Addressing and Reducing the Ventilator Associated Pneumonia (VAP) Vs Ventilator Bundle in Intensive Care Units - An Review

Paramasivam Asari Geetha*, Dr. Mohan Rao[1], Dr. Subala[2]

*Corresponding Author : Paramasivam Asari Geetha, Research Scholar , Chettinad Academy of Research and Education, Kelambakkam, Chennai – 603103, Tamil Nadu, India.

1. Prof Dr. Mohan Rao V R., HOD, Department of General Medicine, Chettinadu Academy Of Research and Education. Kelambakkam, Chennai – 603103,Tamil Nadu, India.
2. Dr.Subhala A.Principal, College of Nursing, Dr. Kumaraswami Health centre , Kottaram , Kanyakumari District . Tamil Nadu. India.

Abstract

Background:
Ventilator-associated pneumonia (VAP) is a common infection that can happen in hospitals, especially in intensive care units. Following proper guidelines to prevent VAP helps reduce infections and improves how patients recover.

Aim:
This study looked at how often VAP occurred, how well nurses followed the VAP care steps (called Ventilator bundle), and whether this affected patient outcomes.

Study Design:
This was a Quantitative study. It included ICU patients who were on ventilators for at least 48 hours..

Results:
Out of 100 patients, 22.3% developed VAP. The infection rate was 5.6 per 1,000 ventilator days. Nurses followed the VAP care bundle 69% of the time, but this decreased over the hospital stay. Higher nurse compliance was linked to:

- Shorter hospital stays
- Fewer days on a ventilator
- Lower hospital costs Patients
- who did not get VAP had better nurse compliance (average 72.9%) than those who did get VAP (average 56.6%).

Conclusions:
Better nurse compliance with VAP guidelines leads to improved patient outcomes. Hospitals need to focus on improving how well staff follow these guidelines.

Keywords:
Nurse compliance, ICU nursing, ventilator care, VAP prevention, patient outcomes

INTRODUCTION

Ventilator-Associated Pneumonia (VAP) is among the most prevalent and fatal nosocomial infections in adult Intensive Care Units (ICUs). It typically develops within 48 hours of endotracheal intubation or invasive mechanical ventilation, leading to extended hospital stays and increased healthcare costs. With survival rates ranging between 25% and 50%, an optimal gold standard for diagnosing VAP has yet to be established. Moreover, existing research has revealed significant gaps in ICU nurses' knowledge regarding ventilator management and inconsistencies in adherence to hospital protocols, contributing to elevated VAP incidence and associated morbidity.

MECHANICAL VENTILATION

Mechanical ventilation is the process of using a machine to support or replace spontaneous breathing by moving air in and out of the lungs. This intervention is essential for patients who are unable to breathe effectively or whose respiratory function is compromised. These machines maintain open airways and enable continuous gas exchange in the alveoli.

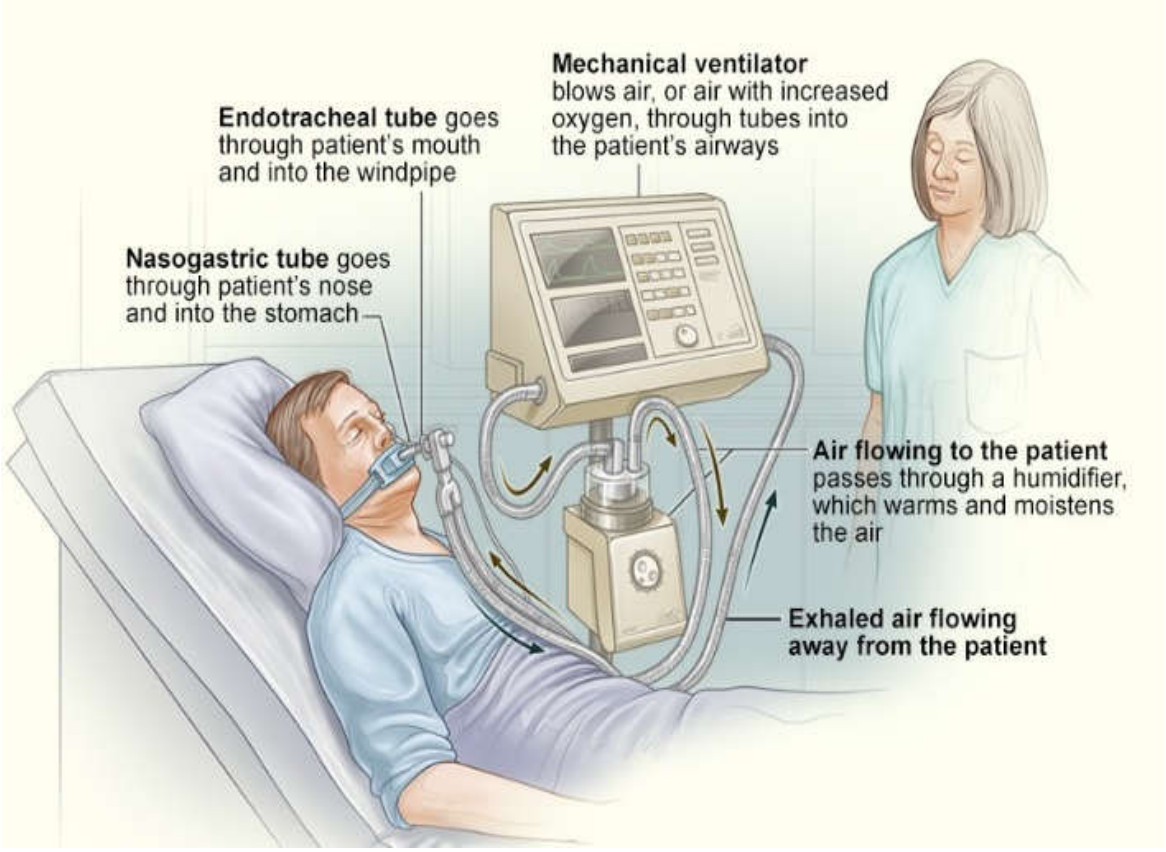
While some patients may require long-term ventilation, most utilize it temporarily during treatment or surgical procedures under general anesthesia. Mechanical ventilation also helps prevent aspiration and stabilizes patients suffering from conditions such as Acute Respiratory Distress Syndrome (ARDS), Chronic Obstructive Pulmonary Disease (COPD), muscular dystrophy, pneumonia, sleep apnea, or traumatic injuries affecting the respiratory system.

HISTORY

Artificial ventilation has ancient origins. In the 2nd century CE, the Greek physician Galen discussed the concept of lung inflation using bellows in animals. In the 16th century, Belgian anatomist Andreas Vesalius also referred to using bellows to revive animals. English physicist Robert Hooke later applied positive pressure ventilation principles to resuscitate animals with lung injuries.

By the late 19th and early 20th centuries, negative pressure ventilators became widely used. In 1864, American inventor Alfred Jones patented one of the first body-enclosing ventilators. However, these machines limited access to the patient's body. To address this, Peter Lord patented a respirator room in 1908, where the patient's head remained outside the enclosure.

In 1927, Philip Drinker and Louis Agassiz Shaw introduced the iron lung, a negative pressure ventilator used during polio outbreaks. World War II brought significant advancements in positive pressure ventilation, and in the following decades, innovations such as CPAP and BiPAP machines allowed for home-based respiratory support.



BASIC MODES OF MECHANICAL VENTILATION

- A/C, VCV - Assisted/Controlled, Volume Cycled Ventilation.
- A/C, PCV - Assisted/Controlled, Pressure Controlled Ventilation (time cycled)
- SIMV - Synchronized Intermittent Mandatory Ventilation.
- PSV - Pressure Support Ventilation.

TYPES OF MECHANICAL VENTILATION

Noninvasive Ventilation

Noninvasive ventilation is administered through nasal or face masks and is appropriate for conscious patients experiencing mild to moderate respiratory distress. Devices like CPAP and BiPAP are commonly used at home for conditions such as COPD, congestive heart failure, or obstructive sleep apnea. These devices require minimal training to operate.

Invasive Ventilation

Invasive ventilation involves inserting an endotracheal or nasotracheal tube through the mouth or nose into the trachea. This method is typically managed by respiratory therapists or anesthesiologists and requires continuous monitoring. Patients often receive sedatives, pain relief, and nutritional support via feeding tubes. Invasive ventilation is a major reason for ICU admission, with 20% to 70% of ICU patients receiving it at any given time

MECHANISM

Modern ventilators primarily function using **positive pressure**, which pushes air into the lungs. This differs from natural breathing, where **negative pressure** generated by the diaphragm pulls air into the lungs. After the ventilator-delivered breath ends, passive exhalation occurs as the chest wall recoils and expels the air.

Historically, negative pressure ventilators, like the iron lung, created a vacuum around the chest to induce lung expansion. When the vacuum was released, normal pressure returned, and the lungs deflated through passive recoil.

RISKS AND COMPLICATIONS

Although mechanical ventilation can be lifesaving, it is associated with numerous risks—particularly with invasive methods. Potential complications include:

- **Ventilator-Associated Pneumonia (VAP)**
- **Sinusitis**
- **Barotrauma**
- **alveolar overdistension**
- **Acute Respiratory Distress Syndrome (ARDS)**
- **Oxygen toxicity**
- **Cardiac arrhythmias**

VAP occurs when bacteria, viruses, or fungi enter the lungs through the ventilatory system. Prolonged mechanical ventilation increases the risk of infection and other adverse outcomes, underlining the importance of strict adherence to preventive measures.

AIMS AND OBJECTIVES

- To evaluate whether the implementation of a ventilator bundle combined with ongoing nurse education improves adherence to VAP prevention protocols.
- To assess the impact of these interventions on VAP incidence rates in adult ICU settings.

HYPOTHESIS

Adult ICU units that implement both a ventilator care bundle and continuous nursing education will experience increased adherence to preventive protocols and a reduction in VAP incidence rates.

Review of Literature

- **Fulbrook P et al. (2019):** Highlighted the pivotal role ICU nurses play in ventilator weaning. Emphasized the importance of nurse-led protocols, which were associated with improved patient outcomes.
- **Tonnelier JM et al. (2018):** Demonstrated that structured nurse-directed weaning protocols are safe and effective for patients ventilated for over 48 hours.
- **Couchman BA et al. (2017):** Found that effective nursing management of ventilated patients includes four core practices: head-of-bed elevation, sedation vacations, stress ulcer prophylaxis, and DVT prophylaxis. Evidence-based nursing, coupled with thorough patient assessment, is critical.
- **Berry AM et al. (2016):** Emphasized the significance of oral hygiene in mechanically ventilated patients and suggested that interventions like subglottic suctioning may enhance outcomes, although a direct correlation with VAP incidence remains inconclusive.
- **Leah S. (2015):** Advocated for the development of nursing protocols for ventilator management in neonatal ICUs, stressing the need for multidisciplinary collaboration in protocol design and implementation.

Material and Methods

This study targets ICU nurses aged 22 and older with at least one year of ICU experience., with a nurse-to-patient ratio 1:1. The hospital already follows a ventilator bundle protocol.

Study Design

The prospective study was conducted Sample Icu Nurses over the age of 22 with one or more years of ICU experience with anticipated employment at said facility for a minimum of 2 years from the start of Research . Each nurse will follow a maximum ratio of 1:1 they must be responsible for ventilator patients. Hospital has already ventilator bundle technique implemented.

Methods

The data collected over 2 month period beginning with an initial phase followed by a subsequent phase . Educational classes on a bi-weekly basis and a monthly questionnaire will be provided to compare and revaluate nurses knowledge of preventative measures as well as

treatment for VAP patients over a prolonged period of time. A data collection sheet was used to record data for each patient from admission day to till discharge. The sheet was reviewed and approved by two experts, one an intensivist and another two doctoral experts in critical care and nursing administration. The sheet had all the 10 elements of the VAP care bundle, and once a day during the morning shift, the researcher would mark either ' ✔ ' or ' **X** ' against each guideline.

Ventilator bundle on Mechanical Ventilator Patient

DAY/DATE	1	2	3	4	5	6	7	8	9	10
Hand hygiene	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Patients nursed in a semi-recumbent position(>30°) unless contraindicated	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Cuff pressure maintained between 20-30 cmH2O (optimally 25cmH2O)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Cuff pressure measurements carried out every4-6 hours and following transfer/mobilisation	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
DVT prophylaxis	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Stress ulcer prophylaxis given	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Oral care given	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Closed suction catheter used whenever possible	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Assess readiness for extubating once a day (spontaneous breathing trials) in patients without contraindications.	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Daily sedation interruption and assessment of readiness to extubate (unless contraindicated)	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

RESULTS:

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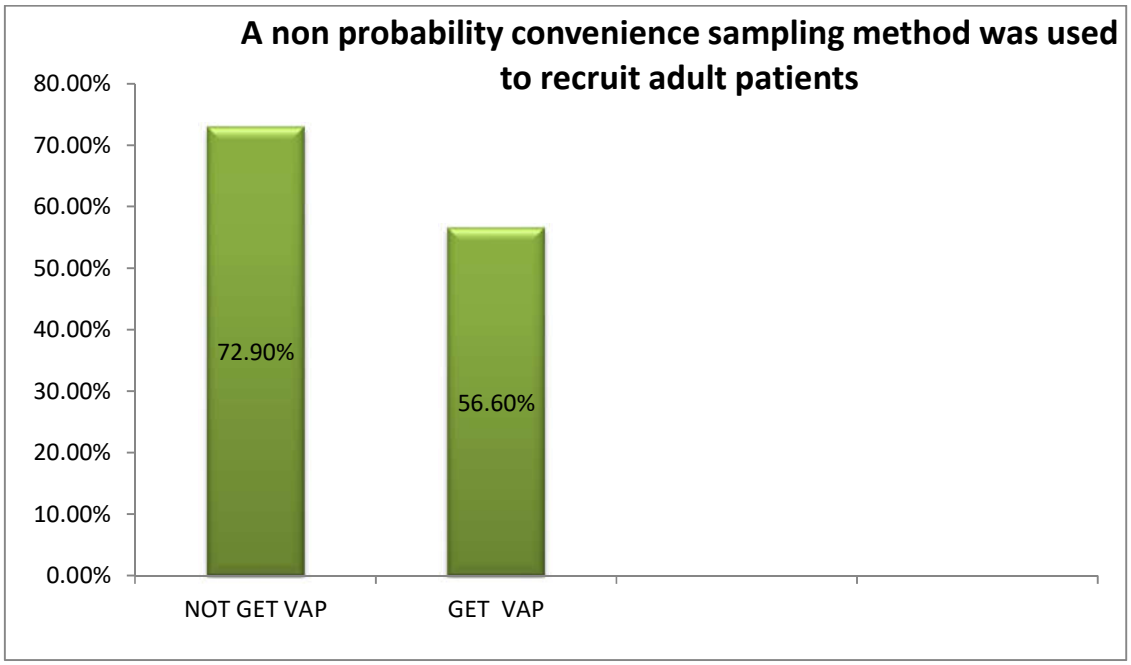

Patients who did not get VAP had better nurse compliance (average 72.9%) than those who did get VAP (average 56.6%).

The data collected from this study will indicate either an increase or decrease in VAP rates. Results will also display an increase or decrease in nurse adherence to protocol prevention treatment of VAP, which indicates the need for increased education.

IMPLICATIONS AND RECOMMENDATIONS FOR PRACTICE

The results of this study are especially important for critical care nurses, as they play a key role in using ventilator-associated pneumonia (VAP) prevention bundles. It is essential that nurses working in critical care are well-trained and have up-to-date, evidence-based knowledge and skills to help reduce VAP rates and improve overall patient care.

The study also highlights the need for continuous quality improvement efforts in intensive care units (ICUs), where patients on ventilators are at high risk for infections. Regular checks or audits on how well nurses follow the VAP bundle are important for lowering infection rates, reducing complications, and improving patient safety and clinical outcomes.

In addition, providing ongoing training and education for critical care nurses can greatly improve how well they follow infection prevention practices. Future studies should look at how effective these standardized prevention protocols are, and how nurses' compliance affects patient outcomes.

This study also shows that VAP rates and bundle compliance vary across countries. Addressing differences in healthcare systems and infection control measures around the world could lead to better outcomes for patients globally.

CONCLUSION

Using a ventilator bundle can help ICU nurses take better care of patients who are on ventilators. Following the bundle correctly can lower the chances of ventilator-associated pneumonia (VAP) and shows how important nurses are in preventing it. These steps are part of daily care, and how well they work depends a lot on the education nurses receive. Training programs help reduce VAP cases, hospital stays, and the number of diagnoses. Still, many past studies have not fully recognized how important education is. Regular training keeps nurses updated and improves how well they follow the guidelines, especially since there is no one best standard for VAP prevention

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