

VENTILATOR ASSOCIATED PNEUMONIA AND NURSE'S ROLE IN PREVENTION

A SCOPING REVIEW

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Abstract/Summary

Ventilator associated pneumonia in the intensive care unit is a common hospital acquired pneumonia, even though it is preventable millions of people are effected every year. VAP is the infection of the lungs, which damages the lungs severely causing death. All patients intubated are at a risk of VAP along with the other risk factors.

This study aims to identify nursing care in the prevention of VAP in the intensive care unit by a scoping review. The scoping review has been chosen as the method of study for this research, and Nola. J Pender's theory of health promotion model as a theoretical frame work, in which 10 articles were selected for the study Six categories were formed, which includes physiotherapy, elevation of the head of bed, mouth care or oral hygiene, suctioning, aseptic techniques, and sedation vacation, which answered the research questions. This study concluded that the nurses play an important role as an educator and instructor, caregivers, and researchers in the prevention of ventilator associated pneumonia. In this present situation of COVID 19, the importance of prevention of VAP is understood. This study has mainly focused on the nurse's perspective knowledge to help the nurses to understand their role in the prevention of VAP, excluding the medical side of prevention. It was found that there is a shortage of studies available in the recent years from the nurse's perspective on the prevention of VAP therefore more studies needs to be done on this relevant topic.

Language: English Keywords: The key concepts are ventilator associated pneumonia, intensive care, prevention, and nurses' responsibility.

Abbreviations:

VAP - Ventilator associated pneumonia.

HAP - Hospital acquired pneumonia.

HAI - Hospital acquired infection.

HOB - Head of bed.

ICU - Intensive care unit.

DVT - Deep vein thrombosis.

CHX - Chlorhexidine.

CDC - Centre of disease prevention and control

COVID19 - Corona virus disease 19

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Appendix 1. Prisma flow chart

Appendix 2. Summary of the article

1 Introduction

Hospital-acquired pneumonia (HAP) roots in the environment-related component of the hospital settings and it is one of the most common health problems in the world even though it is preventable. 1.7 million hospitalized patients acquire healthcare related infections every year, and more than 98,000 of these infected patients die each year according to the United States Centre for disease prevention and control (CDC) (Aysegul, Oznur & Asiye, 2020).

Ventilator associated pneumonia (VAP) is one of the most serious HAPs in the Intensive care units (ICU s). VAP is the pneumonia that is acquired after 48 hours in a patient who is intubated and goes under mechanical ventilation. VAP occurs in a patient who is on mechanical ventilator support for a long time and during the hospital stay and increases the cost. Approximately 90% of pneumonia developed in the ICU s are seen in patients with ventilator support. The risk of VAP is higher in those patients who are intubated for more than 24 hours, compared to the other patients, and the risk increases with the duration of mechanical ventilation (Aysegul, Oznur & Asiye, 2020).

The risk factors related to the occurrence of VAP can be categorized into preventable (Supine position, enteral nutrition, insufficient subglottic aspiration) or non-preventable risk factors (age, gender, underlying diseases). Prevention of the occurrence of VAP by controlling the risk factors is much more economical than treatment of the disease. Hospital acquired infections (HAI) that lead to the development of VAP are reported to be associated with inappropriate practices in hand hygiene, mouth care, and aspiration. It has been seen that the main reason for the occurrence of VAP is the lack of knowledge and compliance with the recommendation and related guidelines. The nurses play a very important role in the prevention of VAP in the ICU by practising the evidence-based guidelines (Aysegul, Oznur & Asiye, 2020).

The authors motivation of this study of prevention of VAP is the previous work experience in the intensive care unit, Where it was seen that the most common problem was pneumonia due to the use of mechanical ventilator.

2 Aim

This study aims to identify the nursing care in the prevention of ventilator associated pneumonia in the intensive care unit by a scoping review.

Research questions:

What are the nursing activities that can be implemented in the prevention of VAP?

What is the nurse's role in the prevention of VAP?

3 Background

To understand the research topic, aim, and research questions it is important to understand the terms used in the study. In this chapter the terms and contents are described briefly for the readers to understand the study

3.1 Ventilator associated pneumonia

VAP is a union of radiological, clinical, and laboratory criteria. VAP is suspected in the patients who are receiving mechanical ventilator support and has the signs and symptoms of newly developed or progressive pulmonary dysfunction along with fever, leukocytes, and purulent tracheobronchial secretions. Pneumonia is classified as ventilator associated pneumonia if the patient gets an infection when the patient is intubated and receiving mechanical ventilator support within or before 48 hours of infection (Sedwick, Lance-Smith, Reeder & Nardi, 2012).

The patients who are intubated with an endotracheal tube are 6-20 times at a higher risk of development of VAP undergoing mechanical ventilation. In the development of VAP, the micro-organisms need to get in contact with the sterile lower respiratory tract. The critical care patients who are seriously ill are the most at-risk patients, for the micro-organism to get into the lower respiratory tract because these critical patients have a lower level of consciousness and an impaired gag reflex, which leads to an accumulation of

approximately 100 to 150 ml of infected secretions within the oropharynx within 24 hours. The insertion of the endotracheal tube results in a natural defense mechanism, against the infection by effective cough reflexes and mucociliary clearance of secretion. Failure of the cough reflexes, accumulation of secretions within the oropharynx, and insertion of endotracheal tube increase the risk of VAP in critical patients (Sedwick, Lance-Smith, Reeder & Nardi, 2012).

3.2 Pathophysiology

The onset of VAP can be divided into 2 types, early and late. Early-onset of VAP develops 48 to 96 hours after intubation and mechanical ventilation support, which is related to an antibiotic-susceptible organism. The late onset of VAP occurs after 96 hours of intubation and mechanical ventilation support, which is related to antibiotic-resistant organisms. The infection process involves 2 main processes i.e., Colonization of the respiratory and digestive tracts and a small amount of aspiration of secretions of the upper and lower airway. Colonization of bacteria is related to the presence of bacteria without an active reaction. Bacterial colonization of the lungs can be because by many sources. The sources of colonization include the oropharynx, sinus cavities, nares, dental plaque, gastrointestinal tract, contact contamination, and ventilator circuit. The inhalation of the colonization from any of the above sources can develop an active host reaction leading to VAP (Augustyn, 2007).

The insertion of an endotracheal tube into the trachea gives a direct opportunity for the colonizing bacteria to enter the lower respiratory tract. The upper airway and oral secretions can flow over the endotracheal tube, lining the tube and forming a coat. Colonization begins earliest 12 hours after intubation. The coat on the endotracheal tube lining contains a large number of bacteria that can be transported to the lungs through the breathing process supported by mechanical ventilation. In addition, the coating on the tube gets displaced by the saline that gets into the endotracheal tube, suctioning, coughing, or repositioning of the endotracheal tube (Augustyn, 2007).

The endotracheal tube causes an interruption between the upper airway and the trachea, bypassing the structure of the upper airway to the lower and providing the bacteria a direct route. The ability of the body to filter and humidify the air is also decreased because the upper airway is bypassed. The cough reflex is absent or decreased due to the presence of an

endotracheal tube. The mucociliary clearance function of the mucus membrane can be impaired due to the injury of the mucus membrane during intubation. The presence of an endotracheal tube provides an opportunity for the bacteria to bind, later increasing in production of mucus and secretions. The dysfunction of these natural host defence mechanisms increases the chances of bacterial colonization and aspiration of the colonized organism (Augustyn, 2007).

Aspiration of the gastric content is another cause of VAP since the gastric contents are the reservoir for bacteria. Almost all patient with mechanical ventilator support has a nasogastric tube or gastric tube for the administration of medication and food. The presence of the tube interferes with the normal functioning of the gastro oesophageal sphincter, which leads to increased gastrointestinal reflux and provides a route for bacteria to translocate into the oropharynx and colonize the upper airway (Augustyn, 2007).

3.3 Diagnosis

Every patient in the critical care unit who is under ventilator support is at is at a risk. Diagnosing VAP is yet difficult and controversial. The diagnosis can be made on the criteria of radiology findings, clinical findings, results of microbiological tests of respiratory tract secretions, or an invasive examination such as bronchoscopy. VAP is usually diagnosed based on new progressive infiltrate chest radiographs, although the chest radio-graphs are not specifically reliable therefore they should not be used alone to diagnose VAP. Other causes of pulmonary infiltration under mechanical ventilator support include atelectasis, pulmonary embolism, aspiration, pulmonary oedema, alveolar haemorrhage, pulmonary infarction, and acute respiratory distress syndrome (Augustyn, 2007).

The clinical findings of the patient with VAP may not be criteria to diagnose VAP, but the clinical assessment is the base for diagnosing VAP. The clinical symptoms such as fever, high leukocyte count, quantity and purulence of the secretions, oxygenation level, type of abnormal radiographic findings, and microbiology sputum gram stain results. These criteria may not diagnose VAP but may alert the physicians and nurses to the possibility of VAP. The other tests that are useful in determining the presence of VAP are blood cultures, pleural fluids, tracheal aspirate, and other respiratory samples obtained by bronchoscopy or needle aspiration. The diagnostic method depends upon the local expertise and facilities

available. The culture's findings help in choosing the appropriate antibiotics, thus improving patient outcomes (Roy, 2007).

3.4 Risk factor

Even though all the patient with endotracheal tube is at risk of developing VAP within 48 hours of intubation, Certain patients are at a higher risk of developing VAP. The risk of VAP can be divided into 3 groups i.e., host-related, devise related, and personnel related. Host related risk factors include pre-existing conditions such as immunosuppression, chronic obstructive lung disease, and acute respiratory distress syndrome. The host related risk factors include body positioning, level of consciousness of the patient, number of intubation, and medications including sedatives and antibiotics. The risk of infection is higher in patients lying in a supine position than in semi fowler's position. The interference of a normal mechanism of cough, and gag reflex contribute to the aspiration of the gastric content into the airways leading to VAP. Re intubation and subsequent aspiration can increase the possibility of VAP (Augustyn, 2007).

Device related risk factors include the device such as an endotracheal tube, ventilator circuit, and the presence of a nasogastric tube and the orogastric tube. Secretion pool above the cuff of an endotracheal tube and a low cuff pressure can lead to a small amount of aspiration containing bacteria into the trachea. Nasogastric and orogastric tubes interfere with the normal function of the reflux mechanism leading to the risk of VAP (Augustyn, 2007).

The personnel related risk factors in the population include those patients with increased risk of aspiration, low immunity, trauma, burn injury, acute lung injury, severity of illness and male gender, old age, obesity, chronic cardiac and pulmonary disease, malignancy, renal disease, diabetes mellitus, and head injury (Roy, 2007).

3.5 Prevention

VAP is a preventable infection although it has numerous risk factors, the nurse's intervention can help prevent VAP. Prevention of Pneumonia begins with vaccination.

Nurses are the first line of defence in the prevention of bacterial colonization of the oropharynx and gastrointestinal tract. Proper hand washing for 10 sec should be practised before and after getting into contact with patients. Gloves should be used while in contact with oral and endotracheal secretions. The reminder post on the doors can minimize the transmission of bacteria. If any patient is resistant to certain antibiotics and is isolated, the use of a gown is recommended (Augustyn, 2007).

Oral care is one of the procedures which helps in reducing the bacteria in the mouth either mechanical or pharmacological and both. The mechanical procedure includes brushing the teeth and rinsing of the oral cavity to remove the dental plaque. The Pharmacological procedure includes the use of antimicrobial agents. Both procedures decrease the probability of colonization in the oropharynx (Augustyn, 2007).

Most patients under mechanical ventilator support are given stress ulcer prophylaxis, with medication that increases the pH of the gastric. Ulcer prophylaxis such as Ranitidine, an H₂-receptor blocker, significantly reduces the risk of clinical bleeding without increasing the risk of VAP. Studies have been conducted on the use of stress ulcer prophylaxis, although the use of these inhibitors has increased in these recent years, according to the studies it has not shown any significant role in the development of VAP but may prevent serious complications of gastrointestinal bleeding (Augustyn, 2007).

Performing endotracheal suctioning with an aseptic technique to prevent the contamination of the airway is essential. Mucus in the airway can become stagnant and serve as a medium of colonization. After the suction, the suction catheter should be rinsed thoroughly so that the catheter is free of secretions and away from the patient. The saline lavage of the endotracheal tube dislodges the bacteria present in the tube to the lower airway, which increases the risk of VAP. Previous studies have not shown any significance in considering saline lavage to thin the secretions, rather it decreased the oxygen level in the lungs and increased blood pressure, heart rate intra-cranial pressure, and finally the risk of VAP. The need for saline lavage can be avoided by maintaining adequate hydration, proper humidification of the ventilator circuit, and using mucolytic agents or nebulizers helps in decreasing the viscosity of secretions (Augustyn, 2007).

Positioning the patient in the Intensive care unit every 2 hours is recommended and should be used as a standard of care, which increases the pulmonary drainage and decreased the risk of VAP. Positioning the patients in semi fowler's position also reduces the risk of aspiration. Elevation of the head end of the bed by 35 to 40 degrees, decreases the

incidence of VAP. The ventilator tubing should be drained out before moving the patients to avoid the risk of draining and inhalation of the infectious pathogen. (Roy,2007).

Hygienic practices are an intervention that can be easily performed but is poorly practised. The use of alcohol is a standard agent in the prevention of infections. Regular hand washing with an alcohol-based solution before and after patient contact is recommended and has proven to decrease the growth of bacteria. The use of gloves is added to hand hygiene practice, which should be used while handling the secretions or body fluid and moving to the next patient. Hand washing should be done before and after gloves use. All the health care team members should stick to the VAP preventions protocols, whether directly or indirectly getting in contact with patients with mechanical ventilator support (Roy,2007).

3.6 Intensive care

The implementation of intensive care units (ICU s) began in the year the 1970s in Brazil, after which the hospital achieved great development in treating critically ill patients, because before that they were not treated in appropriate areas and material resources for good care were lacking. The professionals, working in ICU s need to develop their technical and practical skills on daily basis. The health care team should be committed to systematic training and continuing to prevent, treat or control respiratory infections in critical patients (Oliveira et al.,2015).

The mechanical ventilator is a procedure used in patients with symptoms of gas exchange disorder. When the patient has disorders of gas exchange and is under mechanical ventilator support, the pulmonary defence mechanism is impaired by the underlying disease or by the protective upper airway, causing abnormal respiratory function, ranging from pulmonary hypersecretion to the increased frequency of respiratory tract infections (Oliveira et al.,2015).

Different viral infections caused, may lead to organ failure, including respiratory disease, which can develop, hypoxemia, respiratory failure, and acute respiratory distress syndrome, requiring admission to the intensive care unit (ICU). ICU s are specialized units wherein highly trained specialized health care workers work as a team to provide life-saving therapies. The number of beds in critical care units varies across the countries. Allocation

of beds in critical care units is based on the triage strategy protocol of the hospitals in the increased demand situation of beds, staff, and ventilators. The triage strategy criteria are set to determine which patient needs to be admitted to the critical care unit. In this ongoing COVID-19 pandemic situation, the triage protocol helped the health care system in decision making (Fiest et al.,2020).

3.7 Nurse's role in VAP

According to a study done in Hong Kong studying various research, it is found that the role of a nurse is very important in preventing VAP in intensive care units. Several seriously ill patients admitted to the intensive care unit developed different kinds of pneumonia, which increases the length of stay. The nurses are the guards to these patients who are at higher risk of developing VAP. The nurses are highly responsible to the vulnerable group in preventing VAP. It is critical to practice strict aseptic techniques in the critical care units to prevent infections, so it is very important to practice strict aseptic techniques while performing procedures. In the critical care unit sometimes the nurses, as well as the doctors, perform procedures in an emergency, which is done in a hurry. During these procedures, the nurses or the doctors may perform inadequate infection control practice, which may lead to infection. Thus, practising strict aseptic techniques in intensive care is very important in providing daily care to the patients (Kwong, Chair, & Suen 2009).

The nurses and other health care workers have performed different studies to verify the protocol in which the results are generally similar and useful. Constantly updating knowledge and skills through reading to prevent VAP is another strategy. All the new information will help to update the protocols to prevent VAP. Learning about the pathophysiology, the risk factors, and the prevention of VAP improves the awareness of the problem, therefore preventing the development of VAP (Kwong, Chair, & Suen 2009).

4 Earlier research

Critical nursing care has developed in recent years. The ventilator associated pneumonia bundle, an evidence based practise in the prevention of VAP has been developed. The evidence based practice has significance in a decrease of VAP rates. The aim of the

evidence based safety practices is to deliver and improve health care, resulting in positive patient outcomes. Initially, the VAP bundles indicated the best evidence based interventions that could prevent mortality and morbidity in the intensive care units. The VAP bundles include the combined care delivery implementation to prevent VAP. The VAP bundle focuses based on team care, strengthening the use of protocol and guidelines to bring optimal patient outcomes. These safety measures in the prevention of VAP are evidence based related to a disease process. These interventions are based on the point of patient care. The international health improvement leaders define VAP Bundles as a group of evidence based practices, which result in a reduction in the incidence of VAP, particularly when implemented together. VAP Bundles are the preventive and reliable steps that can be used to prevent VAP with positive patient outcomes. Each VAP Bundle component is supported by science and is evidence based considered a standard of patient care in mechanical ventilator care. The implementation of VAP Bundles should be done within a certain period and space so that effective deliverance of VAP Bundle is ensured. Research has been done which signifies the decrease of VAP incidence with the implementation of VAP Bundles (O'Keefe-McCarthy, Santiago & Lau, 2008).

The VAP Bundles initially originated from the international health improvement recommendations. The key components of the VAP Bundle include earlier head of bed elevation, daily sedation vacation (temporarily reducing sedation while the patient is on a ventilator), early extubation which could reduce the days of the ventilator, and peptic ulcer disease prophylaxis. Later it was suggested that oral care, ventilator tubing condensate, hand hygiene, use of gloves, DVT prophylaxis, and turning the patient from side to side. All the components of VAP Bundles are associated with the reduction of incidence of VAP. The interventions of the VAP Bundle components have their outcome in different ways. The head of bed elevation of 30°-45° reduces the risk of atelectasis by ensuring better ventilation. Head of the bed elevation also reduces the risk of gastric aspiration into the lungs. The DVT prophylaxis has been a practice in the intensive care unit, while the patient is on ventilator support and is sedated. It is accepted that the anticoagulant therapy and application of anti embolic stockings or interval compression devices as DVT prophylaxis is beneficial while on bed rest in the prevention of VAP. Peptic ulcer prophylaxis is implemented because studies have proved that patients with respiratory failure are at a high risk of developing stress ulcers and gastric bleeding. Sedation vacations help the patient to develop readiness for weaning and aim for early extubation which minimizes the use of a ventilator. The use of chemical sedation and paralytic agents might contribute to VAP. Sedation hinders the ability of the patients to swallow or clear the respiratory tract, which

could result in micro aspiration into the lungs. It is seen that the continuous aspiration of the subglottic secretions through the endotracheal tube decreases VAP rates by preventing micro aspiration into the lungs. VAP prevention guidelines included hand washing, use of gloves, and oral hygiene which reduces colonization which is essential in VAP prevention. Hand hygiene is a minimum standard of care along with universal precaution by using clean gloves while performing a closed suction and sterile gloves with open suction. Oral care is suggested to be performed using chlorhexidine gluconate twice a day. The goal-oriented VAP bundle of patient care practice is organized to ensure the successful implementation of bundle strategies. Teamwork and structural support are important to ensure the implementation (O'Keefe-McCarthy, Santiago & Lau, 2008).

5 COVID19 and ventilator associated pneumonia

Coronavirus disease 2019 (COVID19) is an infectious disease that is caused by an, enveloped, positive single-strand RNA virus. Coronavirus is among the pathogens that affect the respiratory system in the human body. Pneumonia caused by the coronavirus is known as acute respiratory distress syndrome coronavirus 2. The individuals affected with coronavirus show the symptoms such as non-productive cough, fatigue, fever, dyspnea, radiology finding of pneumonia, chest pain, and myalgia. Abdomen pain, vomiting, diarrhea, mucus production, headache, dizziness, and nausea are rarely seen. Acute respiratory distress syndrome in severe cases is the leading cause of coronavirus infection and thereafter death (Rauf et al., 2020).

COVID19 is associated with a large number of patients suffering from acute respiratory distress syndrome. These affected patients need intensive care for a longer period, with the majority of the patient requiring mechanical ventilator support. These critically ill patients on ventilator support are at higher risk of hospital acquired ventilator associated pneumonia. The causes of this pneumonia with COVID19 infection in the ventilator are the alteration of normal defence by invasive device, sedation, and absence of coughing reflex and airway clearance. Patients with COVID19 infection are at a higher risk of acquiring Ventilator associated pneumonia compared to non-COVID19 infection patients. A large number of COVID19 infections has led to increasing use of ventilation and longer duration of ventilation, thereafter causing VAP (Mailis et al., 2021).

6 Theoretical framework

For this study as a theoretical framework, the author has chosen, Nola J. Pender's theory of health promotion model. Pender's theory of health promotion model was revised and published in 1996. The foundation of the theory of the health promotion model was Pender's context in nursing, human development, experimental psychology, and education which led to use a holistic nursing perspective, social psychology, and the learning theory. The health promotion model was put together by the use of existing research to form a design of knowledge about health (Nola, 2014).

The theory aimed to combine what was known about health promotion conduct. The health promotion model is close in construction to the health belief model, which describes disease-preventing behavior. The health promotion model serves as a background for research that aims to predict overall health-promoting behaviors. The health promotion model is an instrument for research studies and the conceptual definitions give clarity and lead to a better understanding of the complexity of health behavior phenomena. Nursing speciality is grown and is important. Present clinical practice includes health promotion education. The health promotion model is found relevant in the nursing profession and is applied in global health promotion plans (Nola, 2014).

The health promotion model is used extensively used in nursing education. It has an application focusing on the importance of the assessment of factors that are believed to influence health behavior changes. The theory of the health promotion model is easy to understand. The Health promotion model assumes that individuals actively look forward to balancing their health-promoting behavior. Individuals interact with the environment, continuously transforming the environment as well as being transformed over time. Nurses are part of the interpersonal environment, which influences people throughout their life span. Self commenced changes of the person-environment interactive pattern are essential to changing behavior. The health promotion model outlines the many sides of nature of an individual interacting with the environment as they gain their health. Health promotion is motivated by the willingness to improve well-being and to realize human ability (Nola, 2014).

7 Methodology

A scoping review was done as a method of study. The choice of this method was done because of its quality to gain results in-depth, it provides an overview of the available studies. The scoping review not only answers the research questions but also gives more ideas on the particular topic of study. The steps of the study are directed in a very simple way, which makes it very clear for the researcher to proceed with the study (Arksey & O'Malley 2005).

The scoping review is a method in which the previous studies are summarized in a particular area and the main source and types of evidence available. This method does not only answers research questions but also allows to study of relevant topics in a broad aspect. The scoping studies aim to quickly map the key concepts that support a research topic and the evidence available. Till today there has not been much information available on how to apply scoping study. The scoping study for identifying literature needs to gain depth and broad results. The scoping study method is led by a requirement to select all relevant study articles rather than being highly focused on one type of study design. The researcher may not want to put strict limitations on the search terms, identification of relevant studies, or study selection (Arksey & O'Malley 2005).

There are four main reasons why a scoping study may be chosen as a study method.

- *To examine the depth, range, and nature of the research undertaking.
- *To establish the value of undertaking a full systematic review.
- *To outline and pass on research findings.
- *To recognize research gaps in the existing literature.

The stages of conducting scoping studies are according to Arksey's and O'Malley's model.

7.1 Identifying research questions

In the first step, the starting point in research is to form research questions that guide the study, which will help in building search strategies. It is important to consider which aspects of the research questions are important for example interventions or results (Arksey & O'Malley 2005).

In this study, the research questions are:

What are the nursing activities that can be implemented in the prevention of VAP?

What is the nurse's role in the prevention of VAP?

In this study, the author aims to focus on the areas of prevention. The aim of this study is to identify the nursing care in the prevention of ventilator associated pneumonia in the intensive care unit by a scoping review. The study will be based on interventions carried out by the nurses to prevent ventilator-associated pneumonia, excluding the medical side of prevention.

7.2 Identifying relevant studies

In the second stage, the identification of the relevant studies is done which are suitable for an answer, being comprehensive as possible in selecting material for study, whether published or unpublished (Arksey & O'Malley 2005).

The search for articles is done via electronic databases, websites, journals, and manual searches. In this study, the author has chosen CINAHL EBSCOhost, MEDLINE, and ACADEMIC SEARCH elite as the database for the search of articles for the study material. The search words were, Ventilator associated pneumonia prevention, mouth care, physiotherapy, suctioning, head of the bed elevation, aseptic techniques, sedation vacation, and early extubation. The boolean expressions such as AND, and OR were used at the time of search of study material. The selection of articles was done between 15.11.2021-10.12.2022. See Prisma flow chart. Appendix 1

7.3 Study selection

In the third step, the inclusion and exclusion criteria are to be considered to obtain a more specific topic. Initially, a large number of study materials are chosen, and the method of inclusion and exclusion criteria helps in selecting the appropriate material for the study (Arksey & O'Malley 2005).

In this study the, search for study material was done in the database CINHAI EBSCOhost, MEDLINE, and ACADEMIC SEARCH elite. The search was done according to the research questions. The inclusion criteria were articles that were in full text, peer-reviewed, and articles published in 2014 and later. All the articles that were selected were in English language, abstracts available, and suitable to the research questions. In the same way, the exclusion criteria are the articles that are not available in full text and that were not peer-reviewed. The articles were excluded which were published before 2014. A total of 107 articles were found after inclusion and exclusion criteria, after going through the articles in brief 10 relevant articles were selected for the study. The selection of these articles was done through reading the abstract of the study. 97 articles were excluded since in some studies the results were not clear and completely reliable according to the aim and research questions.

7.4 Charting the data

The fourth step according to the model includes mapping important information obtained from the primary research reports. This means that one needs to go through the collected material and sort it by theme and categories to make it easier to compile the result (Arksey & O'Malley 2005).

In this study, the author went through the final 10 articles selected for study in detail and made a summary of the articles in a table. The table charted the following data i.e. Authors' names and years of publications, title, published journal, aim, methodology, and result. See summary of articles appendix 2. The categories that were formed to make it easier and simple for the readers to understand were according to the results of the articles.

7.5 The compilation, summary, and report results

The fifth step of the model is a compilation, summarizing, and reporting of results. The summary of results in a scoping review is to get an overview of the selected material. The purpose of a scoping review is not to assess the quality of the evidence presented in the entirety of the result (Arksey & O'Malley 2005). The material was analyzed objectively and with the help of clear categories from the previous steps, the results of the articles

could easily be broken down and compiled. The selected articles were read several times and discussed with the appointed supervisor. The results of the study were summarised category wise. In the selected article, the studies showed different results and compared among these results. In the article analysis, the article emerged with purpose, approach, and results. The categories that were formed are physiotherapy, mouthwash or oral care, head of the bed elevation, suctioning, aseptic techniques, and sedation vacation or weaning. At the end, finally, the results were discussed.

7.6 Optional stage: Consultation exercise

Consultation exercise an optional stage is recommended in conducting a scoping review. Although not many studies have applied this optional stage in their studies, it is suggested that it adds strength to the studies underlying logic and confidence with which conclusions can be withdrawn (Danielle, Heather & Kelly, 2010).

In this study, the consultation has been done by the appointed supervisor in all stages. The supervisor has read the work and suggested corrections and additions that are applicable in this study.

8 Ethical considerations

Ethics introduces the moral principles that guide decision-making and behavior or the best way to live a moral life. Moreover, ethics are rules and standards by which the community regulates the behavior of its members. Moral principles, therefore, arise from the belief of what is considered right and wrong, which is socially, philosophically, and professionally based. Finally, the nurses and the nurse researcher are to live, work and research ethically and follow a good life from which any human can prosper physically, emotionally, psychologically, normally, interpersonally, and socially (Ingham-Bloomfield & Becky 2017).

Any person who is part of the research should be respected as a self-determined chooser and free to act upon their priorities. Every possible topic should be explained fully and the

right to refuse participation at any time should be considered. Justice is also known as fairness, which should be considered with the participant. In research, there is a right to privacy which means that both in nursing and nursing research confidentiality should be maintained for each patient or participant. Ensuring the principle of non-maleficence also called not harm is essential in research, which sets a compulsion not to injure others or any participants of the research (Ingham-Bloomfield & Becky 2017).

The ultimate goal of the research should be to bring benefits or to do good to others which is also called beneficence. The risk of exploitation is avoided. The risk and benefits that may happen must be clearly explained in any study. The other two principles are fidelity and veracity. Fidelity means to be honest with agreements and promises between the researcher and the participant. Veracity refers to telling the truth. The nurses' researchers should be able to tell the reason behind all these principles, as the nurses are accountable for their actions. These principles must be understood and followed accordingly (Ingham-Bloomfield & Becky 2017).

In this study, the researcher has done its best to follow the guidelines of the Finnish Advisory Board on Research Integrity. As the study has been conducted in a scoping review method there is no direct connection with any individual. The researcher has taken into consideration the principles of ethics to avoid harm by giving wrong information which directly or indirectly would affect an individual, but benefit others from this study by providing knowledge, especially in this COVID 19 pandemic. Plagiarism has been avoided by writing in own words and not copying the words. The materials borrowed from different articles are cited carefully after each paragraph and the references are given at the end. The researcher has followed the guidelines of the Novia university of applied sciences in conducting research (Finnish Advisory Board on Research Integrity, 2012)

9 Research and findings

This chapter uncovers the results of the selected articles used for study material according to research questions. The results have been segregated into six categories for a clear understanding for the readers. The 6 categories are created in consideration of the research questions i.e nurse's role in the prevention of VAP and nurses activities in prevention of VAP. The six categories are made as follows:

- Physiotherapy
- Elevation of the head of the bed
- Mouth care or oral
- Suctioning
- Aseptic techniques
- Sedation vacation and weaning from mechanical ventilator

9.1 Physiotherapy

Effectiveness of respiratory physiotherapy services was evaluated for patients admitted to the intensive care unit with acute brain injury on the occurrence and purpose of VAP in patients. The findings of the study showed that the use of regular prophylactic respiratory physiotherapy procedures, frequently done six times a day along with positioning and suctioning seem to prevent VAP, and minimize the use of a mechanical ventilator or the length of ICU stay. On the other hand Suctioning hastened the recovery in terms of minimizing the length of mechanical ventilator or ICU stay. The main result of this study was that the use of a regular prophylactic respiratory physiotherapy procedure, along with positioning and suctioning in addition to routine medical and nursing care, seems to prevent VAP, reduce the use of a mechanical ventilator and minimize the length of ICU stay in adults with acute brain injury (Aggarwal, Luhadia, Bhatnagar & Goyal,2018).

Another similar study by the same author done to explain the role of respiratory physiotherapy in preventing and treating VAP in patients with acute brain injury in the ICU. The study aimed to develop if delivering regular prophylactic respiratory physiotherapy interventions, in addition to routine medical and nursing care, affected the incidence and treatment of VAP. The result of the study showed that the effect of regular prophylactic respiratory physiotherapy six times a day including at night, along with positioning of the patient, and suctioning appeared to prevent VAP (Aggarwal, Luhadia, Bhatnagar & Goyal,2018).

9.2 Elevation of the head of the bed

The head of bed elevation (HOB) and early outcomes of gastric reflux, aspiration, and pressure ulcer examined the viability of 45° HOB elevation and described and compared the occurrence of reflux, aspiration, and pressure ulcer development at 30° and 45° HOB elevation. The HOB was elevated at 30° for 12 hours on one day¹ and at 45° for 12 hours on day 2. The patients were positioned according to their clinical needs for the rest of the night time. HOB elevation up to 30° was considered a standard of care and HOB elevation up to 45° was the experimental intervention. In the findings of this study, it said that the patients who were kept at a higher elevation of bed or 45° angle had lower oral and tracheal secretions which lead to lower aspiration and ventilator associated pneumonia rates compared with rates in patients kept in a supine position (Schallom, Dykeman, Methny, Kirby & Pierce, 2015).

9.3 Mouth care or oral hygiene

The effect of 0.12% Chlorhexidine gluconate use for oral care on preventing VAP and VAT with the placebo group was compared, as well as compared its effect on oral health and prevention of oral colonization with the placebo group. The oral care protocol was developed, three times a day with 0.12% Chlorhexidine gluconate by the nurses. In the other placebo group, oral care was performed three times a day with sodium bicarbonate. The oral care procedure was observed and investigated by special nurses. The findings showed that there were significant differences between the two groups' VAP development. In the 0.12% CHX group, there was a higher number of *Pseudomonas aeruginosa* and *Escherichia Coli* isolated from mini-BAL cultures of patients with VAP. There was no significant oropharyngeal colonization found in both groups initially. Although, the incidence of oropharyngeal colonization decreased in the 0.12% CHX group compared with the placebo group later. The presence of *Klebsiella pneumonia*, *Acinetobacter baumannii*, *Enterobacter cloacae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* decreased in the 0.12 % CHX group. Whereas *Klebsiella pneumonia* was reduced more in the placebo group. The final result of the study revealed that 0.12 % CHX gluconate used for oral care is beneficial for the prevention of VAP (Kes, Aydin Yildirim, Kuru, Pazarlioglu, Ciftci & Ozdemir 2021).

One of the study described Four studies done in different methods to show the effect of mouth care with chlorhexidine in the prevention of VAP. The first of four study was done comparing Placebo, chlorhexidine, and chlorhexidine colistine. The results showed the occurrence of VAP was 10% in the patients with mouth care group with chlorhexidine, 13% in those patients who used chlorhexidine colistine, and 18% in those patients who used the placebo. The second study of the four article included was done comparing chlorhexidine and saline. For the result, the VAP diagnosis was done only by the findings of the cultures. Results showed that VAP occurrence in the chlorhexidine group was 41% and 69% in the saline group. The third study among the four described oral care with placebo alone, placebo with chlorhexidine, and with chlorhexidine. The measurement of VAP was based on the widely used clinical pulmonary infection score tool and the presence of pathogens in the pleural fluid. The result showed that the occurrence of VAP was 14% in the chlorhexidine group, 15% in the chlorhexidine placebo group, and 24% in the placebo group. Finally, the fourth study compared the oral solution chlorhexidine and other solution which was not mentioned. The diagnosis of VAP was done by, first, identifying infiltrate on chest X-ray, and then by the findings of the presence of pathogens in the tracheal cultures, Fever, pleurant tracheal aspiration, and leucocytosis. The study found that VAP occurred in 5% of patients in the chlorhexidine group compared with 12% of the other groups (Jackson & Owens 2019).

Focusing on the importance of oral hygiene in the prevention of VAP it was that 60% of VAP can be prevented through the implementation of routine oral care as a standard practice. Dental plaque may serve as a pathogen in patients in ICU. These dental plaques may be removed by tooth brushing. Studies have shown tooth brushing may be an effective intervention in the prevention of VAP. A clinical study showed that after seven days, tooth brushing with sterile water twice a day reduced the occurrence of VAP. In another literature review study, it was indicated that tooth brushing in combination with chlorhexidine was highly recommended as it reduced the incidence of VAP. It indicated that tooth brushing needs to be accompanied by antimicrobial mouth wash. Another study said that manual tooth brushing with chlorhexidine was not beneficial in oral care. Antibacterial effect of chlorhexidine mouthwash significantly reduces the growth of bacteria. Chlorhexidine reduced *Staphylococcus aureus* and negative agents such as *Pseudomonas aeruginosa* and *Acinetobacter* in dental plaques (as a source of bacteria) by 0.12% .On the other side it demonstrated that the use of oral antiseptic chlorhexidine neither caused a significant reduction in the VAP nor changed the mortality rate. Another systematic review and meta-analysis showed that the use of chlorhexidine resulted in a significant reduction of VAP

risk. It was also introduced that the use of 2% chlorhexidine was the most effective implementation to reduce VAP. It has been seen that adverse effects and resistance to antiseptic mouthwashes have occurred in the patients in ICU. Therefore some studies have been undertaken to find antibacterial agents in the plant origin. Herbal mouth wash of persica reduced the growth of bacterial colonization and was effective on certain organisms in the ICU in the patients under mechanical ventilators. The antibacterial effect was compared between herbal mouth wash persica 10%, chlorhexidine gluconate 0.2%, and normal saline in mechanically ventilated patients. The result showed that all three types of mouthwash reduced the colonization after the intervention. Both CHX gluconate 0.2% and persica 10% were similarly effective on *Staphylococcus aureus* and *Streptococcus pneumoniae*. It was then concluded that the herbal mouthwash can be used as an alternative to chemical mouthwash. However, chlorhexidine showed a higher antibacterial effect. (Darvishi et al.,2014).

9.4 Suctioning

It was signified that tracheal suctioning as one of the most common invasive procedures implemented by the nurses in ICU which is important in the prevention of VAP. Closed suction systems with an open suction system were compared to identify the most effective suctioning technique for the prevention of VAP. Neither of these studies explained that the closed suction system was preferable to an open suction system for the reduction of the early onset of VAP and only one study supported a closed drainage system for the prevention of the late onset of VAP. However, it was specified that it did not have enough evidence to recommend the standard use of a closed suction system over the open suction system as a complement to prevent VAP. The study mainly focused in the prevention of VAP by tracheal suctioning. Additionally, it was suggested that the policy guidance, effective training, education, and behavioural and management strategies for the nurses should be implemented to focus on the prevention of VAP (Letchford & Bench 2018).

9.5 Aseptic techniques `

Assessment of the knowledge of the nurses in pneumonia prevention practices associated

with mechanical ventilation was done in the patients hospitalized in the intensive care unit. The nurses had enough knowledge about the standard of care. They stated that basic steps applied by the nursing staff such as hand washing regularly and wearing gloves while taking care of a patient in an intensive care unit could prevent VAP. Hand washing was highlighted as a very important measure in the prevention of VAP specially by the nurses. The nurses are directly connected with the care of critically ill patients, particularly in the ICU s. Hand washing is an infection control measure. Hands are the main route of transmission of micro-organisms therefore, it must take place before and after patient contact, before putting on gloves and after removing them, between one patient to another contact, during the procedure and after the procedure, on getting into contact with patients and environments, after contact with blood, body fluids, secretions, excretions and contaminated articles or equipment's (Oliveira et al.,2015).

A similar study investigated the effect of a simplified prevention bundle with an alcohol-based, dual hand hygiene audit on the incidence of early-onset ventilator associated pneumonia. An unaware external hand hygiene audit was done as a regular and independent task before and after VAP bundle implementation. The 3-component bundle, which was implemented in the study was a compulsory education program for all the health care workers in the cardiac surgery ICU, a known internal hand hygiene audit by a unit-based observer was done, and standard oral care by 0.1% Chlorhexidine gluconate tooth brushing and mouth washing. Bundle reminders were posted in the ICU to involve health care workers' attention regarding bundle care. The external hand hygiene compliance was monitored by a well-trained knowledgeable nurse of the institutional infection control centre at unpredictable times and the feedback was disclosed quarterly. The mouth care compliance was observed by the unit-based observer, a well-experienced nursing leader, who provided feedback to ensure the quality of care and announced the findings monthly. The study resulted in a steady and sustained decrease in total VAP incidence. In conclusion, the 3-component bundle successfully reduced the incidence of early-onset VAP in the cardiac surgery ICU. The study stated that efforts to improve hand hygiene are the leading step to preventing infections (Su et al.,2017).

9.6 Sedation vacation and weaning from ventilator

Delayed weaning and extubation lead to the unnecessary duration of a mechanical

ventilator, VAP, and prolonged ICU stay. Delayed weaning and extubation appeared to be due to the uncoordinated care practices considering different doctors' practices. Therefore, the ICU team developed a mechanical ventilator weaning protocol to address this matter. The team involved two nursing consultants and four ICU nurses and was supported by the ICU doctors. After implementation of the protocol, The ICU nurses commenced the protocol custom of the mechanical weaning once the patient was assessed fit for weaning by the doctor. Then the mechanical ventilator weaning protocol was started by the ICU nurse by setting the ventilator to lower pressure support settings and monitoring the vitals for intolerance of the weaning process. If the patient did not show any signs of weaning intolerance and had a good cough reflex with a minimal amount of sputum suctioned, the patient was considered ready to extubate. After three years of implementation of this weaning protocol, it was seen that the duration of mechanical ventilation duration of the patients was reduced to 81 minutes when compared to the duration of 134 minutes two years back. The implementation of the mechanical ventilation weaning protocol helped in reducing the duration of weaning from mechanical ventilation and timely extubation, thus preventing VAP (So,2020).

Patients who are intubated are at the risk for the development of VAP, and the longer the duration of mechanical ventilation, the higher is the risk of incidence of VAP. Multiple other risk factors have increased the risk increased rate of VAP, some of the risk factors include gender, age, history of chronic diseases, etc. Therefore, ventilator duration-related prevention begins with avoiding or reducing the duration of the mechanical ventilator as much as possible. Several plans of action have been proposed to achieve the goal of VAP prevention. Sedation vacation and weaning trials have been studied as one of the methods along with others to decrease the time of mechanical ventilation to decrease the risk the VAP. Sedation vacation and weaning trials are a plan of action to let the patient out of the mechanical ventilator. This plan of action has been regularly described as a verified action that reduces the time of mechanical ventilation. As the risk of VAP is associated with the time duration of mechanical ventilation, reducing the duration with sedation vacation and weaning have shown a positive outcome related to the prevention of VAP (Keyt, Faverio & Restrepo,2014).

10 Discussion

This chapter's focus is to explain the methods and findings according to Nola J. Pender to find the correlation and point to a new direction of nurse's practice and prevention implementation in this area. This thesis primarily aims to identify the nursing care in the prevention of ventilator associated pneumonia in the intensive care unit.

10.1 Discussion of the method

During the search of the article for the study material, it was found that there is a shortage of articles related to nurses' points of view on the prevention of ventilator associated pneumonia. Many of those articles that were found were published many years before, which were quite old. Those articles that were published in 2014 and after did not mostly study the nurse's role in the prevention of ventilator associated pneumonia. The method, of scoping review, helped the author to make it easier in selecting articles since scoping review does not have limitations or restrictions in study selection. Scoping reviews allow to use of all types of articles published or unpublished for study and it is also a very good method to study a broad topic.

Scoping review helped the author to solve the problem of shortage of articles and discover the lack of study material related to the nurse's point of view instead there were more articles on pharmacological and hospital protocol in the prevention of ventilator associated pneumonia. Some other difficulty faced during the search of the study material was that there were articles that could have been relevant for the study which was hidden behind coasting to pay for the article. Limitations could be Some articles left behind due to the inclusion and exclusion criteria, which were English language, scientific articles, peer reviewed, full-text articles, and lately published articles between 2014 -2022. The database journal used were CINHALL EBSCOhost, Academic Search Elite, and Medline. A total of 107 articles were found after inclusion and exclusion criteria, out of which only 10 were selected due to the unreliability of the article and not be relevant to the research questions.

10.2 Discussions of the findings

Ventilator associated pneumonia is one of the major hospital acquired pneumonia, which has several causes. It is the most common problem in the health care settings even though it is preventable. Hygiene is the of the most important preventive implement in the case of VAP prevention along with other implementations.

Studies carried out by Agarwal et al. (2018) evaluated the effectiveness of respiratory physiotherapy services for patients admitted to the intensive care unit on the occurrence purpose of VAP in patients. Prophylactic physiotherapy six times a day aids in the prevention of VAP and minimizes the hospital stay. On the other side, when a patient has acquired VAP, prophylactic physiotherapy six times a day helps in earlier recovery. The physiotherapy movement of the body parts, specifically the chest physiotherapy allows the mucus or the secretions that get immovably adhered to the sides of the chest to detach from their place and come out while suctioning. If not chest physiotherapy, it would be difficult to reach the inner sides of the chest to suction out the secretion which causes VAP.

Elevation of the head of the bed to 45° is another preventive implementation. Not many studies were found during the search of study material, on the topic of elevation of the head of the bed. Schallom et al.(2015) showed in the result that HOB elevation to 45° assists in the prevention of VAP. Elevation of head of bed prevents (Roy,2007). Aspiration of gastric content into the lungs is one of the most common problems seen in patients with mechanical ventilator support as there is an absence of coughing and swallowing reflux due to the presence of an endotracheal tube. When the patient does not have swallowing and coughing reflux there are very high chances of aspiration since the mucus membrane continues to produce secretions therefore, Positioning the patient at a 45° angle HOB elevation prevents gastric reflux and aspiration of gastric content into the lungs.

Implementation of oral hygiene is another factor that prevents VAP. There are several and most common studies carried out on oral hygiene in the prevention of VAP. (Kes et al, 2021; Jackson, I & Owens, 2019 & Darvishi et al, 2015 concluded that chlorhexidine oral wash agent is the most effective antiseptic agent for oral care 3 times per day which aids in the prevention of VAP. These studies revealed some other agents used for oral care such as an herbal agent known as persica, and saline water, all these agents assisted in VAP prevention to some point, however, chlorhexidine solution of different concentrations was the most effective. Herbal mouth wash persica was suggested to be used for patients who are allergic to chlorhexidine (Darvishi et al.,2014). It showed that different solutions act

differently on different organisms when VAP was acquired by the patients. Proper oral hygiene 3 times a day is to be implemented by the nurses, for which the nurses require training and education to follow the guidelines. The oral cavity is a perfect habitat for all kinds of micro-organism to develop and multiply. It is a cavity that has suitable humidity and oxygenation for the growth of bacteria. The organisms develop and colonizes causing contamination, thereafter transportation of pathogens causing infection into the lungs through the respiratory tract causing VAP. 60% of VAP can be prevented by routine oral hygiene and standard practice (Darvishi et al.,2014).

It was indicated that tracheal suctioning is one of the invasive procedures done by the nurses to remove the secretion from the trachea to prevention of VAP. There are two forms of suctioning, closed and open. The study compared the effectiveness of these open and closed systems, where neither of them showed preferable results over the other. Effective suctioning of the trachea helped in the prevention of VAP. Additionally suggested that the nurses be given effective education, training, and guidelines for the prevention of VAP (Letchford and Bench 2018).

Another most important practice by the nurses is aseptic techniques in the prevention of VAP. There are several components of antiseptic techniques, the two main components include hand hygiene and using of hand gloves while taking care of the patient in the intensive care unit. A study done by Oliveira et al.(2015) stated that hand washing and using hand gloves were practised by all nurses efficiently, which prevented VAP by disrupting the cross contamination. According to Roy (2007) hand, hygiene and the use of hand gloves can prevent VAP. It can be used in different situations such as before and after getting into contact with the patient and the patient's surroundings. This also implies taking care of patients with mechanical ventilator support. Su et al. (2017) concluded that hand disinfection with an alcohol solution helps in the prevention of the spread of micro-organism. The contaminated hands of the nurses spread one person's pathogens to others and cause cross contamination. On the other way when suctioning or another oral hygiene is performed with contaminated hands, the infection causes pathogens to dislodge into the lungs through the respiratory tract. Therefore as aseptic techniques play an important role in VAP prevention.

So,(2020) concluded that delayed weaning from ventilator and extubation, lead to ventilator associated pneumonia and prolonged ICU stay. In this study, a weaning protocol was developed. The ICU nurses assessed the patient's tolerance to low ventilator support, if the patients tolerated low support, they were extubated by the order of the doctor.

Keyt et al.(2014) explained that all patients who are intubated are at risk of developing VAP. Multiple other risk factors have increased the risk increased rate of VAP, some of the risk factors include gender, age, history of chronic diseases, etc. Sedation vacation is one other form of weaning to reduce the ventilation duration to prevent VAP. Weaning the ventilator support and sedation vacation has aided in reducing the use of ventilator support and ICU stay, therefore Prevention in development of VAP.

Nola J Pender's theory of health promotion model aimed at what was known about health promotion behavior. This health promotion model focuses on the health belief model, which explains disease-preventing behavior. It helps in implementing overall health promotion activities. This model helps us to understand how the health promotion model is important and relevant in the nursing profession and education, that is applied globally(Alligood,2014). A study suggested that the policy guidance, effective training, education, and behavioural and management strategies for the nurses should be implemented to focus on the prevention of VAP (Letchford & Bench 2018). The nurses had enough knowledge of the standard of care. It was seen that basic steps applied by the nursing staff such as hand washing regularly and wearing gloves while taking care of a patient in an intensive care unit could prevent VAP. Hand washing was highlighted as a very important measure in the prevention of VAP, especially by the nurses as they are directly connected with the patient care of critically ill patients, particularly in the ICU s (Oliveira et al.,2015). Therefore the health promotion model, helps us to understand the importance of health education and its importance on VAP prevention measures. The nurses can implement their knowledge by practising aseptic techniques when they had received an education. The health promotion model can be applied in the early stage of life by adopting a healthy lifestyle by educating the community so that one can avoid falling into the risk group categories of developing the disease. According to the health promotion model, health promotion education is a part of clinical practice where the nurses play the role of educator by counselling the people for the prevention of disease. All the patients are at a high risk of developing VAP. Certain patients are at a higher risk, which includes pre-existing conditions such as immunosuppression, chronic obstructive lung disease, and acute respiratory distress syndrome (Augustyn,2007).

So, (2020) stated that delayed weaning leads to prolonged use of mechanical ventilator support. According to Keyt et al. (2014) interrupted mechanical ventilator support and sedation vacation reduces the duration of mechanical ventilator use. Comparing both of

these above studies agrees on the reduction of ventilator duration by weaning and sedation vacation prevents VAP. Primary implementation in the prevention of VAP is to avoid prolonged use of mechanical ventilators. The endotracheal tube itself is the primary source of infection placed in the trachea, connected to the ventilator. Therefore the research done, concluded that the minimal use of a mechanical ventilator and early extubation by sedation vacation and weaning protocol prevents VAP.

The nurses play multiple important roles in patient care, particularly in the prevention of ventilator associated pneumonia (Kwong, Chair, & Suen 2009). The nurses role are care giver (Oliveira et al.,2015) supervisor and manager (Su et al.,2017) educator, councillor and instructor (So,2020) and a researcher (Kes et al.,2021). As stated earlier that not much studies have been done in nurse's role prespective in the prevention of VAP, therefore it is required that more studies to be carried out. The recent studies will help the nurses gain and update their knowledge in latest prespective with latest technologies available and thus contribute in VAP prevention.

11 Conclusion

This study has focused on the nurses perspective of prevention of ventilator associated pneumonia in the intensive care unit. The aim of the study is to identify the nurses role in the prevention of VAP, by a scoping review. The results of this study conveyed that the nurses play multiple roles in prevention of VAP, such as a caregiver, educator, councillor and instructor, manager and supervisor, and a researcher. The study identified Physiotherapy, Elevation of head of bed, mouth care or oral hygiene, Suctioning, aseptic techniques and sedation vacation and weaning from the ventilator as the nursing implementation in the prevention of ventilator associated pneumonia and also has described these implementation briefly. As the theory of health promotion model explained above, the nurses play an important role in maintaining health and preventing disease as an educator. The nurses needs to be given education and instructions as they are the one who stand in the front line as a caregiver. In this present situation of COVID19, where there the use of mechanical ventilators have increased and increasing in the numbers of VAP, the importance of nurses knowledge in prevention is understood. During the study in this topic it has been seen that there are shortage of research's in this topic in the recent years. It is recommended that more studies need to be done on nurses responsibilities in VAP prevention to fill the gap.

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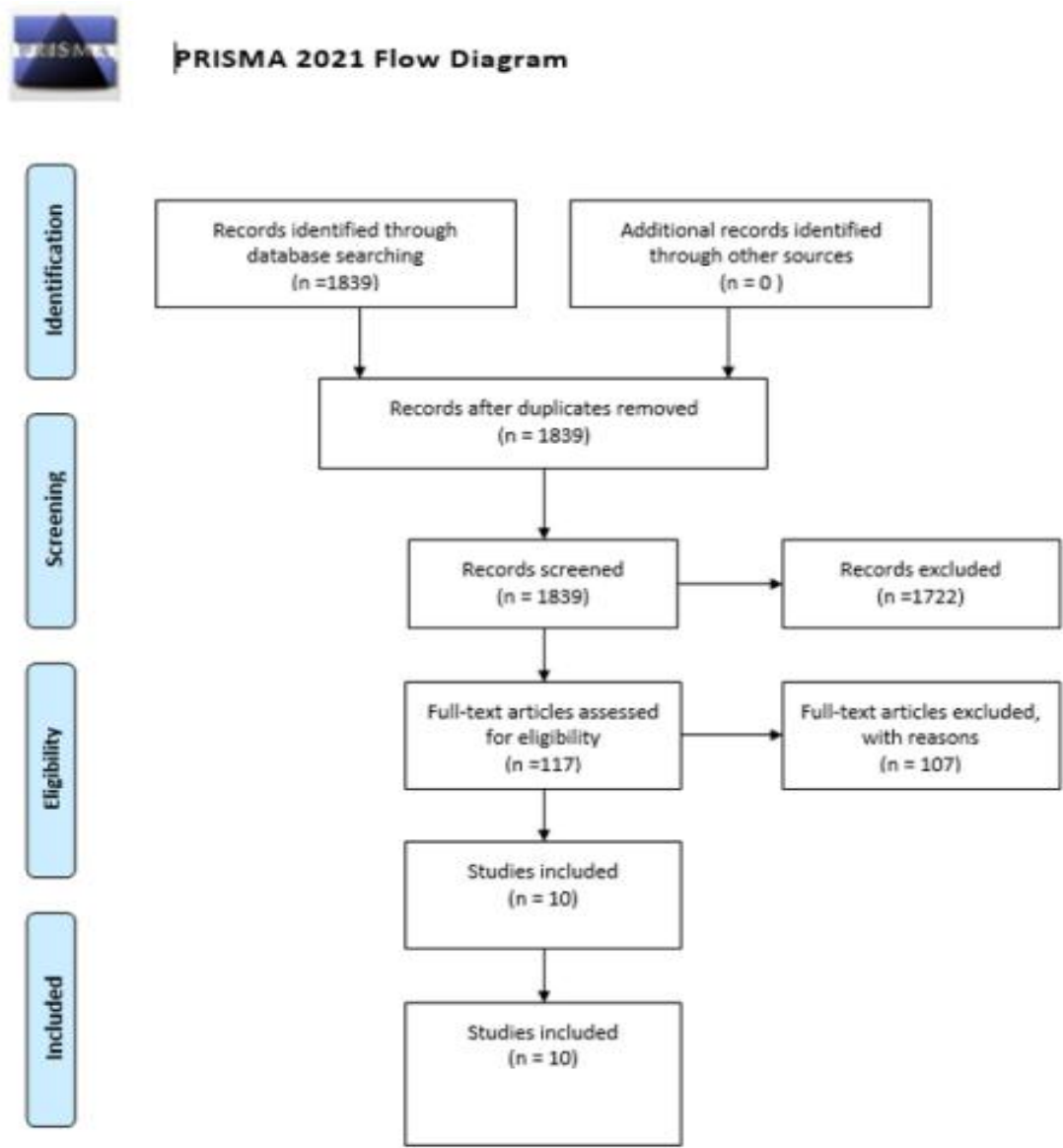
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Appendix 1 : PRISMA FLOW DIAGRAM



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

Appendix 2: SUMMARY OF ARTICLES

No	Author	Topic	Aim	Methods	Results
1	Aggarwal, S Luhadia, S.K Batnagar P and Goyal M. (2018) Indian journal of physiotherapy & Occupational Therapy.	Effectiveness of prophylactic Respiratory Physiotherapy in Reducing the Mechanical Ventilation stay of Patients with Acquired Brain Injury in Intensive care Unit.	This study aimed to provide the first comprehensive objective evaluation of the effectiveness of respiratory physiotherapy services for patients admitted to the ICU with ABI by: <ul style="list-style-type: none"> • Investigating the clinical effectiveness and cost- effectiveness of respiratory physiotherapy interventions in preventing the incidence of VAP and other important clinical outcomes, such as duration of MV and length of ICU stay. • Providing rationale of respiratory physiotherapy service provision to the ICU in terms of clinical effectiveness and cost- effectiveness for patients with VAP following ABI. • Providing acceptance of the required level of respiratory physiotherapy services and staffing in the ICU based on clinical outcomes. 	A prospective randomized trial method was undertaken to investigate the effects of respiratory physiotherapy on the incidence and resolution of VAP in patients admitted with ABI to the ICU. Male and female patients were given continuous physiotherapy every 4 hours, day and night. In addition to routine medical and nursing care and daily passive movements were done.	Regular physiotherapy six times a day along with changing patients' position, MH, and suctioning could prevent VAP, and reduce the duration of MV or length of ICU stay in adults with ABI.

2	<p>Aggarwal S, Luhadia S.k, Batnagar P and Goyal M. (2018)</p> <p>Indian journal of physiotherapy & Occupational Therapy.</p>	<p>Comparison between Non-VAP and VAP patients with acquired Brain Injury who was Admitted to the Intensive Care Unit.</p>	<p>This study aimed to provide the first comprehensive objective evaluation of the effectiveness of respiratory physiotherapy services for patients admitted to the ICU with ABI by:</p> <ul style="list-style-type: none"> •Exploring the clinical and cost-effectiveness of respiratory physiotherapy interventions in preventing the occurrence of VAP and other important clinical outcomes, such as duration of MV and length of ICU stay. • Providing rationale of respiratory physiotherapy service facilities to the ICU in terms of clinical effectiveness and cost-effectiveness for patients with VAP following ABI. • Providing validation of the required level of respiratory physiotherapy services and staffing in the ICU based on clinical outcomes. 	<p>A prospective randomized trial was undertaken to investigate the effects of respiratory physiotherapy on the incidence and resolution of VAP in patients admitted with ABI to the ICU.</p>	<p>Use of a regular prophylactic respiratory physiotherapy regimen, repeated six times per day and comprising of positioning, MH, and suctioning appeared to prevent VAP, and reduce the duration of MV or length of ICU stay in adults with ABI.</p>
3	<p>M Schallom, B Dykeman, N Metheny, J Kirby, and J Pierce. (2015)</p> <p>American Journal of Critical care.</p>	<p>Head-of-bed elevation and early outcome of gastric reflux, aspiration and pressure ulcers: a feasibility study.</p>	<p>The objectives of this study were</p> <ol style="list-style-type: none"> (1) To determine the feasibility of achieving a HOB angle of at least 30°. (2)To describe and compare the occurrence of reflux (pepsin positive oral 	<p>A 2-day crossover trial was conducted with random assignment to HOB elevation sequences. The HOB was elevated to 30° for 12 hours on day 1 and at 45° for 12 hours on day 2. The nurses positioned the patient according to their clinical needs and patients'</p>	<p>HOB elevation greater than 30° is feasible and preferred to 30° for reducing oral secretion volume, reflux, and aspiration without pressure ulcer development in</p>

			secretions), aspiration (pepsin-positive tracheal secretions), and pressure ulcer development (per National Pressure Ulcer Advisory Panel guidelines) at HOB elevations of 30° and 45°, (3) To determine the association between lowered HOB and reflux, and (4) To determine the association between patients' characteristics and reflux	preference. HOB to 30° was considered the standard of care.	gastric fed patients receiving mechanical ventilation. More deeply sedated patients may benefit from higher HOB elevations.
4	D Kes, T Aydin Yildirim, C Kuru, F Pazarlioglu, T Ciftci & M Ozdemir. (2021) The Official Journal of the Society of Trauma Nurses.	Effect of 0.12% Chlorhexidine Use for Oral Care on Ventilator-Associated Respiratory Infections: A Randomized Controlled Trial.	This study aimed to: (1) compare the effect of 0.12% CHX gluconate use for oral care on preventing VAP and VAT with the placebo group. (2) To compare its effect on oral health and prevention of oral microbial colonization with the placebo group.	A prospective, single-blinded, randomized controlled trial method was used. The study was done between April 2019, to March 3, 2020. Subjects were adult patients who were mechanically ventilated in the 18-bed anesthesiology and surgical ICU of an urban training and research hospital in northwest Turkey. An oral care protocol was made by the infection control nurse and the nurses were trained according to the protocol. Oral care was performed 3 times a day. Two groups were made, in one group oral care was done with sodium bicarbonate and in the other group chlorhexidine, 12% was used.	This study indicated that 0.12% CHX gluconate use for oral care three times a day is an effective intervention for VAP prevention and reducing microbial colonization in mechanically ventilated patients. In addition, 0.12% CHX could improve oral health.
5	L Jackson & M Owens (2019) British Journal of Nursing.	Does oral care with chlorhexidine reduce ventilator-associated	This study aimed to determine whether the use of the antiseptic chlorhexidine in the intra-oral cavity	The study conducted a comprehensive literature search, inclusive of patient populations across several specialty ICUs, with only randomized controlled trials	The study showed that chlorhexidine reduces VAP in critically ill, mechanically ventilated adults.

		pneumonia in mechanically ventilated adults?	reduced its incidence in the critically ill, mechanically ventilated adult.	(RCTs) eligible for inclusion.	The use of chlorhexidine was recommended for mechanically ventilated patients.
6	E Letchford & S Bench (2018) British Journal of Nursing.	Ventilator-associated pneumonia and suction: a review of the literature.	To identify the most effective suctioning technique for the prevention of ventilator-associated pneumonia.	A literature review method was used.	Closed suction and open suction systems have no clear advantage over another, but may better prevent late-onset ventilator-associated pneumonia. Subglottic secretion drainage reduces ventilator-associated pneumonia incidence.
7	Oliveira Gonçalves, É., Santos de Lima, M., de Lima Melo, J., Rodrigues Pontes, M. S., Barros Sousa, A. O., & Pinheiro Albernaz, M. (2015) Journal of Nursing UFPE / Revistade Enfermagem UFPE, 9(12),	Practical Nursing Assistants and Pneumonia Prevention Associated with Mechanical Ventilation in Icu.	To assess the knowledge of nurses in pneumonia prevention practices associated with mechanical ventilation in patients hospitalized in intensive care units.	An exploratory, descriptive study of qualitative approach, developed with 19 nurses in an ICU, guided by a semi-structured interview.	The level of knowledge that nurses have about the care practices involving pneumonia associated with mechanical ventilation was satisfactory showing no difficulty to answer. It was identified the importance of the nurses' role to care practices in the care of critically ill patients and the importance of recognizing the clinical findings to establish a diagnosis.
8	H.M So. (2020) The World of Critical Care Nursing.	Multiple Levels of Impact of Nurse Consultant-Led	This research aims to identify what is known about the topic and what is unknown. Research methodology is	A literature review method was used.	The implementation of the protocol-driven mechanical ventilation weaning helped to

		Continuous Quality Improvement: The Experience of a Critical Care Nurse Consultant in Hong Kong.	determined according to the objectives of the research.		reduce the duration of weaning from mechanical ventilation, promote ICU nurses' participation in the weaning process, and ultimately to facilitate timely extubation.
9	H Keyt, P Faverio & M Restrepo. Indian journal of medical research. (2014)	Prevention of ventilator-associated pneumonia in the intensive care unit: A review of the clinically relevant recent advancements	This study reviews the interventions currently available that have a clinical impact concerning a reduction in the incidence of VAP.	A literature review method was used as a method of study.	Sedation weaning protocol has shown success in prevention and patient outcome in minimizing the use of a ventilator for the prevention of VAP.
10	Su, K.-C.,Kou, Y. R., Lin, F.-C., Wu, C.-H.,Feng, J.-Y., Huang, S.-F.,Shiung, T.-F., Chung, K.-C., Tung, Y.-H., Yang, K.-Y., & Chang, S.-C. (2017).	A simplified prevention bundle with dual hand hygiene audit reduces early-onset ventilator associated pneumonia in cardiovascular surgery units: An interrupted time-series analysis.	To investigate the effect of a simplified prevention bundle with an alcohol-based, dual hand hygiene audit on the incidence of early-onset ventilation-associated pneumonia.	3 years quasi-experimental study was done in interrupted time series in a cardiovascular surgery intensive care unit medical center. . Unaware external hand hygiene audit was performed by non-unit-based observers.	Unaware hand hygiene compliance correlated with VAP incidence. Aware hand hygiene compliance might be inflated but it provided better improvement in hand hygiene practice. It is suggested that a dual hand hygiene audit with consistent bundle performance may sustain good practice at both the health care worker and organization levels to prevent VAP occurrence.