Preventing Ventilator-Associated Pneumonia: A Nursing-Intervention Bundle

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Abstract:
Among critically ill patients in acute-care facilities, pneumonia is one of the most common hospital acquired infections. Ventilator Associated Pneumonia (VAP) is the most common nosocomial infection in intensive care units (ICU), and represents 31% of all ICU acquired infections. As VAP is linked with higher morbidity, mortality and costs, preventing ventilated patients from developing VAP is an important patient safety objective. The autonomous nursing-intervention bundle interrupted transmission of microorganisms to the lower respiratory tract. This bundle matches interventions with the two processes known to cause VAP. Bundling the interventions significantly contributed to reducing VAP in critically ill patients, indicating that applying consistent interventions can reduce risk and improve patient outcomes. The concept of matching interventions to the cause of a specific problem can be generalized to address other healthcare challenges. Once interventions are matched to the cause of the problem, nursing interventions can be bundled and evidence can be incorporated into nursing practice and policy.
The literature includes extensive discussion of VAP diagnosis and treatment, along with interventions attributed to reducing its incidence. This article describes a "bundle" of autonomous nursing interventions that can help prevent both of the etiologic processes above and improve patient outcomes.

Keywords: Ventilator-Associated Pneumonia; Nursing-Intervention Bundle; ET tube Cuff Pressure ; Mouth Care ;Head of Bed.

Introduction:

Reducing hospital-acquired pneumonia continues to pose a challenge for healthcare providers [(1)]. Among critically ill patients in acute-care facilities, pneumonia is one of the most common hospital acquired infections. Ventilator associated pneumonia (VAP) is defined as nosocomial pneumonia in a patient on mechanical ventilator support (by endotracheal tube or tracheostomy) for ≥48 hours. VAP is the most common nosocomial infection in intensive care units (ICU), and represents 31% of all ICU acquired infections. As VAP is linked with higher morbidity, mortality and costs, preventing ventilated patients from developing VAP is an important patient safety objective. VAP is divided into early onset VAP which occurs within 5 days of mechanical ventilation and late onset VAP which develops five or more days after initiation of mechanical ventilation[(2)]. The importance of segregating VAP into early and late is that, the pathogenesis, microorganisms responsible and outcome in these two groups are different and so the therapeutic implications also differ [(3)].

VAP arises when there is bacterial invasion of the pulmonary parenchyma in a patient receiving mechanical ventilation. Inoculation of the formerly sterile lower respiratory tract typically arises from aspiration of secretions, or use of contaminated equipment or medications. Risk factors for VAP include prolonged intubation, enteral feeding, witnessed aspiration, paralytic agents, underlying illness and extremes of age [(4)].

The risk factors for VAP can be divided into three categories: host related, device related, and personnel related. Host related

risk factors include preexisting conditions such as immunosuppression, chronic obstructive lung disease, and acute respiratory distress syndrome. Other host-related factors include patients' body positioning, level of consciousness, number of intubations, and medications, including sedative agents and antibiotics [1,5] .

The pathogenesis of ventilator-associated pneumonia usually requires two important processes to take place: bacterial colonization of the aerodigestive tract and the aspiration of contaminated secretions into the lower airway [6].

The diagnosis of VAP is a clinical suspicion. The most accepted clinical definition for suspicion of pneumonia is currently the presence of a pulmonary infiltrate on chest radiograph plus two of the following three criteria: leukocytosis or leukopenia, purulent respiratory secretions and fever or hypothermia. This approach has good sensitivity but poor specificity and the next step is to obtain samples of the lower respiratory tract for microbiological tests [3].

Description of underlying health problem in Egypt:

Since VAP is a critical and lifesaving issue in ICU, and there were little studies handling this important infection, with seldom little or no analysis or specific data reported about it. VAP studies done in Egyptian University Hospitals in the last 10 years to describe the magnitude of the problem of VAP in Egypt exploring its predictors and its most common causative organisms in these ICUs, VAP ranges from 16% to 75%. In comparison with incidence of VAP World Wide, 10–28% and in the United States 9–27%, incidence of VAP in our ICUs is about 2.5 times more. The highest incidence, 75% was noted in Ain Shams University and the lowest incidence, 16% was in Alexandria University, while the incidence in Mansoura University was 22.6% [1, 2, 3, 4, and 6].

Two processes are crucial to VAP development [7]:

• Bacterial colonization of the oral cavity
• Aspiration of contaminated secretions into the lower respiratory tract.

The literature includes extensive discussion of VAP diagnosis and treatment, along with interventions attributed to reducing its incidence. This article describes a "bundle" of autonomous nursing interventions that can help prevent both of the etiologic processes above and improve patient outcomes.

Gap between evidence and practice:

Healthcare teams and researchers have implemented and tested various interventions geared to improving patient safety and reducing untoward outcomes. Selected interventions or care processes have been shown to decrease mortality, morbidity, and healthcare costs in mechanically ventilated patients. These interventions include evidence-based practice guidelines from the Centers for Disease Control and Prevention (CDC) pertaining to VAP prevention, as well as guidelines on hand hygiene, staff education, semi recumbent positioning, oral care and decontamination with antibiotic rinses, early extubation, weaning protocols, aspiration of subglottic secretions, and use of closed-suction catheter systems and silver coated ET tubes[5,8]. But despite the documented findings, gaps exist between awareness of the evidence and implementation of evidenced based guidelines into daily nursing practice. Also, a basic concept must be considered when implementing patient-safety or risk reduction interventions to solve healthcare challenges: matching

interventions to the cause of the problem. Focusing on both of the processes known to cause VAP enables healthcare providers to implement effective patient risk reduction activities [6].

Nursing interventions to prevent VAP:

Over the past 10 years, literature on nursing interventions for reducing VAP has focused on elevating the head of the patient's bed and providing mouth care. During the past 2 years, researchers have explored the importance of maintaining optimal ET-tube cuff pressure. This article focuses on three key interventions that address both known causes of VAP [1,3,7]:

- maintaining ET-tube cuff pressure
- keeping the head of the bed elevated
- providing mouth care.

Although many studies have shown that head-of-bed elevation and mouth care help prevent VAP, these interventions are implemented inconsistently [9]. The American Association of Critical Care Nurses (AACN) has established two evidenced-based practice alerts pertaining to VAP reduction; one addresses head-of-bed elevation and the other addresses oral care. Clinical practices associated with maintaining optimal ET tube cuff pressure vary, largely from lack of knowledge of the benefit of this intervention [10].

Maintaining ET tube cuff pressure:

The cuff at the lower end of the ET tube is used to seal the airway during mechanical ventilation and minimize aspiration into the lower respiratory tract[5]. A routine part of airway care is to measure and monitor ET tube cuff pressure to assess for a tracheal seal. Cuff pressure should be maintained above 20 cm H2O to minimize the aspiration risk, but below the tracheal mucosal capillary perfusion pressure of 25 to 30 cm H2O to minimize tracheal erosion [10].

Elevating the head of the bed:

Elevating the head of the bed is a well-documented way to help reduce VAP. Maintaining an angle of 30 to 45 degrees at all times reduces the aspiration risk, whereas supine positioning has been shown to increase risk [6,8]. AACN's VAP practice alert recommends an elevation of 30 to 45 degrees (unless medically contraindicated) for all patients receiving mechanical ventilation or who are at a high risk for aspiration (for instance, those with an enteral tube and a decreased level of consciousness) [10,11].

Providing mouth care:

Colonization of dental plaque from organisms in the oral cavity has been linked to hospital-acquired infections and VAP in mechanically ventilated patients. Providing mouth care decolonizes the oral cavity [10]. AACN's practice alert recommends providing mouth care every 2 to 4 hours [11]. According to this alert, critical-care and acute-care settings should develop and implement a comprehensive oral hygiene program. The latter should include protocols for brushing the patient's teeth, gums, and tongue and moisturizing the oral mucosa and lips [9].

Bundling interventions to improve care quality:

The Institute of Healthcare Improvement (IHI) defines bundling of interventions as the "grouping of best practices with respect to a disease process that individually improve care, but when applied together result in substantially greater improvement." The

ventilator bundle recognized by IHI and the Joint Commission consists of a group of evidence-based practices that, when implemented together, dramatically reduce VAP incidence in mechanically ventilated patients [6,9]. The bundle includes these interventions [10]:

- Head-of-bed elevation above 30 degrees.
- Peptic-ulcer disease (stress ulcer) prophylaxis.
- Deep-vein thrombosis prophylaxis.
- Appropriate sedation use ("sedation vacation").

The IHI ventilator bundle is included in current national policies and quality-improvement initiatives aimed at improving ventilator care. Hospitals across the country are implementing it and collecting and reporting data on its key interventions [6].

Opportunities to reduce VAP

We know little about how the bundling of autonomous nurse-initiated interventions affects VAP incidence. An autonomous nursing intervention is one that nurses can implement independently, based on their education and knowledge [12]. To date, literature on the three autonomous nursing interventions discussed in this article have been explored individually to reduce VAP [10,11]. The optimal bundle for reducing VAP includes these three interventions [1,3,7,9,13]:

1. Maintaining ET tube cuff pressure between 20 and 25 cm H2O
2. Keeping the head of the bed elevated 30 to 45 degrees
3. Providing mouth care every 2 or every 4 hours.

Study developed by Mohammed[6] found that the risk of developing VAP fell 97.6% and the expected time until VAP occurred was almost 3.5 times longer in patients who'd received the optimal intervention bundle than in those who hadn't. Implementing an autonomous nursing-intervention bundle that minimizes both the risk of aspiration into the lower respiratory tract and oral cavity colonization reduced VAP incidence by 55.4%. Bundling the three interventions achieved better patient outcomes than if these same interventions had been implemented individually.

Conclusion:

The autonomous nursing-intervention bundle described above interrupted transmission of microorganisms to the lower respiratory tract. This bundle matches interventions with the two processes known to cause VAP. Bundling the interventions significantly contributed to reducing VAP in critically ill patients, indicating that applying consistent interventions can reduce risk and improve patient outcomes. The concept of matching interventions to the cause of a specific problem can be generalized to address other healthcare challenges. Once interventions are matched to the cause of the problem, nursing interventions can be bundled and evidence can be incorporated into nursing practice and policy.

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