.

In alignment with previous research conducted by Alfano et al. (2024), which showed that, focused educational initiatives significantly improved outcomes related to VAP prevention, this study corroborates the effectiveness of structured knowledge enhancement programs for nursing staff. The consistent findings across both studies emphasize that educational interventions are critical in reducing the incidence of VAP and improving patient care in intensive care units.⁹ The multifaceted bundle intervention was effective in improving nursing professionals' compliance with care related to ventilator-associated problems, particularly in areas such as ventilator care measures, endotracheal suctioning, oral care, extubation and weaning trials, and DVT prophylaxis. The overall compliance mean score increased significantly from 13.97 to 20.22 (t-value 13.64, p-value 0.000). However, the intervention did not lead to significant improvements in infection control measures, patient positioning, and peptic ulcer prophylaxis, indicating that these areas may require additional focus or alternative strategies for enhancement.

Marini AL et al. (2016) demonstrated that multifaceted bundle interventions effectively reduced VAP rates in multidisciplinary ICUs, consistent with other studies showing the benefits of comprehensive care bundles, such as elevating the head of the bed, sedation vacations, and structured oral care regimens. These strategies, along with the use of closed suction systems and consistent DVT prevention, significantly improved patient outcomes. However, the interventions were less effective in areas like infection control, patient positioning, and peptic ulcer prophylaxis, highlighting the challenges of changing established practices and the complex nature of compliance in busy ICU environments.¹⁰

CONCLUSION

The multifaceted bundle intervention demonstrated a valuable approach in enhancing the compliance of nursing professionals with ventilator-associated care protocols. By addressing various aspects of ventilator care through a comprehensive and structured

intervention, the program effectively targeted critical areas that contribute to the prevention of ventilator-associated complications. The findings suggest that such interventions can lead to improved adherence to best practices, thereby potentially reducing the incidence of complications in ventilated patients. However, the variation in effectiveness across different areas of care indicates that while some aspects of bundle care are more responsive to intervention, others may require more tailored or intensive strategies. This underscores the importance of continuous evaluation and refinement of training programs to ensure that all critical components of patient care are adequately addressed. Additionally, the study highlights the need for ongoing education and support for nursing professionals to sustain and further enhance their compliance with evidence-based practices. Future research should focus on identifying the factors that contribute to the differential impact of the intervention across various care areas and explore methods to overcome these challenges, ensuring comprehensive improvement in patient outcomes.

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