

**EFFECTS OF NURSING QUALITY IMPROVEMENT ON  
PATIENT'S VENTILATOR-ASSOCIATED PNEUMONIA**

The image features a large, faint watermark of the Mahidol University logo in the background. The logo is circular with a gold border and contains a central emblem with Thai script. The text 'WANNAKORN KAMDECH' is centered over the logo.

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Thesis  
Entitled

**EFFECTS OF NURSING QUALITY IMPROVEMENT ON  
PATIENT'S VENTILATOR ASSOCIATED PNEUMONIA**

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**Wannakorn Kamdech**

**EFFECTS OF NURSING QUALITY IMPROVEMENT ON PATIENT'S VENTILATOR-ASSOCIATED PNEUMONIA****WANNAKORN KAMDECH 4536366 PPH / M****M.Sc. (PUBLIC HEALTH) MAJOR IN INFECTIOUS DISEASES AND EPIDEMIOLOGY****THESIS ADVISORS: NOPPORN HOWTEERAKUL, Ph.D. (MEDICINE & HEALTH SCIENCES), NAWARAT SUWANNAPONG, Ph.D. (POPULATION AND DEVELOPMENT), ALONGKORN CHAROENPUN, M.D., FRCP****ABSTRACT**

This quasi- experimental study aimed to assess the effects of nursing quality improvement on reduction of patient's ventilator-associated pneumonia (VAP). All 24 nursing personnel aged 22 – 41 years working in ICU of Fort Suranaree Hospital, Nakhon Ratchasima Province, Thailand were trained in a nursing process according to VAP prevention guidelines. A total of 216 patients, 107 cases 6 months before and 109 cases 6 months after intervention, who were admitted to the ICU and received a ventilator for more than 48 hours, aged 18 – 92 years, were included in the study. Data were collected from medical records and VAP evaluation records. Nursing quality improvement was recorded by ward head and deputy ward head and confirmed by the researcher from 1 June 2003 to 9 June 2004.

During the study period, 23 patients had an occurrence of VAP. Before intervention, the incidence of VAP was 15% (16/107) or 17.5 per 1,000 ventilator-days. After intervention, the incidence of VAP was declined to 6.4% (7/109) or 9.0 per 1,000 ventilator-days. The proportion of nursing personnel practicing the developed nursing guidelines increased from 66.7% to 95.3% ( $p < 0.001$ ). Before improving nursing care, five factors were associated with VAP: mouth care, patient position, enteral feeding, suction, and respiratory care ( $p < 0.001$ ). After improving nursing care, only mouth care was associated with VAP ( $p < 0.001$ ). A patient characteristic associated with VAP was duration of intubations and ventilator reception over 10 days ( $p < 0.001$ ). The findings could be used as a standard nursing guideline to reduce VAP. Nursing quality improvement should be applied to other low resistance patient groups such as cancer patients and potentially drug-resistant bacterial infections.

**KEY WORDS: NURSING QUALITY IMPROVEMENT/  
VENTILATOR-ASSOCIATED PNEUMONIA/ THAILAND****104 pp ISBN 974-04-5935-8**

ผลของการพัฒนาคุณภาพการพยาบาลการป้องกันปอดอักเสบในผู้ป่วยที่ใช้เครื่องช่วยหายใจ (EFFECTS OF NURSING QUALITY IMPROVEMENT ON PATIENT'S VENTILATOR-ASSOCIATED PNEUMONIA)

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บทคัดย่อ

การวิจัยแบบกึ่งทดลองเฝ้าสังเกตและติดตามกลุ่มผู้ป่วยที่ใช้เครื่องช่วยหายใจเพื่อประเมินผลของการพัฒนาคุณภาพการพยาบาลการป้องกันปอดอักเสบในผู้ป่วยที่ใช้เครื่องช่วยหายใจ ในบุคลากรทางการแพทย์ จำนวน 24 คน อายุระหว่าง 22 – 41 ปี ปฏิบัติงานในหอผู้ป่วยวิกฤต โรงพยาบาลค่ายสุรนารี จังหวัดนครราชสีมา ประเทศไทย กลุ่มตัวอย่างที่ศึกษาจำนวน 216 ราย เป็นผู้ป่วยที่ใช้เครื่องช่วยหายใจ ตั้งแต่ 48 ชั่วโมงขึ้นไป อายุระหว่าง 18 – 92 ปี (107 รายก่อนการพัฒนาคุณภาพการพยาบาล และ 109 ราย หลังการพัฒนาคุณภาพการพยาบาล) โดยเก็บข้อมูลผู้ป่วยจากแบบบันทึกการติดเชื้อในโรงพยาบาลค่ายสุรนารีและแบบบันทึกการสังเกตการปฏิบัติการพยาบาลด้านการดูแลผู้ป่วยที่ใช้เครื่องช่วยหายใจ ตั้งแต่ 1 มิถุนายน 2546 ถึง 9 มิถุนายน 2547

ผลการศึกษาพบผู้ป่วยที่เกิดปอดอักเสบจากการใช้เครื่องช่วยหายใจทั้งหมด 23 ราย ก่อนการพัฒนาคุณภาพการพยาบาล อุบัติการณ์ของปอดอักเสบจากการใช้เครื่องช่วยหายใจคิดเป็นร้อยละ 15 (16/107) หรือ 17.5 ครั้ง ต่อ 1,000 วันที่ใช้เครื่องช่วยหายใจ หลังการพัฒนาคุณภาพการพยาบาล อุบัติการณ์ของปอดอักเสบจากการใช้เครื่องช่วยหายใจลดลงเหลือร้อยละ 6.4% (7/109) หรือ 9.0 ครั้ง ต่อ 1,000 วันที่ใช้เครื่องช่วยหายใจ บุคลากรทางการแพทย์มีการปฏิบัติตามแนวทางในการดูแลผู้ป่วยที่ใช้เครื่องช่วยหายใจหลังการดำเนินการพัฒนาคุณภาพการพยาบาลดีกว่าก่อนการพัฒนาคุณภาพการพยาบาลอย่างมีนัยสำคัญทางสถิติ ( $p < 0.001$ ) โดยเพิ่มจากร้อยละ 66.7 เป็นร้อยละ 95.3 ก่อนการดำเนินการพัฒนาคุณภาพการพยาบาลพบว่าการปฏิบัติการพยาบาล 5 ด้าน คือ การดูแลความสะอาดภายในช่องปากและฟัน การจัดทำนอน การให้อาหารทางสายยาง การดูดเสมหะ และการดูแลระบบทางเดินหายใจ และอุปกรณ์ของเครื่องช่วยหายใจมีความสัมพันธ์กับการเกิดปอดอักเสบจากการใช้เครื่องช่วยหายใจอย่างมีนัยสำคัญทางสถิติ ( $p < 0.001$ ) หลังการดำเนินการพัฒนาคุณภาพการพยาบาลพบว่าการปฏิบัติการพยาบาลเกี่ยวกับการดูแลความสะอาดภายในช่องปากและฟันมีความสัมพันธ์กับการเกิดปอดอักเสบจากการใช้เครื่องช่วยหายใจอย่างมีนัยสำคัญทางสถิติ ( $p < 0.001$ ) และระยะเวลาเฉลี่ยที่ผู้ป่วยใช้เครื่องช่วยหายใจตั้งแต่ 10 วันขึ้นไปมีความสัมพันธ์กับการเกิดปอดอักเสบจากการใช้เครื่องช่วยหายใจอย่างมีนัยสำคัญทางสถิติ ( $p < 0.001$ ) ผลการศึกษานี้สามารถนำไปใช้กำหนดมาตรฐานการปฏิบัติในการดูแลผู้ป่วยที่ใช้เครื่องช่วยหายใจ เพื่อช่วยลดอัตราอุบัติการณ์ของการเกิดปอดอักเสบจากการใช้เครื่องช่วยหายใจ ในโรงพยาบาล ดังนั้นการพัฒนาคุณภาพการพยาบาลจึงควรนำไปศึกษาในกลุ่มผู้ป่วยที่มีภูมิคุ้มกันต่ำ เช่น ผู้ป่วยมะเร็ง และ ผู้ป่วยที่มีการติดต่อยาปฏิชีวนะต่อไป

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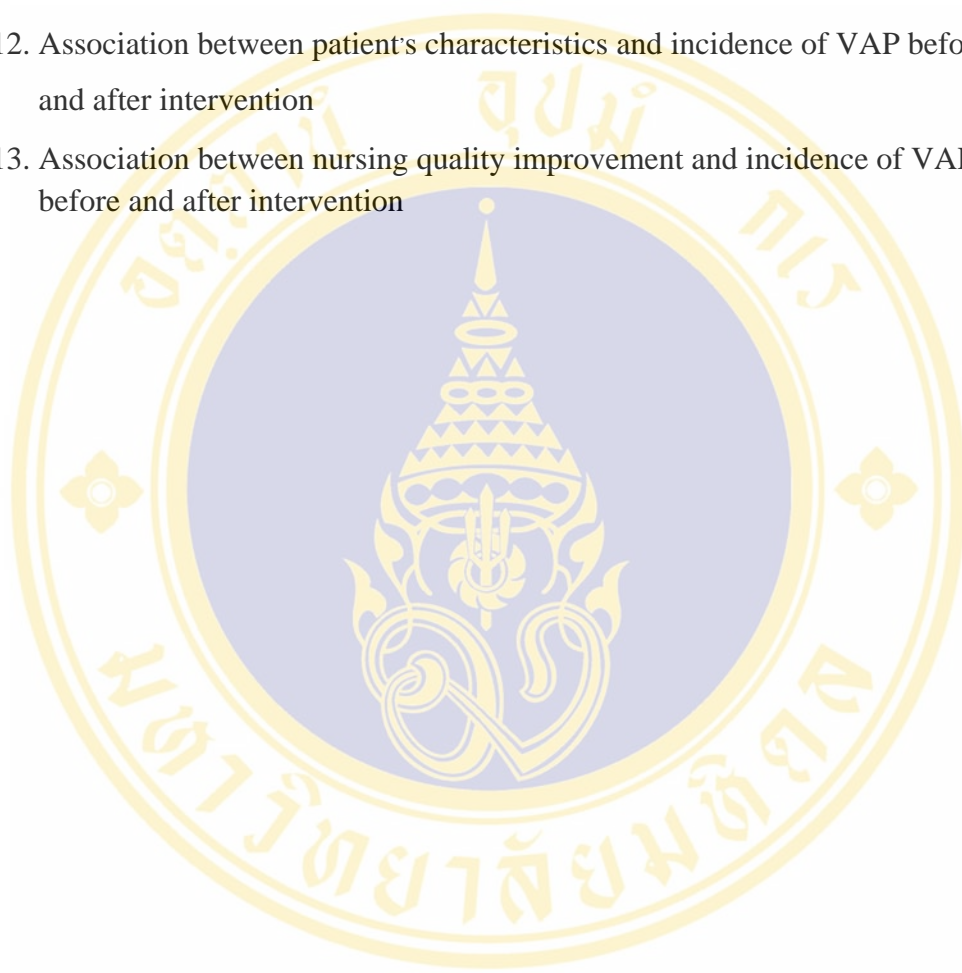
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# CHAPTER I

## INTRODUCTION

### 1.1 Rationale and justification

Nosocomial pneumonia, which accounts for 13-18% of all nosocomial infections, is the leading cause of death from hospital acquired infections. It has an estimated incidence of 4-7 cases per 1,000 patients hospitalized, the highest incidence being among intensive care unit (ICU) patients (up to 25%), and associated mortality exceeds 25% in most studies. Ventilator-associated pneumonia (VAP) is the most common nosocomial infection among ICU patients. VAP specifically refers to nosocomial pneumonia that develops greater than 48 hours after endotracheal intubation. Nosocomial pneumonia occurring within 48 hours of intubation is often the result of aspiration during intubation and frequently caused by community-acquired pathogens. Nosocomial pneumonia occurring greater than 48 hours after intubation has a worse prognosis because it is often caused by resistant organism. Many authors use the terms nosocomial pneumonia and VAP interchangeably to indicate the latter (1-5).

In Thailand, Danchaivijitr and Chokloikaew (1988) reported that nosocomial infection from the respiratory tract the major concern is the high proportion approximately 20.1%, 28.4% and 30.3% in 1994, 1998, and 2000 which are associated with increased mortality, prolong hospital stay and increasing the cost 5,683 US\$ or 238,689 baht (2 - 3).

In hospital, intensive care unit (ICU) patients gets risk of nosocomial infection because of the critical illness, severe underlying diseases, major surgery of the patients and they need more special equipments for monitoring.

The National Nosocomial Infection Surveillance (NNIS) in USA reported the second infection of nosocomial infection were pneumonia, pneumonia was 18% of all

nosocomial infection and the critical patients were frequency of infectious at 31% of nosocomial infection which occurred in ICU(4).

VAP have mortality rate between 25-50 % (5) and the cost per episode of VAP is substantial, although specific data are lacking. The average cost per episode of nosocomial pneumonia is estimated at US\$3000 to US\$ 6000, and the additional length of stay for patients who develop VAP is estimated at 13 days (6).

For 30 years, the treatment of patients had developed about special equipments, intubation and using ventilator, these new techniques could be the risk factor of nosocomial infection etc, VAP reported by Maki et al (7), the intubation patients have pneumonia more than the patients who non used it were 7-21 times. Because patients who used ventilator or tracheostomy will be easy to expose colonization of gram negative bacteria in case of lower respiratory tract infection or pneumonia although having awareness of aseptic technique.

In the past, most researches focused on the incidence rate of respiratory tract infection factors related to pneumonia was the old age, underlying in chronic obstructive pulmonary diseases, condition of coma, take care by used ventilators, aspiration, thoracic surgery, treatment by antacid drug, changing frequency of respiratory circuits and duration time for intubation (4 - 8).

Fort Suranaree Hospital is a soldier hospital under the Military Medical Department occupying 400 beds. The surveillance of nosocomial infection during the year of 2000-2002 had almost infected in lower respiratory tract infection in the surveillance of nosocomial infection were 35.71% or 22.12 times per 1,000 ventilator days (9). In 2002, the surveillance of nosocomial infection in ICU of Fort Suranaree Hospital showed the highest VAP was 28.57 % or 31.01 times per 1,000 ventilator days (9). For 2-3 years ago, Fort Suranaree Hospital had increased the using ventilators. However, no research was conducted to examine the impact from using them, including effect to case of pneumonia. Thus, the researcher was interested in developing the nursing quality improvement for prevention of pneumonia in patients who used ventilators. The researcher and nursing personnel who have been working in ICU would be planning the project of nursing

quality improvement for prevention pneumonia in patients who used ventilators by brain storming and Continuous Quality Improvement concepts. The objective of project was known by everyone in ICU. Brain storming was conducted to solve the problems and improve process of master plan, monitoring, set standard guideline and follow it continuously. The purpose was to increase the effectiveness of nursing care to the patients who used ventilators.

### **1.2 Objectives**

1. To compare the quality of nursing care on VAP prevention before and after implementing nursing quality improvement at ICU of Fort Suranaree Hospital.
2. To compare the incidence of VAP patients before and after implementing nursing quality improvement on prevention of VAP patients at ICU of Fort Suranaree Hospital.
3. To determine the associations between patient's general characteristics, i.e., age, underlying diseases, surgery, level of conscious, duration of intubation and used ventilators, and the nursing care of VAP prevention, i.e., cleaning in mouth and teeth, patients position, enteral feeding, suction, respiratory care and respiratory circuits and the incidence of VAP.

### **1.3 Hypotheses**

1. Nursing personnel in ICU would provide nursing care adhere to the VAP prevention guideline after implementing the nursing quality improvement project.
2. Incidence of VAP would be decreased after implementing the nursing quality improvement project.
3. There are associations between patient general characteristics, i.e., age, underlying diseases, major surgery, level of consciousness, duration of intubation and using ventilators with the incidence of VAP.

4. There are associations between nursing quality improvement i.e., cleaning in mouth and teeth, patient position, enteral feeding, suction, respiratory care and respiratory circuit with the incidence of VAP.

#### 1.4 Definitions of terms

**Nursing quality improvement** refers to improve process of nursing care for all patients who received ventilator. The process could be continuous practiced by member of the organization, and it is client-centered, including management by using data and fact, focusing on analysis of management, improving process, supporting new creative idea and creating efficiency of base-line process to bring up the best practice.

**Continuous quality improvement (CQI)** refers to improve process of administration in hospital by objective of process will be known everyone in hospital. Brain storming to solve the problems and improve process of master plan, monitoring, set standard guideline for practicing that will be implemented continuously and regularly. The purposes need maximum effectiveness of nursing care and everyone happy in job.

**Nursing quality improvement on prevention of patient's ventilator associated pneumonia** refers to approved process of nursing care the patient who used ventilators continuously in intensive care unit, that is developing to practice of nursing for prevention of pneumonia in patient who used ventilator.

**Patient who used ventilator** refers to the patient was intubation of endotracheal tube into trachea by pass mouth or nose and the patient was operated tracheostomy and insert tracheostomy tube for receiving mechanical ventilation.

**Mouth care** refers to practice of nursing care in oral and dental care of patients who used ventilators for improving the oral health or reduce bacteria with normal flora in oropharyngeal by special mouth wash.

**Patient Position** refers to practice of nursing care to elevate the head of the bed to 30 - 45 degree (semi-recumbent positioning). Semi-recombency is generally continued for the duration of mechanical ventilator and turn patients by side (right to left or left to right) every 2 hours.

**Enteral feeding** refers to the delivery of liquid feedings through a tube. Enteral feeding, or tube feeding, is used for patients who have a functioning gastrointestinal tract, but are unable to orally ingest adequate nutrients to meet their metabolic needs.

**Suction of sputum** refers to practice of nursing care the patients who would be intubated endotracheal tube or tracheostomy tube for respiration and suctioning of lower respiratory tract secretion from endotracheal tube for decreasing collection secretion in respiratory tract by aseptic technique.

**Respiratory care and ventilator circuit** refers to practice of nursing care the patients who would be intubated endotracheal tube or tracheostomy tube for respiration and suctioning secretion from lower respiratory tract and taking care position of endotracheal tube or tracheostomy tube, changing ventilator circuits by aseptic technique.

**Underlying diseases** refers to diagnosis of doctor about chronic diseases and past history of sickness which have an impact to respiratory failure such as, chronic obstructive pulmonary diseases (COPD), cerebro vascular diseases (CVD), diabetic mellitus (DM) etc.

**Major surgery** refers to the patients who are operated and need to use ventilator which are also at risk to be infected of pneumonia from ventilators such as, craniotomy, thoracoabdominal surgery and explore laparotomy etc.

**Level of consciousness** refers to the state of being awake rather than being asleep or unconscious, is maintained by a system of upper brainstem and thalamic neurons, the reticular activating system (RAS), and its broad connections to the cerebral hemispheres, classification of consciousness can separated into 2 levels as the following:

Good consciousness refers to someone regain consciousness, their mind and their thoughts.

Semi-coma or coma refers to means someone lose consciousness, is in a state of deep unconsciousness.

**Duration of mechanical ventilation** refers to the duration until the first day of intubation for using ventilators to the last day of using ventilators or extubation endotracheal tube or tracheostomy tube.

**Effects of nursing quality improvement** refers to the results of nursing quality improvement i.e. mouth care, patient position, enteral feeding, suction, respiratory care and respiratory circuits which are measured by reduction of VAP.

**Incidence of VAP** refers to number of VAP occurred infectious during time more than 48 hours per 1,000 ventilator days.

**Ventilator-associated pneumonia** refers to nosocomial pneumonia in patients who have been on mechanical ventilation support (by endotracheal tube or tracheostomy tube) for  $\geq 48$  hours, which include the appearance of a new or progressive pulmonary infiltrate, fever, leukocytosis, and purulent tracheobronchial secretions.

**Prevention of patient's ventilator associated pneumonia** refers to nursing care of VAP prevention who used ventilators that recommendation the nursing care in mouth care, patient position, enteral feeding, suction of sputum, respiratory care and ventilators circuits for aseptic technique that all consider by standard guideline of center disease of control in USA and guideline on prevention of patient's ventilator associated pneumonia at Fort Suranaree Hospital.

**nursing personnel** refers to nurse, practical nurse, non – commissioned officers and nurse aide, who can practice nursing care on prevention of patient's ventilator associated pneumonia.

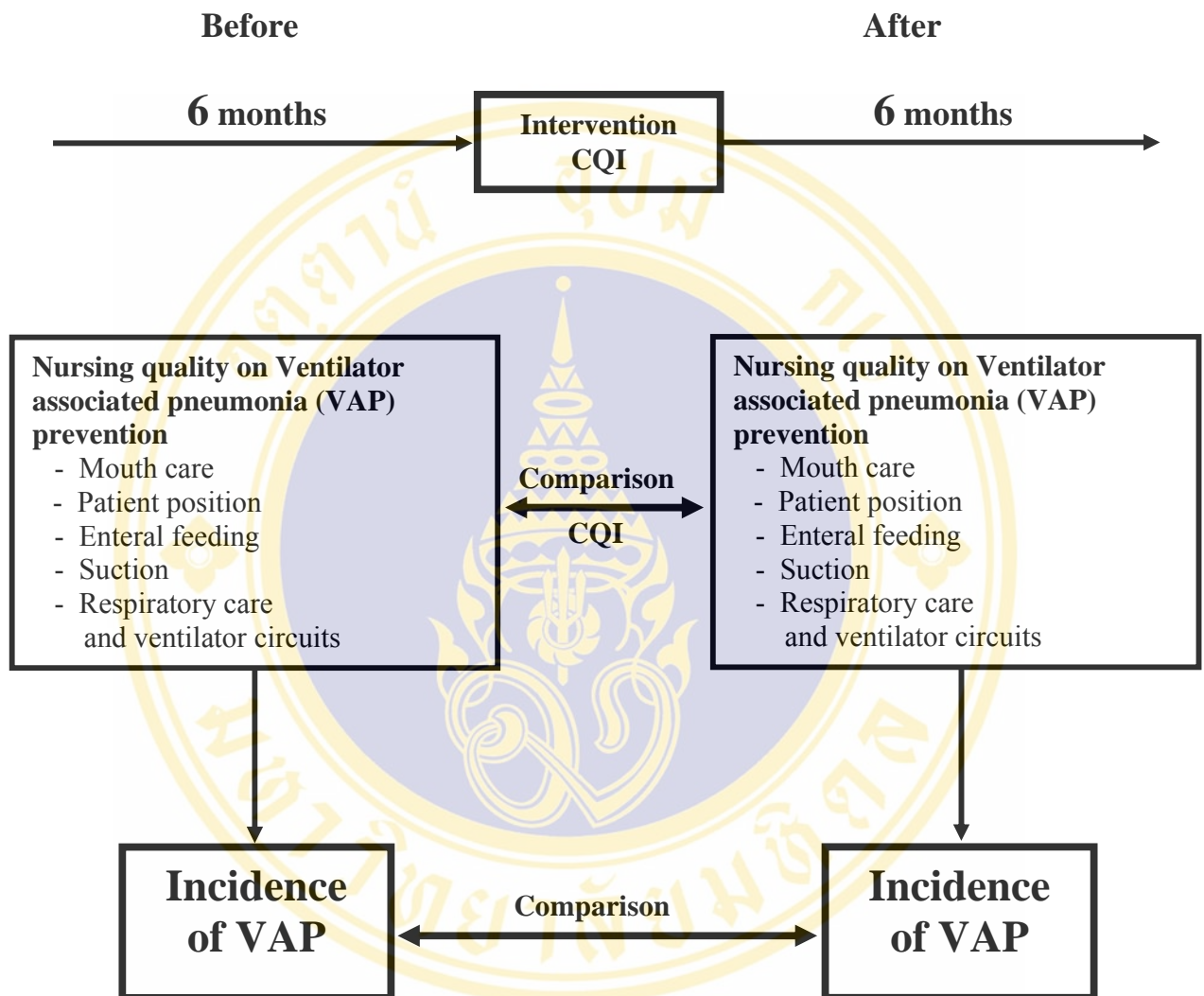


Figure 1 Conceptual framework of effects of nursing quality improvement on reduction of patient's ventilator-associated pneumonia.

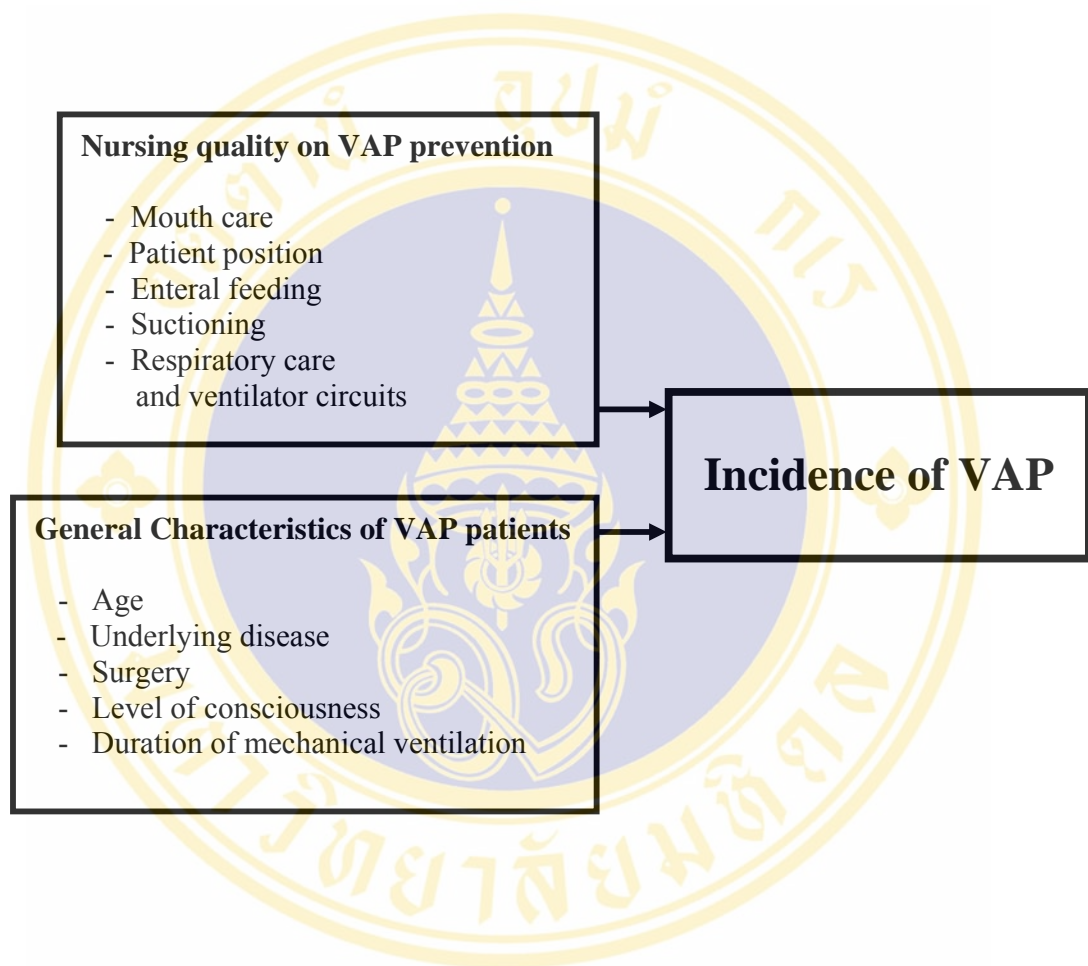


Figure 2 Association between nursing quality on VAP prevention, general characteristics of VAP patients and the incidence of VAP

## **CHAPTER II**

### **LITERATURE REVIEW**

This chapter reviews the literature related to nosocomial infection, guideline on prevention of patient's ventilator associated pneumonia, concepts, theories and process of nursing quality improvement.

#### **2.1 Nosocomial infection**

##### **2.1.1 Definition of nosocomial infection**

Nosocomial infection is defined as a localized or systemic condition: 1) that results from adverse reaction to the presence of an infectious agent or its toxins and 2) that was not present or incubating at the time of admission to the hospital. For most, bacteria nosocomial infections, this means that the infection usually becomes evident 48 hours (i.e., the typical incubation period) or more after admission. However, because the incubation period varies with the type of pathogen and to some extent with the patient's underlying condition, each infection must be assessed individually for evidence that links it to the hospitalization(10,11).

There are several other important principles upon which nosocomial infection definitions are based. First, the information used to determine the presence and classification of an infection should be a combination of clinical findings and results of laboratory and other tests. Clinical evidence is derived from direct observation of the infection site or review of other pertinent sources of data, such as the patient's chart. Laboratory evidence includes results of cultures, antigen or antibody detection tests, or microscopic visualization. Supportive data are derived from other diagnostic studies, such as x-ray, ultrasound computed tomography (CT) scan, magnetic resonance imaging (MRI), radiolabel scan, endoscopic procedure, biopsy, or needle aspiration(10,11).

### **2.1.2 Ventilator- associated pneumonia (VAP)**

Hospital acquired pneumonia or nosocomial pneumonia is defined pneumonia when it occurs more than 48 hours after the patient's admission to the hospital, and when it was not in incubation at the time of hospitalization. Ventilator- associated pneumonia specifically refers to nosocomial pneumonia which develops greater than 48 hours after endotracheal intubation. Nosocomial pneumonia occurring greater than 48 hours after intubation has a worse prognosis because it is often caused by resistant organisms. Many authors use the terms nosocomial pneumonia and ventilator-associated pneumonia interchangeably to indicate the latter (12).

Pneumonia refers to inflammation of the distal lung caused by infection with microorganisms, and is characterized histologically by the accumulation of neutrophils in the distal bronchioles, alveoli, and interstitium. Three types of nosocomial pneumonia can be distinguished: hospital- acquired pneumonia, early-onset VAP, and late-onset VAP. Pneumonia is defined as VAP when diagnosis in an intubated, mechanically ventilated patient after more than 48 hours of ventilation; early-onset VAP occurs within the first 4 days of mechanical ventilation (if pneumonia develops within 96 hours of the patient's admission to an ICU or intubation for mechanical ventilation), and late-onset VAP occurs thereafter (if pneumonia develops after 96 hours of the patient's admission to an ICU or intubation for mechanical ventilation) (4-5).

VAP specifically refers to nosocomial pneumonia which develops greater than 48 hours after endotracheal intubation. Nosocomial pneumonia occurring within 48 hours of intubation is often the results of aspiration during intubation and frequently caused by community-acquired pathogens. Nosocomial pneumonia occurring greater than 48 hours after intubation has a new or progressive radiographic infiltrate that has persisted for at least 48 hours plus at least two of the following: a temperature above 38.5 °C or below 35 °C, a leukocyte count of more than 10,000 per cubic millimeter or less than 5,000 per cubic millimeter, purulent sputum, or isolation of pathogenic bacteria from an endotracheal aspirate (12, 13).

### 2.1.3 Diagnosis of pneumonia

Diagnosis in pneumonia case in the hospital adapted from CDC surveillance definition of nosocomial infection (3, 13) that is considered by signs and symptoms on daily including data from laboratory, X-ray and any of the following:

1. Patient has rales or dullness to percussion on physical examination of the chest. And at least one of the following:
  - 1.1 New onset of purulent sputum or change in character of sputum.
  - 1.2 Organism cultured from blood.
  - 1.3 Isolation of an etiologic agent from a specimen obtained by transtracheal aspirate, bronchial brushing, biopsy.
2. Patient has a chest radiographic examination that shows new or progressive infiltrate, consolidation, cavitation or pleural effusion plus at least two of the following: (3, 5)
  - 2.1 Body temperature  $> 38.5^{\circ}\text{C}$  or  $< 35^{\circ}\text{C}$
  - 2.2 A leukocyte count of more than 10,000 per cubic millimeter or less than 5,000 per cubic millimeter.
  - 2.3 New onset of purulent sputum or change in character of sputum.
  - 2.4 Isolation of an etiology agent from a specimen obtained by transtracheal aspirate, bronchial brushing, or biopsy.

### 2.1.4 Specimens for examination of VAP

A diagnosis of nosocomial pneumonia is histopathologic examination of lung tissue obtained by respiratory secretions which many methods (12, 13) as follows:

Endotracheal aspirate (ETA) culture was done by using catheter suction in the endotracheal tube We could be modified by using sputum trap connect to suction catheter for decreasing contamination sputum. The accuracy of quantitative culture and microscopic examination of lower respiratory tract secretions for the diagnosis of VAP was finding predominant organism with  $\geq 10^5$  CFU/ml and  $\leq 1\%$  squamous

epithelial cells had 100% sensitivity and specificity for the diagnosis of bacterial pneumonia (13).

Bronchoscopy (Bronchoalveolar lavage) was involving the infusion and aspiration of sterile saline through the bronchoscope from an affected bronchial segment. The act of passing the bronchoscope through the nasopharynx or endotracheal tube may contaminate the bronchoalveolar lavage specimen with upper respiratory tract secretions. When done with minimal contamination by upper airway secretions, however, quantitative culture of greater than  $10^4$  colony-forming units (CFU) obtained from the bronchoalveolar lavage technique is reported to have a sensitivity of 72 – 100% and a specificity of 69-100%. This method cannot examine in every institute and was not decreasing mortality rate in VAP (13).

Blood culture was finding bacteremic VAP at 8 – 20 %. The pathogens were defined as a laboratory-confirmed positive blood culture for bacteria, fungus, or both performed more than 48 hours after admission and these positive blood culture were faithfully because of the pathogens no contamination from upper respiratory tract. In addition to the pathogens in blood stream were not mean that infection of lung or VAP that may be another anatomic site at the time of positive culture expect the pathogens in blood stream as same as secretions, pleural fluid or specimens from infection site (13).

Pleural fluid culture has been able to reliably diagnose cases of VAP because the pathogens no contamination from upper respiratory tract but the patients were very severity and we cannot obtain pleural fluid for investigation (13).

### **2.1.5 Pathogenesis**

Most respiratory pathogens arise from the patient's endogenous flora, but they can also be transmitted from contaminated respiratory therapy equipment, from other patients and the hospital personnel. Pathogens usually enter the lung by aspiration of contaminated secretion. Inhalation of contaminated aerosols or the hematogenic spread from extra-pulmonary sites are potential but infrequent access routes to the lung (5).

Aspiration of small amounts of secretions from the upper respiratory tract occurs frequently in patients and is favoured by disturbed swallowing, increased

gastropharyngeal reflux and accumulation of secretion above the endotracheal cuff. Aspiration of pharyngeal secretion means a higher risk of pneumonia for an ICU patient than for a health person (5).

### **Nosocomial Pneumonia**

Nosocomial pneumonia was the leading cause of aspiration bacteria that colonization in oral cavity and tracheal or tracheobronchial tree and the patients who good conscious would be aspiration at 45% in sleeping, at 75% for the patients who semi-coma or coma though intubation had be inflated cuff. Aspiration bacterial was always occurrence but occasion of VAP had been rare in normal host. In addition to aspiration bacterial which could be severity or no severity but should be more these may be VAP (14).

### **Routes of Colonization**

1. Microorganisms reach the lungs after aspiration of colonized oropharyngeal fluid. Pathogens colonizing the respiratory tract and causing VAP are derived from either endogenous or exogenous sources. The stomach and intestine are the most important endogenous sources. In addition, pathogens colonizing the upper respiratory tract (oropharynx, sinus cavities, the nares and dental plaque) may be aspirated. Contaminated environment, contaminated equipment (mechanical ventilation devices, ventilator circuits, radiographic equipment, etc.), contaminated enteral feeding, and other colonized patients in ICU are potential exogenous sources (15-17).

2. Transmission of infection organism to the host. The pathogens from another source could be enter in respiratory tract of patients in many ways such as the pathogens in environments from aerosal droplet which had been less than 1 micron and could be in air for a long time these causation by airborne transmission or contamination from hand of patients or hand of medical personnel (14).

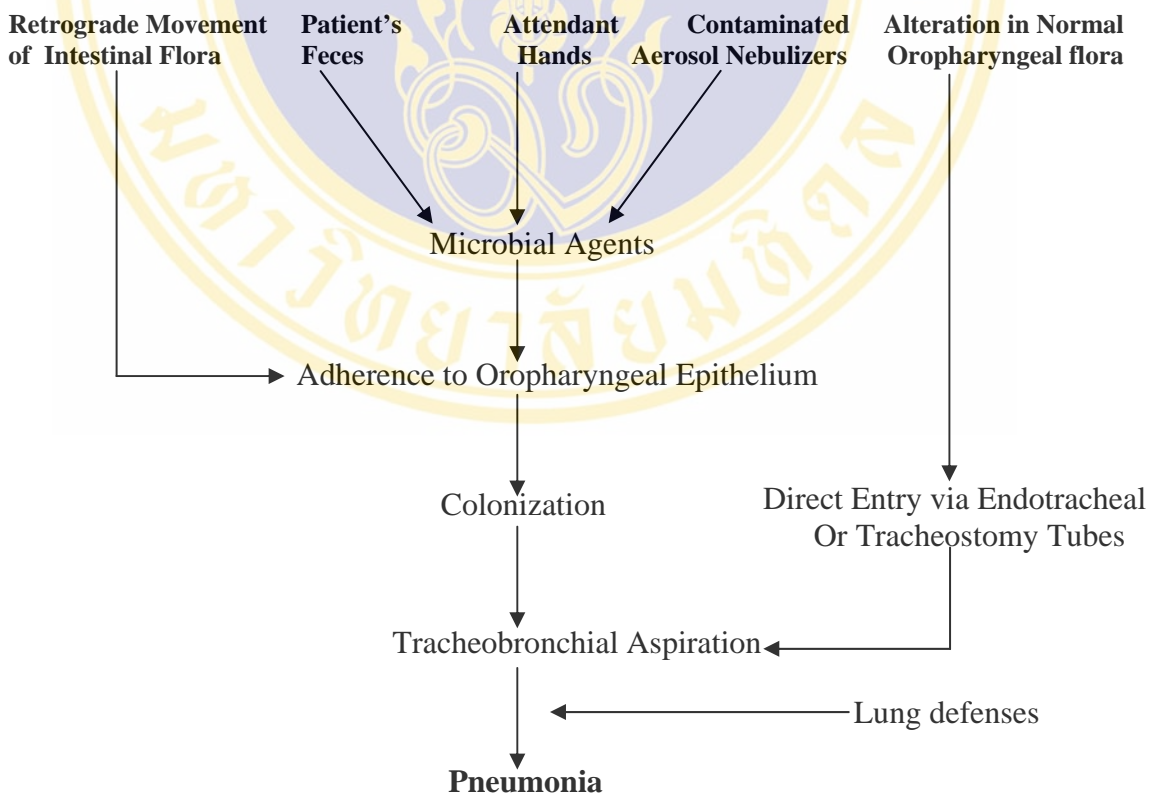
3. Colonization of the host's upper respiratory tract by infectious organism. Colonization was an important step of infection in respiratory tract. In natural person would be gram negative bacilli (GNB) colonized in upper respiratory tract approximately 2 – 18 %, in critical patients had be 45 % and the patients who were respiratory disease in ICU had be 75 – 100 % that important causation to be

colonization may be changing of surface properties of cell lining and susceptible for colonization was more than in natural person.

4. Routes of infectious organism into tracheobroncheal tree and lungs of the host. Aspiration was an important causation. There were researcher showed that the patients who depressed consciousness 70 % had been aspirate pharyngeal secretion and 45 % of healthy subject in sleeping and oropharyngeal secretion had be highly bacterial density and would be approximately  $10^{10}$  organisms/ml so aspiration a little 0.01 ml would be massive inoculation to  $10^6$ - $10^8$  organisms into lower respiratory tract.

5. Interaction with and overcoming of host's antibacterial defenses

Defense mechanism had been important action was PMN from circulating blood and circulating complement. In addition to some pathological such as hypoxia, alveolar edema, acidosis, previous viral infection, drugs could be impair function of antibacterial mechanism in lung.



**Figure 3 Pathogenesis of Nosocomial Pneumonia**

### 2.1.6 Epidemiology

Nosocomial infection of respiratory tract infection, especially nosocomial pneumonia was frequently finding infection in every hospital all the world. The Center for Disease Control of USA approximately nosocomial pneumonia was frequently finding at the second series (17.8%) or the third series (13.0%) and was the most common nosocomial infection among intensive care unit (ICU) patients (10).

Statistics of nosocomial infection in respiratory tract infection of Thailand as same as study in foreign country, in somewhere this disease would be important problem of nosocomial infection such as the first finding in ICU because of most patients must be using ventilators. In addition to finding that were be risk factors such as underwent thoracoabdominal surgery and craniotomy (16).

Cross and Roup (17) studied the patients who admission in hospitals about 13,086 patients finding that 914 intubation patients on endotracheal tube could be hospital acquired pneumonia at 0.3% (grouping unused ventilators), the groups which on endotracheal tube with ventilators at 1.3%, on tracheostomy tube at 25% and tracheostomy with ventilators at 66%. We were not found nosocomial pneumonia in patients who used ventilators less than 24 hours. A studied on 120 times of nosocomial pneumonia showed that intubation on nasal endotracheal tube and oral endotracheal tube were be risk factor of nosocomial pneumonia about seven times of patients who not be intubation (18). Haley et al (19) showed that nosocomial pneumonia was increasing 21 times in the patients who used continuous ventilators.

The incidence of nosocomial pneumonia, duration of intubation and using mechanical ventilation were association. Fagon et al (20) showed incidence rate of VAP was be approximately increasing at 1% per day. Langer et al (21) reported 68% of patients who used ventilators more than 30 days show that 90% of patients were be VAP would be signs within 10 days in this way show that the time would be the most infection.

Although the various pathogens such as virus, fungus and parasite that causation of nosocomial pneumonia but the most etiologic agents was bacterial. The Center for Disease Control of USA (CDC) show that most pathogens approximately 70% of patients in nosocomial pneumonia were *Pseudomonas aeruginosa* that be

gram negative bacterial which was the most found pathogens (16) especially the patients who used ventilators for a long time.

### 2.1.7 Morbidity and Mortality

VAP is associated with a crude mortality rate of 20% - 70%, which mainly depends on the nature and the severity of the underlying disease. Whether VAP represents an independent risk factor of death in critically ill patients, or whether variations in mortality are merely a reflection of the underlying condition of the patient, is contradictory. Multivariate risk factors analyses (20) as well as matched cohort studies have demonstrated an independent influence of VAP on survival. Attributable mortality rates between 27% and 72% were determined by Fagon and others (20). Craven et al (25) showed that mortality as a result of VAP was especially high, when it was caused by multi-resistant microorganisms like *Pseudomonas spp.* or *Acinetobacter spp.* in contrast to these findings.

In Thailand approximately 1.47% of admission patients were nosocomial infection of respiratory tract infection or 58.80 patients per year. Each patient must be treated for 4 – 12 days, cost per day of pneumonia was estimated to be 2,000 bahts therefore, each year the cost was estimated to be 470.40 - 2,469.60 million bahts. Based on economical analyses, the prolongation of hospitalization and the increase of cost per case of pneumonia was estimated to be 6 to 30 days (10).

VAP is a common and highly morbid condition in critically ill patients, and would be higher than other wards. The studied in Europe found that odds ratio (OR) of VAP death was 1.6 – 2.3 (5) and the crude mortality rates was 20 to 70% from statistics in foreign country would be approximately as well as service quality for treatment in Thailand will be death in critically ill patients 32.2 – 80.5 per day or 11,760 - 29, 400 patients per year. That was be important problem for improving (10).

The patients who were nosocomial pneumonia would be increase mortality rate as follows:

1. Underlying cardiovascular disease
2. Conditions of hypimmunity.

3. Intubation and used mechanically ventilation would be mortality rate more than 50%.
4. The pathogens were be gram negative bacterial such as *Pseudomonas aeruginosa* or *Acinetobacter spp.* with multiple drug resistant and would be mortality rate more than 50% comparative with gram positive bacterial would be mortality rate 5 - 25%.

Trend in nosocomial infection of respiratory tract infection would be increase important for global civilization because of oldest patients and severity patients who were specially treatment for life such as using ventilator would be risk factors for increase infection.

### **2.1.8 Risk factors related VAP**

Among the patients who used ventilators and the critically ill patients, it was found that there were two ways of route of pathogens as follows:

1. The pathogens enter to lung through endotracheal tube by hand of nursing personnel or ventilator circuits. In the studied of patients who used ventilators and chronic tracheostomy shows that bacterial which frequently finding was *Pseudomonas species* at tracheobronchial tree in the first and no colonization of pathogens in upper respiratory tract and encourage tracheobronchial mucosa of patients who intubation occurred colonization of *Pseudomonas species* may be demolished to cell wall of tracheal.

1. Bacterial enters to lung in patients who were intubation by Migration Retrograde which colonization in stomach to oropharynx and aspiration secretions around endotracheal tube into tracheal.

The patients who were intubation have defense mechanism to reject the ventilator which could be another risk factors to VAP as follows:

1. Factors that encourage aspiration into lung.

- 1.1 Colonization of pathogens and pre increasing of pathogens at tracheal post nasal cavity, tracheal post oral cavity, inside of endotracheal tube and tracheobronchial tree and associated with VAP so factors that encourage colonization was important risk factors of VAP which allocate 2 characters as follow:

### 1.1.1 Intrinsic factor

- Age: Facon et al (20) show that incidence rate of VAP in patients average age 65 years but aged factors were not directly risk factors may be increasing of another medical underlying disease and cause of illness which admission in hospitals while the studied of Torres et al (23) show that age was not statistics significantly associated with VAP.

- Disease and basic factors such as coma, hypotension, metabolic acidosis, chronic alcoholism, diabetic mellitus, neutropenia, neutrophilia, chronic obstructive pulmonary disease (COPD), human immunodeficiency, cardiovascular disease and malnutrition. Torres et al (23) show that the patients who were underlying disease not severity would be VAP at 10% but the patients who were severity underlying disease would be VAP at 24%.

- Acute lung injury: The ARDS patients were an acute lung disease which necessary to treatment by using ventilation and seldom complications as nosocomial pneumonia. Acute lung injury might be associated with decreased defense mechanical of several respiratory tract which causation risk factors in VAP. Pulmonary edema could be trouble Alveolar Macrophage in demolishing of bacterial, function of acute lung material and surfactant by decreasing quantity and changing characteristics. Lung injury was directly causation of bacterial entry to lung but not cause of death in patients. ARDS could be attachment antibodies IgG and IgA and decreasing movement of cilia and digest Fibronectin at Buccal Epithelial Cell so there had most of receptors for attachment of bacterial.

- Serious Illness: The patients who used ventilators were severity signs and symptoms because of underlying disease and complications. The critically ill patients had be risk factors for colonization in respiratory tract by Enteric Gram Negative Bacilli (EGNB) and were be VAP. Johanson et al (24) show that EGNB was colonization in oral cavity and pharynx of patients would be associated with level of severity disease although seldom finding EGNB in oral cavity and pharynx of normal persons but finding that the most critically ill patients would be these EGNB at 75%.

- Smoking quantity : The persons who were smoking would be high risk factors of VAP post intubation and used ventilators. The finding was

increasing quantity of smoking until 10 – 50 pack-years but Torres et al (23) show that smoking was not statistically significantly associated with VAP.

#### 1.1.2 Risk factors from treatments.

- Prior antibiotic therapy especially Cephalosporins and the routine use of combination antibiotic therapy had been advocated as a means of reducing the subsequent emergence of bacterial resistance and was be risk factors of VAP by increasing of colonization and incidence rate of VAP from gram negative bacterial in gastrointestinal tract. *Pseudomonas aeruginosa*, *Acinetobacter baumannii* and *MRSA* were several bacterial drug resistant.

- Intubation shows that risk of VAP was increasing post intubation and used ventilators by increasing amount days until the second day of intubation or increasing risk at 1% every one day. Torres et al (23) show that intubation more than one time was risk factors which associated with VAP. Celis et al (18) show that the patients who was tracheostomy would be risk of VAP more than the patients who was not tracheostomy 3.5 times and the patients who was intubation and used ventilators for a long time would be risk of VAP more than the patients who was not intubation at 20.9 times.

- Enteral feeding can increase of colonization in tracheal post oral cavity and sinus. Celis et al (18) show that nasal nasogastric tube into stomach would be VAP higher than the patients who was not nasogastric tube 6.6 times.

- Stress-Ulcer Prophylaxis such as Sucralfate, antacid and H<sub>2</sub>- receptor antagonists finding that lowering gastric pH was increasing colonization of pathogens in stomach so that was increasing incidence of VAP. Torres et al (23) show that incidence of VAP in the patients who used antacid or H<sub>2</sub>- receptor antagonists more than two times of patients who was not use antacid.

#### 1.1.3 The other risk factors show that incidence of VAP was

increasing to be related pathogenesis of VAP such as underwent cranial surgery, throat, thoracic and upper abdomen, using intracranial pressure monitoring, cough remedies, analgesics, muscle relaxants, HIV, multiple organ failure and no activity. Craven et al (25) studied the risk factors of VAP show that the patients who nursing care with intracranial pressure monitor was the highest risk of VAP because of these patients had be another factors such as consciousness, underwent cranial surgery and

using antacid for stress ulcer. Celis et al (18) show that the patient who was underwent throcoabdominal surgery had be increasing opportunity risk of VAP more than the patients who had not these factors 6.9 times.

1.2 Aspiration secretions show that the patients who was intubation and reintubation had be increasing aspiration and related with pathogenesis of VAP in this way:

1.2.1 Endotracheal tube was a trouble of swallowing secretions in upper respiratory tract all over coughing which was natural mechanical of excretion secretions. In addition to intubation could be leakage of secretions into lower respiratory tract and leakage around cuff because of changing in capacity of tracheal of swallowing and breathing.

1.2.2 Nasogastric tube had be increasing reflux of gastric content in esophagus into respiratory tract by another mechanical as increasing volume of stomach in enteral feeding and stop function of lower esophagus. In addition to patient positioning by turning face upwards in enteral feeding was increasing risk of VAP, intermittent or continuous drip, size of tubing and position in intragastric or intrajejunum had be risk or no correctly data. Celis et al (18) show that a large of aspiration secretions into lung had be opportunity risk of VAP 12.5 times of the patients who was not aspiration secretions into lung. Torres et al (23) show that incidence of VAP in the patients who used ventilators more than 48 hours show that aspiration gastric content into lung was statistics significantly associated with VAP.

## 2. Risk factors from medical therapy equipment.

2.1 Endotracheal tube: Intubation and using ventilators all over equipments and some handicrafts which relate to using ventilators had be important characteristically of VAP. The patients who using ventilators the pathogens could be entry to lung as 2 ways as fallow:

2.1.1 The pathogens entry to lung through endotracheal tube by hand of nursing personnel or ventilator circuits. In the studied of patients who used ventilators and chronic tracheostomy show that bacterial which frequently finding was *Pseudomonas species* at tracheobronchial tree in the first and no colonized of pathogens in upper respiratory tract and encourage tracheobronchial mucosa of

patients who intubation occurred colonization of *Pseudomonas species* may be demolish to cell wall of tracheal.

2.1.2 Bacterial enter to lung in patients who were intubation by migration retrograde which colonization in stomach to oropharynx and aspiration secretions around endotracheal tube into tracheal.

Intubation was the most important causation of VAP. The patients who were intubation would be opportunity risk of VAP four times of the patients who was not intubation because of endotracheal tube was trouble defense mechanical of tracheobronchial tree for elimination the pathogens. Intubation was trouble of shut down in piece of wall of larynx and decreasing effectiveness of coughing. Endotracheal tube may be contamination or the pathogens entry into lung by suctioning and saliva around cell wall of tracheal.

Intubation could be decreased efficiency of mucosa of tracheal for protection the pathogens and was trouble protection system of nasopharynx and epiglottis which was be protection for a large of pathogens into lung and endotracheal tube was source of bacterial which cover inside endotracheal tube and entry into lung when insert suctioning tubes would be attachment of the pathogens on endotracheal tube by Polysaccharide glycalyx material around the cell wall of bacterial. *Pseudomonas aeruginosa* could be attachment to inert substance such as endotracheal tube. The studied of intravascular catheter shows that Polyvinyl chloride had bacterial attachment more than Teflon. (14)

In addition to the intubated patients could be receiving oxygen by nebulizer and contamination bacterial if take care was not correctly and these pathogens could be entry into lung and causation of VAP.

Inflating cuff of endotracheal tube for positive pressure in ventilators and prevention of aspiration secretions but inferior point shows that cuff was be injured to wall of tracheal and cilia that decreased causation of function for protection gram negative bacterial in respiratory tract. In addition to cuff may be not effectiveness for protection aspiration the pathogens into lung.

2.2 Ventilator circuit shows that the pathogens which colonization in ventilator circuit may be the pathogens in patients. And changing circuit to the patients especially the critically ill patients was not safety. The most studied had concluded as

duration of changing ventilators circuit on 7 days, 14 days, 30 days could not increase incidence of VAP but changing ventilator circuit every 24 – 48 hours has increase incidence of VAP and was risk factors (26 - 30). Cross and Roup (17) studied function of ventilator to VAP show that the patients who used ventilators less than 24 hours was not VAP, duration of using ventilators in non VAP groups average 5.9 days and duration of using ventilators in VAP groups average 9.1 days. But contamination the pathogens in ventilators circuit was not causation of VAP in the patients who used ventilators.

2.3 Resuscitation bag, oxygen analyzer, ventilator spirometers these equipments had be simply contamination but hardly cleaning in using by contamination secretions or condensate fluid all over touching of personnel show that using those equipments had be contamination secretions or condensate fluid inside circuit. Using of sharing between the patients was be risk factors of pathogens entry into lower respiratory tract all over spread from one person to another persons.

## **2.2 Guidelines on prevention of patient's ventilator associated pneumonia.**

Recommendations of Guideline on prevention of patient's ventilator associated pneumonia by Hospital Infection Control Practice Advisory Committee, HICPAC (13) and practicing for prevention of patient's ventilator associated pneumonia (31) are consisting of:

### **1. General measures:**

1.1 Encouraging and providing knowledge by managing training for the staffs and nursing personnel who take care the patients that were be intubation and using ventilators in order to be aware of standard guideline of infection control such as emphasized on cleaning all equipments which have been used, personal hygiene especially hand washing.

1.2 Studying of epidemiology of VAP in the hospital to be aware of some important data such as incidence rate and prevalence rate, the pathogens, and bacterial drug resistant.

2. Contributing immunization: Various vaccination programs in adults and children have reduced the incidence of pneumonia casued by specific pathogens,

including *H.influenzae* type B strains, *Strep.pneumoniae*, and *influenzavirus*. These vaccinations for aged  $\geq 65$  years, Chronic obstructive pulmonary disease (COPD), Chronic cardiovascular disease, Diabetes mellitus (DM), Alcoholism, Cirrhosis, patients who were function or anatomic asplenia and conditions of hyp immunity. Vaccination against these pathogens may prevent some hospital-acquired infections as well. Indeed, the difference between nosocomial and community- acquired infections is becoming less clear, particularly in the era of managed care, when patients with acute and chronic illness often receive medical care outside the hospital. Therefore, pneumococcal vaccination and influenza vaccination should be considered before hospital discharge or included in the discharge planning for all patients at risk for subsequent respiratory infections, including ventilator-associated pneumonia (12).

3. Mouth care and teeth: Oropharyngeal cleaning and decontamination with an antiseptic agent: develop and implement a comprehensive oral-hygiene program (that might include the use of an antiseptic agent) for patients in acute-care setting or residents in long-term care facilities who are at high risk for health-care associated pneumonia. Oropharyngeal cleaning should be decreasing dental plaque which had be the most collecting of bacterial (32). By oropharyngeal cleaning every 2 times per day and when dirty with special mouth wash by soft toothbrush or applicators or Chlorhexidine oral rinse for the prevention of health-care associated pneumonia in all postoperative or critically ill patients and/or other patients at high risk for pneumonia. Use an oral chlorhexidine gluconate 0.12% rinse during the perioperative period on adult patients who undergo cardiac surgery (33).

4. Aspiration: Although VAP is community due to the aspiration of contaminated secretions into the lower airway, the origin of these infected inocula varies. The stomach, upper airway, teeth, artificial airway, ventilator-circuit condensate, and nasal sinuses have all been implicated as potential sources of aspirated secretions. Unfortunately, the relative importance of these sites, particularly the stomach, as sources of the causative agents of pneumonia is uncertain, and this uncertain has resulted in considerable controversy. The issue is important because the provision of adequate nutritional support to patients receiving mechanical ventilation is thought to prevent the occurrence of ventilator-associated pneumonia. Therefore, it

seems reasonable to administer nutritional support in a manner that minimizes the risk of bacterial colonization of the aerodigestive tract and subsequent aspiration (33).

Gastric overdistention should be avoided by reducing the use of narcotics and anticholinergic agents, monitoring gastric residual volumes after intragastric feeding, using agents that increase gastrointestinal motility (e.g., metoclopramide), and when necessary, supplying enteral nutrition through small-bore feeding tubes directed into the small bowel instead of the stomach (13).

4.1 Patient position: Semi-recombent positioning is generally defined as elevation of the head of the bed to 45 degrees. Semi-recombency is generally continued for the duration of mechanical ventilation. Aspiration of upper-airway secretions is common even in healthy adults. Patients receiving mechanical ventilator should be placed in a semi-recombent position to reduce the occurrence of aspiration. In addition, measures to reduce unplanned extubation (e.g., appropriate use of physical and chemical restraints and securing of the endotracheal tube to the patient) and the need for subsequent reintubation performed with the patient in the supine position may also be beneficial. Rotating kinetic beds is supporting for excretion of secretions and decreasing aspiration and reduce incidence rate of VAP (23).

4.2 Enteral feeding: Feeding should start as soon as possible and try to make the least regurgitation of feeding. This can be done by setting the patients in semi-recombent positioning, avoiding the gastric residuals which has to be followed up to adjust the appropriate quantity and time for feeding, avoiding some medicines which decrease the movement of gastrointestinal tract (muscle relaxants) such as narcotic and anticholinergics drugs, prescribing metoclopramide occasionally to activate the squeeze and movement of gastrointestinal tract, monitoring gastric residual volumes after intragastric feeding, using agents that increase gastrointestinal motility (e.g., metoclopramide), and when necessary, supplying enteral nutrition through small-bore feeding tubes directed into the small bowel instead of the stomach or far beyond pylorus (13). And mouth care by specially (34).

4.3 Stress-Ulcer Prophylaxis: Prevention of stress ulcer and result in the condition of acidity within the stomach and create less disease's colony, they have no result for VAP occurrence distinctly. In addition, it is found the incidence of bleeding more in the upper of gastrointestinal tract. Patients receiving mechanical ventilation

are at high risk for upper gastrointestinal hemorrhage from stress ulcers; they thus require preventive therapy. The rule of gastric pH in the pathogenesis of VAP is controversial. Bacterial colonization of the stomach, enhanced by the administration of pH-lowering drugs (e.g., histamine H<sub>2</sub> – receptor antagonists and antacids), is thought to be an important source of pathogens that can cause pneumonia. Hence, to consider which group of drugs should be prescribed depends on the patient's factor as using enteral feeding, drug interaction and the price of drugs.

4.4 Providing continuous subglottic suction: Patients put on the ventilator has to swallow endotracheal tube which causing accumulation of saliva and lingual saliva over the level of cuff of the ventilator and this probable will be aspirated into the lower of respiratory tract. Thus someone has devised the ventilator with special open hole located above the level of cuff in order to be the way to evacuate the liquid which has been accumulated out of it. There was also a study found that this device could decrease the incidence rate of VAP to 43%, especially, in the first week. However, another way to prevent aspiration which has been proved to be the best is more important: to check the pressure within the cuff regularly in the level of 20 cm.H<sub>2</sub>O. It was found that doing this could diminish both the aspiration and the incidence of VAP, especially, the first stage of VAP.

4.5 Avoiding being intubation through the patient's nose (Nasal intubation). This should not be done unless if it's necessary should not more longer than 48 hours since it will cause the infection within sinus till become sinusitis and can lead to aspiration into the lower of respiratory tract which is the cause of VAP.

5. Decreasing some bacterial spread into respiratory tract which can be done through the following methods (10):

#### 5.1 Decreasing contamination by:

5.1.1 Hand washing is the best way and the easiest, including the most economical way to protect any kinds of infection in the hospital as hands are the most important means leading diseases to the patients, Anyone who takes care of the patients who has been ill because of the respiratory tract system needs to keeps their hands clean otherwise they can let such diseases into the patients easily such as when providing the suction or prescribing some drugs. Hence, all nursing personnel need to wash their hands before and after taking care of each patient (10).

5.1.2 Separating and protecting the spreading of diseases into respiratory tract. Some patients can be easily infected; they need to be separated from the others who have had dangerous diseases and those who were infected of the respiratory tract, especially, the patients who had tracheostomy or intubation into the tracheal. The diseases spread from the patients through their cough, so that to separate these patients is very necessary (10).

5.1.3 Taking care of the mechanical ventilator circuits especially, the part connected with gas into the respiratory tract needs to be aseptic technique. If there is even little contamination, it may cause infection to the lung easily (10).

#### 6. Protecting with antimicrobial agents:

6.1 It is necessary to rotate using antibiotic, especially, in the ICU where there are infected patients having the treatment quite often. To prescribe the same group of antibiotic to cure infected patients for a long period of time can cause Bacterial resistance to Antibiotics, there is rotating antibiotic from time to time can diminish the chance of Bacterial resistance to Antibiotics.

6.2 Select to prescribe antibiotic with broad spectrum or empirical combination only in the case of severe septic which highly could be cause Bacterial resistance to Antibiotics such as *Pseudomonas aeruginosa* and *Acinetobacter spp.* or it is suspected that there is multiple pathogens infection only on the first stage. If we were aware of the real kind of disease found, we should consider adjusting prescribing drugs as it's necessary and selecting the ones providing narrow spectrum, cheapen and can be used with such diseases in order to diminish incidence of Bacterial resistance to Antibiotics. Bacterial resistance to Antibiotics may cause repeated infection later and the diminish of Bacterial resistance to Antibiotics helps to keep the ecology system of such disease within the patient's body and also in the ICU as well, including to prevent the occurrence of new species of Bacterial resistance to Antibiotics which could create in the latter.

6.3 Avoiding antibiotic in the form of Prophylaxis therapy as it was found that to prescribe antibiotic aimed to protection in the forms of both aerolized antibiotic and injected antibiotic through veins were not efficiency enough to prevent VAP. Contrarily they increased more of incidence of Bacterial resistance to Antibiotics in the later time. However, there was a study which was done later identifying only the

group of patients who were in coma condition and needed to intubation. The patients were prescribed Cefuroxime antibiotic through their veins in order to protect incidence of VAP, and it needs to be followed up later.

7. Changing the ventilator circuits so as to clean them: At present, it is suggested to change the circuits after using them over 48 hours. According to a study which found that a patient who was intubation up to 3 days caught infection of the respiratory tract for 28.0 % (35). And from a study of contamination of microbial agents in the ventilator circuits which found that the amount of microbial were increased and caused VAP during 3 – 5 days after using the ventilator (36). Hence, it is necessary to change the ventilator circuits at least every 72 hours. In case of the patients need to apply the aerosol nebulizer since there is a treatment to prescribe the bronchodilator, it is possible to have contamination which can lead to be VAP by inhaling the disease into their lungs (37). It was necessary to change the ventilator circuits every time between each patient, but if it's applied for only the same patients, it needs to be changed every 24 hour. And during the period of time waiting to reuse it next time, the circuits need to be kept sterilization and should be rubbed all over joints of the aerosol nebulizer by cotton with 70% alcohol every time before and after using them.

8. Suctioning sputum is not necessary to connect In-line suction catheter if it is an open suction. There has been a study lately shown that the In-line suction catheter was not needed to be changed everyday if it has been applied unless it becomes obstruction or there was any dirty.

Suction by aseptic technique as follows: (38)

8.1 There should be 2 persons: One is to do the suction and another one is a helper.

8.2 Hand washing well every time before doing the suction.

8.3 Listen to the respiration at the lung so that we know which part of the secretion was located most.

8.4 Turn on the pressure gauge approximate 120 mmHg with adult patients and 80 mmHg with child patients, and the does should wear sterilized gloves before suctioning the sputum within endotracheal tube, mouth and throat to be clear, then release some air out of cuff.

8.5 Provide 100% oxygen to the patients by pressing resuscitation bag and let it flow 5 – 10 liters / minute in order to help the patients respiring 4 – 5 times before doing the suctioning next time.

8.6 Set the patient's position while suctioning by turning their face to the opposite side of the lung or the bronchial needed to suction and if the patients were not suffered, should do the suctioning in every position.

8.7 In case of sticky sputum and hard to evacuate them, they may need to put some appropriate sterile dissolvable substance such as sterile normal saline solution which was actually 4 – 5 drops and not more than 0.5 ml. for children and 2 – 5 ml. For adult, then press the resuscitation bag appropriately 3 times in order to activate the patients to cough and start suctioning again.

8.8 After having done the suctioning, put sufficient air into the cuff of endotracheal tube, make sure that there were no leak and clean the ventilator joints with cotton consisting of 70% alcohol before connecting them into the endotracheal tube.

8.9 After having done the suctioning, listen to the respiration at the lung again to assess the efficiency of the suction and to see the position of the endotracheal tube or tracheostomy tube and used ventilator.

8.10 Outside diameter of the suction catheter not more than half of the diameter appeared on open hole of the endotracheal tube or tracheostomy tube. The suction catheter should be sterilization or has been disinfectant by various methods (34).

#### 9. Attempt to reduce contamination from:

9.1 The patients themselves: Trying to prevention and not allow the retrograde movement of the intestinal flora to happen or to contamination from feces which may occur through the patient's contaminated hands, bed sheets and other equipments by providing appropriate nursing care.

9.2 The nursing personnel who take care of the patients: Doctors and nurses need to wash up their hands before and after touching the patients through the correct method of washing up and applying the proper antiseptics.

9.3 The equipments and accessories used to cure the respiratory system: Various joints of the ventilator should be cleaned by cotton consisting of 70% alcohol

no matter whenever take off or put into the ventilator and should not let some water left in the tubes connected with the oxygen tube. The humidifier must be sterilization before using and taken care correctly such as change them every 24 hour, but if these are done incorrectly like cannot be changed within the fixed time may cause to have contamination which lead to the infection later on. Or to do the suction, it should be done appropriately one-fifth of the drainage capacity up to the stated point, then drain out waste water substance, wash the drainage and disinfectant and sterilization before using next time. In case of little waste water substance left from the suction, the drainage should be replaced every 8 hours (22).

9.4 Reduce contaminated environment: This may cause resistant strain of bacteria and can be solved by prescribing antibiotic which is considered to be suitable and provided narrow spectrum as possible.

10. Provide the most efficiency respiratory care technique: Try not to injury the lung which may result in lung defense mechanism such as technique of suction, technique of draining secretions, technique how to apply the ventilator and technique of how to prescribe various drugs which may cause defense mechanism, etc.

11. Early Recognition of any problems happened and performed early appropriate management so that this can prevent diseases from spreading to other patients.

12. Encouraging the surveillance of the infection within the respiratory system, especially, occur in the ICU or in the infectious ward in order to aware of the problems happened promptly, including can find the cause and plan for the protection and treatment immediately.

## **2.3 Concepts, theories and process of continuous quality improvement and related researches.**

### **2.3.1 Concepts on continuous quality improvement**

Continuous quality improvement refers to approved process of administration in hospital by objective of process will be known everyone in hospital. Brain storming to solve the problems and improve process of master plan, monitoring, set standard guideline are used which will be implemented continuously and regularly. The purposes want to maximum effectiveness of nursing care the patients and everyone happy in job. The process of continuous quality improvement concepts need to the highest achievement with efficiency by gathering collaboration from every personnel within the organization. All have collaborated to solve the problems, quality improvement according to the process of planning, perform and rectify, assess, fix the performance standard and improve the quality continuously (39).

The whole quality started in Japan after World War II which caused improvement both the products and services of the industry in Japan. Japan found its success and well development till the United States of America began to seek for factors beyond Japan's success. The United States of America submitted this concept in the early 1980. For public health task was changed its aim from structure standard to process standard and at present has been changed to an outcome standard (39).

Both Deming and Juran believed that quality management required long-term commitment and involvement of top management. They also believed that slogans did little to motivate persons and that the process and not the operator usually caused problems in an organization. They both understood the value of planning at high levels of the organization and that these plans impacted the outcome downstream noly if properly communicated to the operators of the process (39).

### 2.3.2 Principle, tools and techniques of the total quality.

The total quality is an innovation of administration which becomes feasible to improve public health services. The total quality is a new thinking method with different way of managing the organization. It emphasizes on process of management and the consumers, leadership, continuous improvement, colleagues' authority, team work and individual responsibility. These are parts of total quality philosophy (39).

Three experts on the total quality: W. Edwards Deming, Joseph M.Juran and Phillip Crosby submitted their concepts which were summarized as the following:

Deming stated that the total quality on services was a new method of leadership which all subordinates would be activated for collaboration in the process of decision-making administration. This would improve the quality continuously for both the products and the services (39).

Juran submitted that administrative mission of the whole organization was suitable for consumers. Both the products and services were consistent with the need and the consideration of the consumers by emphasizing on 3 main processes such as 1) quality control; 2) quality improvement and 3) quality planning (39). He also suggested the process of standard quality improvement which divided into 3 stages as the following:

1. Analyze the symptoms
2. Identify the cause
3. Apply the Remedies

Crosby recommended Zero Defect Program and founded the Quality College in Winter Park, Florida,U.S.A. The philosophy of management which Crosby mentioned was similar to the ones of Deming and Juran's (39).

Crosby suggested 4 methods of quality administration:

1. Quality went along with the regulations.
2. Prevention was the best quality system.
3. The performance outcome must appear without defect.
4. Quality measurement was the result of the difference from the regulations.

In addition, Crosby emphasized that education and awareness were main keys

which could lead quality administration to meet an achievement well and everyone in the organization needed to understand his role performing in the process of quality administration, including had an opportunity to be aware of those roles as well.

### **2.3.3 Nursing quality improvement**

Administrative system for developing the quality of nursing followed by the theory of continuous improvement in the process of operation recommended by 2 Americans theorists: Deming and Juran. The important issues of this theory emphasized on well understanding, including review of the procedure and the results continuously (39). Consider the following stages:

1. The leader must lead or begin to improve the quality first with the faith that public health service system at the moment is in good condition and with the collaboration within the organization can make it better than it is now.
2. To invest for quality improvement has to be done seriously because it could be given such worthwhile reward and reduce expenses as well as other businesses.
3. Trust and pay respect to personnel of different duties equally no matter they are doctors, nurses or workers.
4. Arrange to have the meetings in order to let the suppliers and consumers see and exchange ideas among each others on public health services.
5. Provide academic knowledge, tools with high technology and update to improve the procedure with the public health system.
6. Public health service institution must set the regulations in order to emphasize on quality improvement services as the main criteria in the organization.
7. All regulations concerning with public health task should be amended to favor the quality improvement services.
8. All public health personnel must be a part of the organization to consider the best ways to provide services properly and avoid quoting the minimum standard of services.
9. All doctors as well as personnel must pay their most attention and endeavor to improve the quality of services continuously.

### **2.3.4 Tools used for improving and developing the quality of services (39).**

The process of continuous quality improvement will be efficiency with effective results or not, it depends on the most important factor which means tools. Since each stages of the operation needs accurate and reliable data, hence, tools used for collecting, communicating and analyzing data should apply the following technique:

1. Fishbone or Ishikawa Diagrams or Cause and Effect Diagrams help specifying the main and subordinate causes which related to the problems and the outcomes.

2. Pareto Diagrams shaped like bar graphs which ranging the frequency from maximum to minimum. This diagram is suitable for chronological significance of the problems.

3. Check sheets shaped like a table used for recording data, stages and methods so that we can know the deficiency.

4. Histograms shaped like bar graphs which characterize the scattering of data when it was measured several times.

5. Scatter Diagrams showed groups of spots which relate to the characteristic of scattering 2 groups of data cause and effect.

6. Control Charts showed graph lines represent the changes and the impacts occurred from controlling the process of operation by stating the upper and lower limits as its scope.

7. Graph and Charts are tools showed various data which have been collected during the process of problem solution in order to follow up the progress and the changes.

8. Flow diagrams are the ones showed different stages in the process of operation as the priority and the point of making decision.

9. Brainstorming is the method of gathering in group in order to collect the data on problems and decision-making summary about various alternatives and methods which emphasize the role “No comment on the other’ s proposals.”

Moreover, there are other tools which can help developing the task quality or various services such as Pie Charts, Tree diagrams and Decision-making Matrices.

### **2.3.4 Patient's ventilator associated pneumonia through continuous quality improvement.**

The researchers has applied the concept of hospital accreditation to perform the quality team in developing the quality of services by granting a group of people to whom the researcher would help solving the problems and to become collaborated staffs in this research. All personnel are emphasized and encouraged to join in solving the problems in order to improve the task quality according to the process of planning, performing and solving the problems, examining, improving and setting the performing standard. Then it is necessary to follow up and do the assessment continuously.

Seubsaion et al (40) conducted a study at Buddhachinarat hospital reported that after implementing the program of diminishing infection in the patients put on the ventilators staying in the intensive-care unit (ICU) within the hospital was operated. It was found that infection occurred in the hospital through the patients put on the ventilators before and after the improvement were 22.8 and 19.2 respectively for 100 patients. Especially, the occurrence of infection in the lower respiratory tract before and after the improvement was 16 and 11.6 respectively for 100 patients who used ventilators. The results of this research appeared that the process of developing the quality of services could provide knowledge and skills on protection and control of infection even more to the personnel. It also helped to diminish the infection occurred in the hospital, thus created better quality services in the nursing home.

Concept of solving the problems through the process of TQM which stressed on collaboration of all personnel from every levels joining to solve the problems of the organization would make them follow and perform strictly more on the stated principles. This could be shown from the study of Pinsakul (41) in Lampang hospital which found that after allowing the nurses collaborated to solve the problems, they followed and performed their duties according to the stated principles of infected protection through medical and public health services strictly and increasingly by the level of statistic significant ( $p\text{-value} < 0.01$ ).

The study of Nenprom (42) in the infancy ward of Uttraradit hospital appeared that the way to solve the problems occurred by allowing the nurses working in that

ward collaborated to solve the problems had caused the correctness increasingly through their strictly following and performing the duties according to the principles on prevention of patient's ventilator associated pneumonia. The increment appeared from 57.2% to 91.8% and become 93.9% after the problems were solved within the first and the second months respectively.

From the study of Lally et al (43) found that to improve the task quality according to the concept of the quality control group through PDCA circle of Deming's could decrease incidence of VAP from 14.6 times per 1,000 ventilator-days to 7.0 times per 1,000 ventilator-days.

From the study of Kaewkongma et al (44) a staff working in the Emergency Unit 2 of Nakornpink hospital, Chiangmai, found that after implementing the program of developing the quality of services was operated to take care of the patients with burnt wound in the Emergency Unit 2, it appeared that the process of developing the quality of services made the personnel realize of the important of taking care of the patients with burnt wound, well understand and become skilful on protection and control of infection even more. Personnel could perform their duties as stated in the standard for 84.9%.

Thus, to develop the quality of services with quality team by using the concept of hospital accreditation should be one of several methods that could activate those nursing personnel to perform their duties according to the principles on prevention of patient's ventilator associated pneumonia more accurately. This resulted direct to the patients to receive the better quality services and also the protection and control of infection in the hospital were found more efficiency.

Conclusion: Incidence of VAP in the ICU could be found infection more often in the hospitals and the rate of infection seemed to be increased which made the mortality rate be higher level as well. According to the incomplete immunization of the patients and various supported factors such as some nursing personnel ignored to follow the principles on prevention of patient's ventilator associated pneumonia which were consisting of several activities like to take care the cleanness of oral hygiene, to set the position and turn over, to provide enteral feeding, suctioning sputum and to take care of respiratory tract and respiratory circuits. From the revision of related researchers found that if nursing personnel strictly followed and performed their duties

along with the principles on prevention of patient's ventilator associated pneumonia, they could decrease the incidence rate of VAP. Another supported factors on general characteristics were ages, underlying disease, underwent surgery, level of patient's consciousness, duration of intubation and using ventilators had been associated with the incidence of VAP. There were many ways to activate and encourage those nursing personnel to strictly follow and perform their duties according to the principles of protection and control of the infection, but it was found and appeared that those ways could not last longer and drive the nursing personnel to strictly follow the principles sufficiently. Hence, there was a concept to grant all personnel collaborating and helping in solving the problems more in every stages ranging from analyzing the problems to performing and it appeared that this concept was a better one in order to develop and encourage all nursing personnel to follow and perform their duties due to the stated principles more and it's hoped to be last longer (45).

## **CHAPTER III**

### **MATERIALS AND METHODS**

This chapter describes the research method. It includes study design, population and sample selections, sample size, research instrument, validity of the instrument, data collection, statistical analysis, and ethical issues.

#### **3.1 Study Design**

This study utilized a quasi - experimental, One group Pre-Post test design.

#### **3.2 Setting and participant**

**3.2.1 Nursing personnel:** All 24 nursing personnel of ICU who are taking care the practice on respirators in ICU, Fort Suranaree Hospital from 1 June 2003 to 9 June 2004 were enrolled in this study.

**3.2.2 Patients:** The target population was the patients on respirator in ICU, Fort Suranaree Hospital from 1 June 2003 to 9 June 2004.

#### **Inclusion criteria**

1. Patients, aged over 15 years, they were allowed by their family to complete in the informed consent form. The hospital allowed to use the data from the medical record department for studying.

2. They were intubated on ventilator, the chest X-rays on the first day result show no infiltration, consolidation, cavitation, crepitation and no at least 2 conditions of the following:

- Body temperature >38.5°C or > 35°C.
- Complete blood count (CBC) shows white bloods > 10,000 cell / mm<sup>3</sup> or > 5,000 cells / mm<sup>3</sup>
- New onset of purulent sputum or change in character of sputum.
- Isolation of an etiology agent from a specimen obtained by transtracheal aspirate, bronchial brushing, or biopsy.

#### Exclusion criteria

1. The patients who used ventilator more than 48 hours before admission in ICU.
2. Low resistance patients such as MDRGNB (Multi-drug resistant gram negative bacteria), MRSA (Methicillin-resistant *staphylococcus aureus*), VRE (Vancomycin resistant enterococci) and HIV.

### 3.3 Sample size

The estimated sample size was calculated from the following formula.

$$n = \frac{\left[ Z_{\alpha} \sqrt{p_0(1-p_0)} + Z_{\beta} \sqrt{p_1(1-p_1)} \right]^2}{[p_0 - p_1]^2}$$

Where, n = The estimated sample size.

$\alpha$  = The level of statistical significance was set at 0.05

1 -  $\beta$  = The power of discrimination value 95 %

$P_1$  = The incidence rate of VAP (posttest) = 0.05

$q_1$  = (1 -  $P_1$ )

$P_0$  = The incidence rate of VAP (pretest) = 0.15

$q_0$  = ( $P_1$  -  $P_0$ )

Where,  $P_0$  = 0.15 From surveillance survey incidence rate of VAP who used ventilator in ICU of Fort Suranaree Hospital during 2002 – 2003 (9)

$$\alpha = \beta = 0.05 \quad \Rightarrow \quad Z_{\alpha} = Z_{\beta} = 1.645$$

$$n = \frac{\left[ 1.645 \sqrt{(0.15)(0.85)} + 1.645 \sqrt{0.05(0.95)} \right]^2}{(0.15 - 0.05)^2}$$

$$n = 90$$

Therefore, at least 100 subjects were required for this study.

### 3.4 Research Instruments

The research instruments used in this study consisted of 2 categories.

1. Intervention Instrument consisted of the nursing process, the VAP prevention guideline or nursing standard for nursing personnel who had joined to improve practice activities under the continuous quality improvement concepts.

2. Instrument for collecting data of nursing care on VAP prevention.

Data collection was undertaken by the following sections:

2.1 Instrument documents and group process implementation were prepared by the researcher. The intervention instrument was developed by the VAP prevention procedure of Fort Suranaree Hospital and completed the data by infectious control ward nurse (ICWN). The document was consisted of 3 following categories.

Part 1: General characteristics of patient data that included, name, surname, aged, sex, HN, AN, admitted and discharged date, pre-diagnosis, past history, and underlying disease. These documents were twelve points.

Part 2: VAP risk factors data, data collection about general characteristics, level of consciousness, major surgery while the patients used respirator, and duration of mechanical ventilation. These documents were fourteen points.

Part 3: The result of VAP, evaluate from the first day intubation until 72 hours after extubation and completed data document of nosocomial infection. These documents were nine points.

2.2 Data collection document, count on the ventilator days, length of ICU stay and infection rate related VAP.

2.3 The questionnaire for nursing personnel that included name, surname, aged, education, position, experience and training about VAP and source of knowledge.

2.4 The observation form for VAP guideline, developed by the researcher. The document were created to cover the prevention by the Hospital Infection Control Practice Advisory Committee, HICPAC (13, 33), and guideline of the infection control committee of Fort Suranaree Hospital. It consisted of 5 items regarding procedures of mouth care, patient position, enteral feeding, suction, and respiratory care. The practice was checked by the observation and record scores in the opening space to count the score.

One score was given for correct practice.

Zero score was given for incorrect practice.

2.5 Guideline for VAP infection control was developed by the researches and HICPAC (13, 33), Fort Suranaree Hospital.

### **3.5 Content validity and reliability.**

Content validity instrument.

1. The nursing practice procedure and the observation forms were evaluated by 3 experts and examined the content validity of the instrument.

Content validity index (CVI) = 1.00 and 0.94.

The 3 experts are one ICO (Infectious control officer), one ICN (Infectious control nurse) who has 3 years experiences, one professional nurse expert on ventilator care.

2. Content validity of the nursing practice procedure related to VAP infection control of the nursing personnel who joined the intervention was reviewed by 3 experts as follows:

- |   |   |          |
|---|---|----------|
| 1. 3 years experiences ICN                | 2 | persons. |
| 2. 3 years experiences professional nurse | 1 | person.  |

All instruments were revised according to the recommendations of the experts before pre-testing with the subjects.

### 3.6 Procedure

The study period was from 1 June 2003 – 9 June 2004.

#### 1. Preparation stage

1.1 The researcher introduced the nursing practice of VAP prevention to the chief executive officers in Fort Suranaree Hospital, department head nurse, ward head nurse, ICN, ICU nurse who were responsible for the intervention.

1.2 Instrument, documents and the group process implementation were prepared at the ICU.

The data collection process was as follows:

- Sputum culture and chest X-rays after 24 hours on ventilators.
- Sputum culture and chest X-rays every cases when they have signs of improved pneumonia for high fever, change in character of sputum, dyspnea, or crepitation.

1.3 Every morning in ICU nurses complete the document at 10.00 a.m.

The researcher recorded the number of patients who received ventilators and all data of patients who received ventilators from the infection control document.

1.4 The researcher collected the data of patients who used ventilators from the infection control document 6 months before intervention.

1.5 Completing data collection form and checked all data of patients who used ventilators from the infection control document before coding.

1.6 Analysing data before the intervention.

#### 2. Data collection procedure was as follows:

2.1 The data were collected by the researcher using observational check lists for 24 nursing personnel.

2.2 The researcher informed the ICU head nurse about the all steps of this intervention.

2.3 The researcher observed the sessions during the routine nursing activities on respirator care using observation form in the first month of the intervention.

2.4 Event sampling everyday which divided into 3 days morning shift, 08- 16 hrs, 3 days evening shift, 16 – 24 hrs and one day night shift, 24 – 08 hrs.

3. Root cause analysis and problem solving by VAP infection control procedure as follows:

3.1 The researcher organized the meeting groups to orientate the nursing personnel regarding for planning and problem solving by random 10-12 nursing personnel for each group. The observation period was 1 hour and 30 minutes. The researcher was the moderator, used the tape recorder during the meeting to collect data. After the meeting was finished, all group members concluded and confirmed the progression results and problem solving to practice.

3.2 The nursing personnel practice according to the standard guideline of VAP prevention and all the problems solving, developing ideas in nursing discussion until the problems will be solved. The researcher evaluated program meeting 1 month after finished the program.

3.3 Evaluation the nursing care observation according to the VAP prevention guidelines after implementing nursing quality development in the sixth months.

### 3.7 Statistical analysis

The data were analyzed as follows:

1. Descriptive statistics, i.e., frequency, percentage, mean and standard deviation was used to describe all variables.

2. Results of data which collected from observing nursing personnel who practiced to prevent infection by VAP prevention guidelines were analyzed by frequency, and percentage. The adherence to nursing care guidelines were calculated using the following formula.

$$\text{Adherence to nursing care guidelines} = \frac{\text{Number of correct practice according to the guideline}}{\text{Total observation times}}$$

3. Paired t-test was used to compare the nursing quality improvement of nursing personnel before and after implementing nursing quality improvement on VAP prevention.

4. Chi-square test was used to examine the association between factors of general characteristics, nursing quality improvement and the incidence of VAP.

5. Incidences of VAP in all patients who are using ventilators were calculated using the following formula.

$$\frac{\text{Number of evidence cases from VAP in 6 months}}{\text{Total days of patient using ventilators in the same period}} \times 1000$$

### 3.8 Ethical issues

The research protocol was submitted and approved by the Ethical Committee of Faculty of Public Health, Mahidol University (see Appendix A). Permission to carry out was obtained from the Chief of Infectious Control Committee, Fort Suranaree Hospital, Nakhon Ratchasima Province. Written consents for interviewing and observing during study were obtained from all participated subjects. Collected data were used only for the purposes of this study. All information obtained during interview was confidential.

## CHAPTER IV

### RESULTS

The studied results are described as the following topics: general characteristics of 24 nursing personnel in ICU of Fort Suranaree Hospital, mean scores of the nursing quality improvement on VAP prevention before and after intervention i.e., mouth care, patient position, enteral feeding, suction, respiratory care and ventilator circuits, general characteristics of all patients i.e., age, underlying disease, major surgery, level of consciousness, and duration of mechanical ventilation and the incidence rate of VAP. The last part shows the relationship between nursing quality improvement and the incidence rate of VAP.

#### **4.1 General characteristics of 24 nursing personnel in intensive care unit**

Of the 24 nursing personnel, 17 nursing personnel were in age group 20 - 29 years. The age ranged from 22 to 41 years with the mean of 28.6 years. Only 7 nursing personnel finished bachelor's degree. Regarding working position 9 were nurse-aid while 3 were Non-commission officers. Thirteen nursing personnel had working experience in ICU 0-5 years, and 3 had working experience more than ten years. The ICU working experience ranged from 0.2 - 20 years. All nursing personnel ever received training for respiratory care and 22 nursing personnel ever received training for VAP care.

Table1 General Characteristics of 24 nursing personnel in intensive care unit of Fort Suranaree Hospital

Variable	Number
<b>Age (year)</b>	
20 – 29	17
30 – 39	6
> 39	1
Mean = 28.6      SD = 5.1      Range = 22 - 41	
<b>Education</b>	
Bachelor's degree	7
Diploma/Certificate	17
<b>Type of nursing personnel</b>	
Nurses	7
Practical nurses	5
Non-commission officers	3
Nurse Aid	9
<b>Working experience in ICU (years)</b>	
0 – 5	13
6 – 10	8
11 – 15	1
> 15	2
Mean = 5.8      SD = 5.1      Range = 0.2 - 20	
<b>Ever received training for respiratory care</b>	
Yes	24
No	0
<b>Ever received training for VAP care</b>	
Yes	22
No	2

#### 4.2 Comparison of nursing quality of nursing personnel before and after implementing nursing quality improvement on VAP prevention.

After implementing nursing quality improvement on VAP prevention, the 24 participated nursing personnel were observed whether they were adhere to VAP prevention guideline for six months. Table 2 indicated that the mean of overall and individual aspects nursing quality improvement in VAP prevention of the nursing personnel were all statistically increased ( $p < 0.001$ ).

Table 2 Mean and standard deviation (SD) of overall and individual aspects of nursing quality improvement among 24 nursing personnel before and after implementing nursing quality improvement on VAP prevention

Variable	Before (n =24)	After (n =24)	Change	p-value
	Mean (SD)	Mean (SD)	Mean (SD)	
Overall	110.0 (21.9)	157.2 (20.4)	+ 47.2 (1.5)	< 0.001
Mouth care	9.3 (1.0)	15.9 (0.4)	+ 6.6 (0.6)	< 0.001
Patients position	7.5 (1.6)	11.9 (0.3)	+ 4.4 (1.3)	< 0.001
Enteral feeding	21.7 (12.9)	32.3 (19.1)	+ 10.6 (6.2)	< 0.001
Suction	56.3 (5.1)	73.8 (2.6)	+ 17.5 (2.5)	< 0.001
Respiratory care and ventilator circuitd	15.3 (2.3)	23.3 (0.5)	+ 8.0 (1.8)	< 0.001

After implementing nursing quality improvement for six months, 24 nursing personnel were observed whether they provided care adhering to VAP prevention guidelines. Table 3 shows the prevalence of overall and individual aspects of mouth care, patient position, enteral feeding, suction, respiratory care and ventilator circuits after intervention. The proportion of patients who received overall nursing care according to VAP prevention guidelines was increased from 66.7% (2641/3960) to 95.3% (3773/3960). The proportion of patients received proper mouth care increased from 58.3% (224/384) to 99.5 % (382/384).

Table 3 Prevalence of overall and individual aspects adherence to nursing guidelines among nursing personnel before and after implementing nursing quality improvement on VAP prevention intervention

Nursing quality improvement On VAP prevention	Before (n =3960)		After (n =3960)	
	%	( times)	%	( times)
Overall nursing care	66.7	(2641/3960)	95.3	(3773/3960)
Mouth care	58.3	(224/384)	99.5	(382/384)
Patient position	62.5	(180/288)	99.3	(286/288)
Enteral feeding	65.8	(521/792)	97.9	(775/792)
Suctioning	70.3	(1350/1920)	92.2	(1771/1920)
Respiratory care and ventilators circuit	63.5	(366/576)	97.1	(559/579)

Upon further analysis into individual aspects of VAP prevention, Table 4 shows that before implementing intervention, 2.1% of patients received nursing care on position on the bed. The occurrence of nursing personnel who adhere to the guideline of VAP prevention on mouth care increased almost all of the VAP prevention items except the item regarding forceps or cotton buds or toothbrush for mouth care. The proportion that the patients who received over proper nurse practiced on mouth care after intervention was 99.5%.

Table 4 Nursing quality of 24 nursing personnel before and after implementing nursing quality improvement on VAP prevention on mouth care

Item	Before (n =96) % (times)	After (n = 96) % (times)	Change % (times)
Mouth care	58.3 (224)	99.5 (382)	+ 41.2 (158)
Position on the bed	2.1 (2)	99.0 (95)	+ 96.9 (93)
Hand washing / sterile gloves	62.5 (60)	100.0 (96)	+ 37.5 (36)
Forceps or cotton buds or toothbrush for the mouth care	100.0 (96)	99.0 (95)	- 1.0 (1)
Mouth care with dry cotton or sterile gauze	68.8 (6)	100.0 (96)	+ 31.2 (30)

Table 5 shows nursing quality after invention by observing 96 times of nursing care on patient position. All patients were changed position every two hours. Almost all patients were received nursing care on patient position. The occurrence of nursing personnel adhere to the guideline of VAP prevention increased almost all of the VAP items. The proportions that nursing personnel practice on each item of VAP prevention on patient position after intervention were almost the same as ( $\geq 99\%$ ).

Table 5 Nursing quality of 24 nursing personnel before and after implementing nursing quality improvement on VAP prevention on patient position

Item	Before (n = 96)	After (n = 96)	Change
	% (times)	% (times)	% (times)
Patient position	62.5 (180)	99.3 (286)	+ 36.8 (106)
Position on the bed	44.8 (43)	99.0 (95)	+ 54.2 (52)
Check plaster and tapes on endotracheal tube	42.7 (41)	99.0 (95)	+ 56.3 (54)
Changes patient position every two hours	100.0 (96)	100.0 (96)	0.0 (0)

Table 6 shows nursing quality after invention by observing 72 times of nursing care on enteral feeding. Before intervention, no patients received nursing care on stopping enteral feeding when the patients cough. After intervention almost all patients were received nursing care on every items of enteral feeding care according to the guidelines of VAP prevention on enteral feeding.

Table 6 Nursing quality of 24 nursing personnel before and after implementing nursing quality improvement on VAP prevention on enteral feeding

Item	Before (n = 96)	After (n = 96)	Change
	% (times)	% (times)	% (times)
Enteral feeding	65.8 (521)	97.9 (775)	+ 32.1 (254)
Hand washing / sterile gloves	27.8 (20)	88.9 (64)	+ 61.1 (44)
Position on the bed	100.0 (72)	100.0 (72)	0.0 (0)
Suction in the tubes	100.0 (72)	100.0 (72)	0.0 (0)
Test naso gastric tube	100.0 (72)	100.0 (72)	0.0 (0)
Check gastric content	100.0 (72)	100.0 (72)	0.0 (0)
Slowly enteral feeding	100.0 (72)	100.0 (72)	0.0 (0)
Stop enteral feeding when patients cough	0.0 (0)	100.0 (72)	+ 100.0 (72)
Stop enteral feeding when patient aspirated and clear airway	61.1 (44)	100.0 (72)	+ 38.9 (28)
Feeding water 50 cc. after the enteral feeding and clean NG tube by 70 % alcohol	51.4 (37)	87.5 (63)	+ 36.3 (26)
Fowler's position on the bed after the feeding within 1 hour	33.3 (24)	100.0 (72)	+ 66.7 (48)
No suction after the enteral feeding within 1 - 2 hours	50.0 (36)	100.0 (72)	+ 50.0 (36)

Table 7 shows nursing quality after invention by observing 96 times of nursing care on suction. Before intervention, no patients received nursing care on assistant clean tube and resuscitating bag by 70% alcohol. After intervention, almost all patients were received nursing care on every items of suction care according to the guideline of VAP prevention on suction. The proportion of overall proper suction care was 92.2%.

Table 7 Nursing quality of 24 nursing personnel before and after implementing nursing quality improvement on VAP prevention on suction

Item	Before (n = 96)	After (n = 96)	Change
	% (times)	% (times)	% (times)
Suction	70.3 (1350)	92.2 (1771)	+21.9(421)
To assess signs and symptoms	55.2 (53)	97.9 (94)	+ 42.7 (41)
Position on the bed	44.8 (43)	97.9 (94)	+ 53.1 (51)
Hand washing	29.2 (28)	83.3 (80)	+ 54.1 (52)
Surgical mask on the face	100.0 (96)	94.8 (91)	- 5.2 (5)
Sterile gloves	100.0 (96)	100.0 (96)	0.0 (0)
Prepared sterile tubes for suctions	100.0 (96)	100.0 (96)	0.0 (0)
Insert suction tubes in the suction monitor by aseptic technique	100.0 (96)	100.0 (96)	0.0 (0)
Open suction pressure 80 – 180 mmHg	67.7 (65)	100.0 (96)	0.0 (0)
Assistant help for removing the endotracheal tube	43.6 (42)	95.8 (92)	+ 52.2 (50)
Assistant clean tube and resuscitating bag by 70 % alcohol	0.0 (0)	79.2 (76)	+ 79.2 (76)
Assistant help for ventilation by 100 % oxygen	52.1 (50)	80.2 (77)	+ 28.1 (27)

Table 7 Nursing quality of 24 nursing personnel before and after implementing nursing quality improvement on VAP prevention on suction (continued)

Item	Before (n = 96)	After (n = 96)	Change
	% (times)	% (times)	% (times)
Suctions in the endotracheal tube by quickly soft and tender (10 – 15 sec.)	70.8 (68)	100.0 (96)	+ 29.2 (28)
Insert sterile normal saline 1 - 2 cc. in the endotracheal tube on cases of sticky secretion	66.7 (64)	77.1 (74)	+ 11.6 (10)
Assistant help for ventilation by 100 % oxygen after the suction	100.0 (96)	97.9 (94)	+ 2.1 (2)
Cleaned in the endotracheal tube by 70% alcohol and inserted tube to ventilator	100.0 (96)	80.2 (77)	+ 19.8 (19)
Cleaned the Ambu bag by 70 % alcohol and cover by sterile cloths	65.6 (63)	78.1 (75)	+ 12.5 (12)
Release the suction tubes in the infectious rubbish	100.0 (96)	100.0 (96)	0.0 (0)
Record characteristics of secretion	60.4 (58)	82.1 (79)	+ 21.7 (21)
Change secretion container within 24 hours or $\frac{3}{4}$ of container	50.0 (48)	100.0 (96)	+ 50.0 (48)
Only one resuscitating bag for one patient and clean every 24 hours	100.0 (96)	100.0 (96)	0.0 (0)

Table 8 shows nursing quality after invention by observing 96 times of nursing care on respiratory care. All patients were received care on changed respiratory circuit every 72 hours before and after intervention. After intervention, nearly all patients were received nursing care on respiratory care according to VAP prevention guidelines. The proportion of patients received overall proper respiratory care was 97.1%.

Table 8 Nursing quality of 24 nursing personnel before and after implementing nursing quality improvement on VAP prevention on respiratory care

Item	Before (n = 96)	After (n = 96)	Change
	% (times)	% (times)	% (times)
Respiratory care	63.5 (366)	97.1 (559)	+ 33.6 (193)
Take care the endotracheal tube to the correct position	40.6 (39)	100.0 (96)	+ 53.1 (51)
Rinsed off water traps in the respiratory circuit	40.6 (39)	83.3 (80)	+ 42.7 (41)
Changed the respiratory circuit every 72 hours	100.0 (96)	100.0 (96)	0.0 (0)
Add sterile water to the nebulizer jar by aseptic technique and changed nebulizer jar every 24 hours	45.8 (44)	99.0 (95)	+ 53.2 (51)
Only one aerosal nebulizer for one patient	100.0 (96)	100.0 (96)	0.0 (0)
Changed the aerosal nebulizer every 24 hours	47.9 (46)	100.0 (96)	+ 52.1 (50)

### **4.3 General characteristics of patients using VAP prevention in intensive care unit**

Table 9 shows the general characteristics of 216 patients who used ventilator in Intensive Care Unit on the prevention of VAP before and after implementing the nursing quality improvement with the number of patients of 107 and 109, respectively.

Six months before nursing quality improvement, 38.3% of 107 respondents were aged between 60 – 74 years with the mean average of 62 years. About 61.7% were male patients. Approximately 35.5% stayed in ICU 1–3 days with the mean of 10.7 days. About 42.1% were received 1-3 ventilator-days with the mean of 9 days. Most of active diseases were over one disease (27.1%) e.g. ESRD (End-staged Renal Failure) and CAPD (Continuous Ambulatory Peritoneal Dialysis), ESRD and ARDS (Adult Respiratory Distress Syndrome), ESRD, respiratory failure and CHF (Congestive Heart Failure), CHF and septic shock etc. which CVA and GI.tract ranged the second (22.4%). Most of underlying diseases were over one disease (29.9%) which CVA ranged the second (23.4%). The patients who had major surgery with ventilator were 21.5%. The patients who had tracheostomy with ventilators were 8.4%. The patients who had good consciousness were 33.6% and 66.4% for semi – coma or coma.

Six months after nursing quality improvement, 38.5% of 109 respondents were aged between 60 – 74 years with the average of 64 years. There were 68 men (62.4%) and 41 women (37.6%). The hospital days were between 1–3 days (33.0%) with the mean of 9 days. The ventilator days were between 1 – 3 days (42.2%) with the mean of 7 days. The most active diseases were over one disease (43.1%) e.g. ARDS and acute pancreatitis, COPD and respiratory failure, CRF (Chronic Renal Failure), UTI (Urinary Tract Infection) and pulmonary edema etc. which CVA ranged the second (26.6%). Most of the underlying diseases were over than one disease (41.3%) which CVA ranged the second (25.7%). The patients who had major surgery with ventilator were 30.3%. The patients who had tracheostomy with ventilator were 7.3%. The patients who had good consciousness were 58.7% and 41.3% for semi – coma or coma.

Table 9 General characteristics of patients before and after implementing nursing quality improvement on VAP prevention

Variable	Before (n=107)		After (n=109)	
	N	%	n	%
<b>Age (years)</b>				
15 - 29	3	2.8	5	4.6
30 - 44	10	9.3	13	11.9
45 - 59	28	26.2	18	16.5
60 - 74	41	38.3	42	38.5
75 - 89	24	22.4	29	26.6
≥ 90	1	0.9	2	1.8
Mean ± SD	62.1 ± 15.5		63.9 ± 17.0	
Range	18 - 92		18 - 90	
<b>Gender</b>				
Women	41	38.3	41	37.6
Men	66	61.7	68	62.4
<b>Length of ICU stay (days)</b>				
1 - 3	38	35.5	36	33.0
4 - 6	21	19.6	30	27.5
7 - 9	14	13.1	17	15.6
≥ 10	34	31.8	26	23.9
Mean ± SD	10.7 ± 14.3		9.1 ± 11.5	
Range	1 - 85		1 - 78	
<b>Ventilator days (days)</b>				
1 - 3	45	42.1	46	42.2
4 - 6	18	16.8	27	24.8
7 - 9	13	12.1	13	11.9
≥ 10	31	29.0	23	21.1
Mean ± SD	9.1 ± 12.9		7.5 ± 10.2	
Range	1 - 85		1 - 78	

Table 9 General characteristics of patients before and after implementing nursing quality improvement on VAP prevention (continued)

Variable	Before (n =107)		After (n =109)	
	N	%	n	%
<b>Active diseases</b>				
COPD or asthma	5	4.7	3	2.8
CVA	24	22.4	29	26.6
DM, HT	2	1.9	0	0.0
Over 1 disease	29	27.1	47	43.1
GI.Tract	24	22.4	11	10.1
Heart and blood circulation	14	13.1	12	11.0
CRF, ESRD	4	3.7	2	1.8
Orthopedics	4	3.7	4	3.7
Cancer of colon	1	0.9	1	0.9
<b>Underlying diseases</b>				
COPD or asthma	6	5.6	4	3.7
CVA	25	23.4	28	25.7
DM, HT	4	3.7	6	5.5
Over 1 disease	32	29.9	45	41.3
GI.Tract	20	18.7	11	10.1
Heart and blood circulation	11	10.3	8	7.3
CRF, ESRD	4	3.7	1	0.9
Orthopedics	4	3.7	5	4.6
Acute pancreatitis	1	0.9	1	0.9

Table 9 General characteristics of patients before and after implementing nursing quality improvement on VAP prevention (continued)

Variable	Before (n =107)		After (n =109)	
	n	%	n	%
Major surgery with ventilator				
No	84	78.5	76	69.7
Yes	23	21.5	33	30.3
Tracheostomy with ventilator				
No	98	91.6	101	92.7
Yes	9	8.4	8	7.3
Consciousness				
Semi-coma, coma	71	66.4	45	41.3
Good conscious	36	33.6	64	58.7

#### 4.4 Incidence of patients with VAP in Intensive Care Unit before and after intervention

During the study period, VAP occurred in 23 patients. Before intervention, the incidence of VAP was 15% (16/107) or 17.5 per 1,000 ventilator-days. After intervention, the incidence of VAP was declined to 6.4% (7/109) or 9.0 per 1,000 ventilator-days.

VAP occurred in 23 patients during the study period, 16 caese before and 7 cases after implementing the nursing quality improvement intervention was showed in Table 10.

Table 10 Incidence of VAP patients before and after implementing intervention by patient's general characteristic

Variable	Before (n =107)		After (n = 109)	
	VAP =16	%	VAP =7	%
<b>Age (years)</b>				
15 - 29	2	1.87	0	0
30 - 44	1	0.94	3	2.75
45 - 59	3	2.80	1	0.92
60 - 74	5	4.67	2	1.84
75 - 89	5	4.67	0	0
≥ 90	0	0	1	0.92
<b>Gender</b>				
Men	7	6.54	5	4.59
Women	9	8.41	2	1.84
<b>Ventilator days (days)</b>				
1 - 3	0	0	0	0
4 - 6	0	0	0	0
7 - 9	1	0.94	1	0.92
≥ 10	15	14.02	6	5.51
<b>Length of ICU stay (days)</b>				
1 - 3	0	0	0	0
4 - 6	0	0	0	0
7 - 9	0	0	1	0.92
≥ 10	16	15.00	6	5.51
<b>Active diseases</b>				
COPD or asthma	0	0	1	0.92
CVA	5	4.67	2	1.84
DM, HT	0	0	2	1.84
Over 1 disease	4	3.74	0	0
GI.Tract	2	1.87	0	0

Table 10 Incidence of VAP patients before and after implementing intervention by patient's general characteristic (continued)

Variable	Before (n =107)		After (n =109)	
	VAP =16	%	VAP =7	%
<b>Active diseases</b>				
Heart and blood circulation	2	1.87	1	0.92
CRF, ESRD	3	2.80	0	0
Orthopedics	0	0	1	0.92
<b>Underlying diseases</b>				
COPD or asthma	0	0	1	0.92
CVA	6	5.61	2	1.84
DM, HT	0	0	0	0
Over 1 disease	5	4.67	2	1.84
GI.Tract	2	1.87	0	0
Heart and blood circulation	1	0.94	1	0.92
CRF, ESRD	2	1.87	0	0
Orthopedics	0	0	1	0.92
<b>Major surgery with ventilator</b>				
No	13	12.15	4	3.67
Yes	3	2.80	3	2.75
<b>Tracheostomy with ventilator</b>				
No	11	10.28	4	3.67
Yes	5	4.67	3	2.75
<b>Consciousness</b>				
Semi-coma, coma	8	7.50	4	3.67
Good conscious	8	7.50	3	2.75

Table 11 shows the incidence VAP patients before and after intervention by type of pathogens.

Six months before the nursing quality improvement, the majority of VAP cases were caused by *Pseudomonas aeruginosa* (6.54%), followed by: *Acinetobacter spp.* (2.80%), *Acinetobacter baumannii* (1.87%), *Pseudomonas aeruginosa*, and *Acinetobacter baumannii* (1.87%).

Six months after the nursing quality improvement, the majority of VAP cases were caused by *Acinetobacter baumannii* (4.59%) and *Pseudomonas aeruginosa* (1.84%).

Table 11 Incidence of VAP patients before and after intervention by type of pathogens

Pathogen	Before (n = 107)		After (n = 109)	
	VAP =16	%	VAP =7	%
<i>Pseudomonas aeruginosa</i>	7	6.54	2	1.84
<i>Pseudomonas spp.</i>	1	0.94	0	0
<i>Acinetobacter spp.</i>	3	2.80	0	0
<i>Acinetobacter baumannii</i>	2	1.87	5	4.59
<i>P.aeruginosa</i> and <i>Acinetobacter spp.</i>	1	0.94	0	0
<i>P.aeruginosa</i> and <i>Acinetobact baumannii</i>	2	1.87	0	0

#### **4.5 Association between patients' general characteristics with the incidence rate of VAP before and after nursing quality improvement on prevention of patient's ventilator associated pneumonia.**

Table 12 demonstrates the association between patient's general characteristics, i.e., age, underlying diseases, major surgery, level of consciousness, duration of intubation and using ventilators and the incidence of VAP before and after nursing quality improvement on prevention of VAP.

Six months before implementing the nursing quality improvement only ventilator days, length of ICU stay were statistically associated with the incidence of VAP ( $p < 0.001$ ).

Six months after implementing the nursing quality improvement, it was found that length of ICU stay and ventilator days were statistically associated with the incidence of VAP ( $p < 0.001$ ).

Table 12 Association between patient's characteristics and incidence of VAP before and after intervention

Variable	Before (n =107)		p-value <sup>a</sup>	After (n =109)		p-value <sup>a</sup>
	Non-VAP	VAP		Non-VAP	VAP	
Age (years)			0.942 <sup>b</sup>			0.216 <sup>b</sup>
15- 59	35	6		32	4	
≥ 60	56	10		70	3	
Underlying diseases			0.550 <sup>b</sup>			0.416 <sup>b</sup>
CVA	25	6		29	3	
Non CVA	66	10		73	4	
Major surgery			0.772 <sup>b</sup>			0.431 <sup>b</sup>
Yes	20	3		30	3	
No	71	13		72	4	
Level of consciousness			0.133 <sup>b</sup>			0.378 <sup>b</sup>
coma, semi-coma	63	8		41	4	
Good conscious	28	8		61	3	
Ventilator days (days)			<0.001			<0.001
1-9	75	1		85	1	
≥ 10	16	15		17	6	
Length of ICU stay (days)			<0.001			<0.001
1-9	73	0		82	1	
≥ 10	18	16		20	6	
Pathogens			n / a			n / a
Yes	0	16		0	7	
No	91	0		102	0	

a  $\chi^2$  test

b Fisher's Exact Test

n / a not applicable

#### **4.6 Association between the nursing quality improvement and the incidence of VAP before and after nursing quality improvement on prevention of patients' ventilator associated pneumonia.**

Table 13 demonstrates the association between of nursing care factors, i.e., mouth care and teeth, patient position, enteral feeding, suctioning of sputum, respiratory care and respiratory circuits and the incidence of VAP before and after nursing quality improvement on prevention of VAP.

Six months before the nursing quality improvement, practice on mouth care, patient position, enteral feeding, suctioning of sputum, respiratory care and respiratory circuits were statistically associated with the incidence of VAP ( $p < 0.05$ ).

Six months after the nursing quality improvement only mouth care practice was statistically associated with the incidence of VAP ( $p < 0.001$ ).

Table 13 Association between nursing quality improvement and incidence of VAP before and after intervention

Variable	Before (n =107)		p-value <sup>b</sup>	After (n =109)		p-value <sup>b</sup>
	Non-VAP	VAP		Non-VAP	VAP	
Mouth care			<0.001			<0.001
No	10	16		11	7	
Yes	81	0		91	0	
Patient position			<0.001			n /a
No	6	16		0	7	
Yes	85	0		102	0	
Enteral feeding			0.002			0.194
No	58	16		76	7	
Yes	33	0		26	0	
Suction			<0.001			n /a
No	9	16		0	7	
Yes	82	0		102	0	
Respiratory care and ventilator circuit			<0.001			n /a
No	21	16		0	7	
Yes	70	0		102	0	

b     Fishers Exact Test  
n /a   not applicable

## CHAPTER V

### DISCUSSION

This chapter is intended to discuss the study of the incidence of VAP for mechanically ventilated adult patients and to identify the main risk factors of VAP improvement in a critical illness of ICU, incidence of VAP, nursing quality improvement of VAP for 24 nursing personnel, comparison association between nursing quality improvement and the incidence of VAP, comparison association between general characteristics of patients with the incidence of VAP before and after intervention and limitations of the study.

#### **5.1 Incidence of VAP.**

After intervention, the incidence of VAP declined from 15.0% (16/107) to 6.4% (7/109). The different results might occur due to the available of guideline on prevention of VAP patients and a different group of nursing care. Amnartmanee and Payaprom (46) reported that the guideline on prevention of patient VAP is required to reduce such a problem on VAP. Pichiansatien (47) reported that adhering to the guidelines on prevention and control nosocomial infection was a good method used to activate and enhance nursing personnel in order to better understand on prevention and control nosocomial infection.

#### **5.2 Nursing quality improvement of VAP for nursing personnel in ICU.**

After implementing nursing quality improvement on prevention of VAP, nursing quality improvement for VAP prevention of nursing personnel has been markedly improved on the practice adhering to the guideline more than before implementing nursing quality improvement. The adherence of practicing according to guidelines on mouth care increased from 58.3% to 99.5%. Other practices also increased over 90%

(Table 3). The results corresponded with the study of Amnartmanee and Payaprom (46).

From this study, it was found that nursing personnel who were trained on prevention of VAP patient received better knowledge than the nursing personnel who never received training. As shown in the study of Charearnlap (48) the nurses who ever trained on prevention and control nosocomial infection got higher mean scores than those who were never trained. Prawaltip (49) showed that after training on nosocomial infection surveillance the nursing personnel were significantly increased correctly practice on nosocomial infection surveillance.

In addition, the experience is a factor supporting the nursing personnel to correct the nursing care. Chatrung (50) reported that the working experience of nursing personnel was statistically associated with prevention and control nosocomial infection. However, the effective group should be have working experience in ICU between 1 and 5 years (Table 1) because the experience on nursing care of patient's ventilator associated pneumonia was declined after this period.

**5.2.1** Guideline of mouth care and teeth, it was found that the sampling groups on this guideline had the lowest practice of 58.3% (Table 4). Also, doing position on the bed and elevate a head of patients having slope about 30 - 45 degree from base was 2.1%. Effects of the position to turn face upwards for such a long time occurred due to collecting secretions in respiratory tract and aspiration secretions into lungs. Tablan et al (51) showed that the patients who used ventilators and position to turn face upwards had amount of secretions in trachea more than the patients who took up a head of patients having slope about 30 - 45 degree from base. The patients who had the position to turn face upwards got a percentage of microorganism investigation as same as secretions from stomach. In contrast, upper trachea was higher than position on the bed and take up a head of patients having slope about 30 - 45 degree from base (52). Therefore, to prevent aspiration and to reduce the collection of secretion, the patients could be in the position on the bed and a head of patients could have a slope about 30 - 45 degree from base and could be changed position every two hours (53). In addition, hand washing before mouth care on practicing in the guideline was 62.5% (Table 3). Some nursing personnel in present study suggested that hand washing was very importance to prevention nosocomial infection but we are lacking of activating

nursing personnel to practice. Piyadamrongkul (54) showed that personnel could not wash their hands before nursing care due to an inappropriate of equipments of hand washing. Hand washing before and after the nursing care was important because it decreased the amount of microorganism on the hands. Hixon et al (55) showed that after promoting the nursing personnel who were working in NICU (Nursery Intensive Care Unit) about gloving and hand washing before and after nursing care could be controlled.

**5.2.2** Guideline of patient position is related to patient position, In this study the proportion of patients who received proper care on patient position was 62.5% (Table 5). For individual aspects of patient position, 44.8% of patients were received proper position care on the bed and turn patients by side to slope about 30 - 45 degree from base. Therefore, we must changing patients position every two hours and doing semi-recombent positioning (is generally defined as elevation of the head of the bed to 45 degrees) on prevention of aspiration of gastric secretions and decreased a mount of secretions in respiratory tract (53). Observing plaster and tapes on endotracheal tube. And changing plaster and tapes when dirty was 42.7%. The researcher found that the patients had been leakage of saliva all over times, Nursing personnel would not be observe plaster and tapes on endotracheal tube and not changing when dirty. These might be at high risk for putting off endotracheal tube so we must be changing plaster, tapes and positioning of endotracheal tube all over times before the new changing patients positioning (51).

**5.2.3** Guideline of enteral feeding regarding. Before intervention, 65.8% of patients received proper care on enteral feeding was 27.8% (Table 6). For individual aspects of enteral feeding, practice on hand washing/sterile glove was 27.8%. No practices on stopping enteral feeding when patient aspirations because when the patients coughed, reflux of gastric secretions from the stomach to esophagus will occur. Then, it might be into respiratory tract and may be aspiration (23). Therefore, after enteral feeding could be fowler's position on the bed within 1 hour had been practiced was 33.3%. Because of increase of the pressure in thoracic gravity and abdomen for using ventilators will be always aspiration (54) so that we must be enteral feeding by slowly and doing fowler's position on the bed within 1 hour before and after enteral feeding (55). No suction after the enteral feeding within 1 - 2 hours had

been practiced at 50.0 percents because of suctioning after enteral feeding cause be coughed and will had be reflux of gastric secretions from the stomach to esophagus and then might be into respiratory tract and may be aspiration in lung (23). Cleaning the nasogastric tube by 70% alcohol after enteral feeding had been practiced was 51.4% so that no cleaning the nasogastric tube by 70% alcohol could be contamination the pathogens at the tip of nasogastric tube and into stomach and causes of VAP because of the patients aspirations of gastric secretions from the stomach to esophagus and into respiratory tract and might be aspiration in lung so we must be aseptic technique all over of enteral feeding (56).

**5.2.4** Guideline of suction: Before intervention, 70.3% of patients received overall suction care according to the guideline (Table 7). For individual item, no patients received suction care on cleaning endotracheal tube and resuscitation bag by 70% alcohol from assistant before blowing oxygen into lung. Only 43.6% of patients received removing the endotracheal tube and cover with sterile cloths or gauzes. These guidelines cause of contaminations on respiratory circuits from exogenous pathogens into lung and causes of VAP (57). And hand washing was practiced only 29.2% before suctioning of sputum.

**5.2.5** Guideline of nursing care of respiratory care regarding show that respondents on this guideline had been practiced was 63.5% (Table 8). For individual item, patients received respiratory care was only 40.6%. These may be gram negative bacteria in the water traps of the respiratory circuits (58). In addition to that water traps could be flowed into respiratory tract on changing positioning patients, so we must be rinsed off water traps every times on nursing care and do not poured back into the nebulizer jar (51). Add sterile water to the nebulizer jar by aseptic technique and changed nebulizer jar every 24 hours had been practiced was 45.8% cause of oxygen flowing into lung had be decreased humidity and to be irritated on mucous of the respiratory tract (59).

### **5.3 Association between patient's general characteristics and the incidence of VAP before and after intervention**

**5.3.1** Six months before nursing quality improvement, aged was not found statistically associated with the incidence of VAP ( $p > 0.05$ ). Torres et al (23) who found that age was not associated with VAP. Underlying diseases, major surgery, level of consciousness and ventilator associated pneumonia of this study were not significant ( $p > 0.05$ ) (Table12).

Six months after nursing quality improvement, the results aged was not found statistically associated with the incidence of VAP ( $p > 0.05$ ). The highest incidence of nosocomial infection was found in patients who aged 61 – 75 years old. This corresponded with the research of Limtongkul et al (61) who found that the patients aged over 60 years had the incidence rate of VAP about 88.6% while the patients aged less than 60 years had the incidence rate of VAP at 57.2 %.

**5.3.2** Six months before and after nursing quality improvement, length of ICU stay, ventilator days were found statistically associated with the incidence of VAP ( $p < 0.001$ ). The results study of Blinkhorn (62) who found that the risk of VAP increased 6.5%, 19% and 28% for 10, 20 and 30 days, respectively. This corresponded with the research of Torres et al (23) showed that the risks of VAP increased after incubation and ventilators used with a numbers of days which started from the second of incubation. The risks of VAP daily increased 1%. Cross and Roup (17) studied the causation of ventilators to the incidence rate of VAP and it was found that the patients who used ventilators less than 24 hours were not incidence of VAP and durations of ventilators for non VAP groups were about 5.9 days while durations of ventilators for VAP groups were about 9.1 days.

#### **5.4 Association between nursing quality improvement on VAP prevention i.e., mouth care, patient position, enteral feeding, suction, respiratory care and respiratory circuits with the incidence of VAP before and after intervention**

**5.4.1** Six months before nursing quality improvement, mouth care, patient positions, enteral feeding, suction, respiratory care and respiratory circuits were found statistically associated with the incidence of VAP ( $p < 0.001$ ).

**5.4.2** Six months after nursing quality improvement, mouth care was found statistically associated with the incidence of VAP ( $p < 0.001$ ). Pierce (57) found that mouth care and throat with humidity increased in the efficiency for decontamination of pathogens in oral. Deriso et al (63) reported that the routine use of an oral chlorhexidine rinse for the prevention of health-care-associated pneumonia in all postoperative or critically ill patients and/or other patients at high risk for pneumonia.

**5.4.3** Six months after nursing quality improvement, patient position was not statistically associated with the incidence of VAP. ( $p > 0.05$ ). Drakulovic et al (64) reported that patients who used ventilators and semi-recombent positioning had the incidence of VAP for 5 % while the patients who used ventilators and turned up by side had incidence of VAP for 23%. In addition, the incidence of VAP increased for 50% when the patients were turned up by side and had been enteral feeding. Prevention of aspiration and decrease in secretions in respiratory tract might be semi-recombent position and changing position every 2 hours (53).

**5.4.4** Six months after nursing quality improvement, enteral feeding was not statistically associated with the incidence of VAP ( $p > 0.05$ ). Deriso et al (63) showed that bacteria in the stomach increased due to some conditions such as non-hydrochloric acid in stomach, malnutrition, use of antacid for stress bleeding prophylaxis in patients receiving mechanically assisted ventilation, gastro intestinal tract diseases and enteral feeding. At the pH of 6.4 – 7.0, acidity decreased in stomach enhanced bacterial growth. The study of Grap & Munro (56) showed that cleaning tip of nasogastric tube by 70% alcohol after enteral feeding could not remove pathogens at the tip of nasogastric tube and into stomach.

**5.4.5** Six months after nursing quality improvement, suction was not statistically associated with the incidence of VAP ( $p > 0.05$ ). Suctioning process, most

nursing personnel released respiratory circuit and did not clean the tip of endotracheal tube by 70% alcohol and laid down the bed so that these guidelines caused contaminations on respiratory circuits from exogenous pathogens into lung leading to VAP (57).

**5.4.6** Six months after nursing quality improvement respiratory care and respiratory circuit was not statistically associated with the incidence of VAP ( $p > 0.05$ ). Pierce (57) investigated that releasing respiratory circuit, no cleaning tip of endotracheal tube by 70 % alcohol before blowing oxygen into lung and no cover tip of endotracheal tube by sterile cloths or gauze these practices caused of contaminations on respiratory circuits from exogenous pathogens into lung and caused of VAP. Silvestri (65) showed that patients who used ventilators for 3 days were infected in respiratory tract at 28.0%. Berrouane (66) showed that the contamination of respiratory circuit increased pathogens causing of VAP on the day third and fifth of using ventilators therefore, respiratory circuit could be changed every 72 hours. The cases in which aerosol nebulizer was used for inhalation therapy might be cause contamination of aerosol nebulizer and increased pathogens leading to VAP from inhalation the pathogens into lung (37). After using aerosol nebulizer, it must be sterilized and taken care of correctly. If guidelines were incorreced such as no change on times contamination and cause of VAP would occur. Also, changing secretion container within 24 hours or after three-quarter of container, cleaning and sterilization before using next times secretion containers could be changed every 8 hours (22).

### 5.5 Limitations of the study

This study has two major limitations. The first limitation is that in present study we used a clinical diagnosis of VAP, and the presence of VAP was established without invasive diagnostic procedures. As a result, some cases with non-infectious etiologies for pulmonary infiltrates might be misclassified as VAP. Therefore, the incidence of VAP was higher than other studies due to over estimated of VAP. The combination of infiltrates on the chest radiographs and at least 2 of 3 clinical criteria (fever, leukocytosis, and purulent secretions) had a sensitivity of 69% and a specificity of 75% for diagnosis VAP. Moreover, several studies demonstrated a similar diagnostic with invasive and noninvasive techniques and produced a similar to the patient outcomes in terms of mortality, ICU stay, and duration of mechanical ventilation. No diagnosis criteria, using different diagnosis criteria, lengths of ICU stay, and lack of adequate system that is used to compare illness severity and invasive diagnostic or therapeutic procedure.

The second limitation is that most patients in this study were received an antibiotic, therefore, it could not use this factor as a potential risk factor. The exposure of antibiotic may be another reason to explain the higher incidence rate of VAP in this study. The prophylactic use of antibiotics is not recommended, and the exposure of antibiotics is a significant risk factor for colonization and infection with nosocomial multidrug-resistant pathogens. The judicious use of appropriate antibiotics may reduce patient colonization and subsequent infections with multidrug-resistant bacteria.

Although there are some limitations, the findings of the incidence of VAP in mechanically ventilated patients are important. Risk factors identified in this study need a further validation.

## CHAPTER VI

### CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Conclusions

The objectives of the quasi – experimental research were to study the effects of the nursing quality improvement on VAP prevention. This quasi-experimental study aimed to assess the effects of nursing quality improvement on reduction of patient's ventilator-associated pneumonia (VAP) by Continuous Quality Improvement (CQI) concept. All 24 nursing personnel aged 22-41 years working in ICU of Fort Suranaree Hospital, Nakhon Ratchasima Province, Thailand were trained in a nursing process according to VAP prevention guidelines. A total of 216 patients, 107 cases 6 months before and 109 cases 6 months after intervention, who were admitted to the ICU and received a ventilator for more than 48 hours, aged 18-92 years, were included in the study. Data were collected from medical recorded by ward head and deputy ward head and confirmed by the researcher from 1 June 2003 to 9 June 2004.

During the study period, 23 patients had an occurrence of VAP. Before intervention, the incidence of VAP was 15% (16/107) or 17.5 per 1,000 ventilator-days. After intervention, the incidence of VAP was declined to 6.4% (7/109) or 9.0 per 1,000 ventilator-days. The proportion of nursing personnel practicing the developed nursing guidelines increased from 66.7% to 95.3% ( $p < 0.001$ ). Before improving nursing care, five factors were associated with VAP: mouth care, patient position, enteral feeding, suction, and respiratory care ( $p < 0.001$ ). After improving nursing care, only mouth care was associated with VAP ( $p < 0.001$ ). A patient characteristic associated with VAP was duration of intubations and ventilator reception over 10 days ( $p < 0.001$ ). The finding could be used as a standard nursing guideline to reduce VAP. Nursing quality improvement should be applied to other low resistance patient groups such as cancer patients and potentially drug-resistant bacterial infections.

In conclusion, the nursing quality improvement intervention appeared to be effective to reduce the incidence of VAP. After implementing the intervention, the prevalence of overall and individual aspects adherence to nursing guidelines on VAP prevention among nursing personnel was markedly increased. Furthermore, the incidence of VAP also decreased. However, several limitations in this study should be considered. The findings of this study need a further validation.

## 6.2 Recommendations of the study

1. The head of ICU Fort Suranaree Hospital should support all nursing personnel for the nursing quality improvement on prevention of patient's VAP by continuously improving the nursing care to decrease the risks and incidence of VAP.
2. The chief officers and head of nursing are important to motivate and remind the nursing personnel to improve the nursing quality improvement. These can be appropriate practice nursing care on the prevention of VAP.
3. The orientation on prevention of patient's VAP should be promoted to all nursing personnel for improving knowledge. Also, nursing personnel could be correctly trained and practiced nursing care on the prevention of patient's VAP by continuously improving the nursing care.

## 6.3 Recommendations for further study

1. In present study, the subjects were VAP patients aged more than 15 years old. Further study should be conducted in VAP patients aged less than 15 years.
2. Applying the study for the prevention of patient's VAP in low resistance patient groups such as MDRGNB (Multi-drug resistant gram negative bacteria), MRSA (Methicillin-resistant *staphylococcus aureus*), cancer patients and HIV.
3. Applying the nursing quality improvement on the prevention of patient's catheter related blood stream infection, catheter related urinary tract infection, and surgical site infection.

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## APPENDIX A



NO. 202/2003

**Documentary Proof of Ethical Clearance  
The Committee on Human Rights Related to  
Human Experimentation  
Mahidol University, Bangkok**

.....

**Title of Project:**      **Effects of Service Quality Development on Prevention of  
Patient's Ventilator Associated Pneumonia in Fort Suranaree  
General Hospital Nakornratchasima Province**

**Principle Investigator:**      **Maj. Wannakorn Kamdech**

**Name of Institution:**      **Faculty of Public Health**

**Approved by the Committee on Human Rights Related to Human Experimentation**

**Signature of Chairman:**   
(Professor Dr. Srisin Khusmith)

**Signature of Head of Institute:**   
(Professor Dr. Pornchai Matangkasombut)

**Date of Approval:** 30 DEC 2003

## **APPENDIX B**

### **INFORMATION SHEET**

**Project Title:** Effects of nursing quality improvement on reduction of patient's ventilator associated pneumonia.

#### **Objectives**

1. To compare quality of nursing care on VAP prevention before and after implementing nursing quality improvement at ICU of Fort Suranaree Hospital.
2. To compare the incidence of ventilator associated pneumonia of patients in before and after implementing nursing quality improvement on prevention of patient's ventilator associated pneumonia at ICU of Fort Suranaree Hospital.
3. To determine the associated between patients general characteristics, i.e., age, underlying diseases, surgery, level of conscious, duration of intubation and used ventilators, and the nursing care of VAP prevention, i.e., cleaning in mouth and teeth, patient position, enteral feeding, suction, respiratory care and respiratory circuits and the incidence of VAP.

#### **Benefit of the study**

1. Reduces the incidence rate of ventilator associated pneumonia.
2. Improving nursing care to the patients who used everlastingly ventilators.
3. Setting guideline for preventing of ventilator associated pneumonia.

#### **Research methods**

This study utilized a quasi – experimental, one group Pre test – Post test design. That research study in 216 patients who used ventilator in intensive care unit of Fort Suranaree Hospital. During pretest compare posttest. The researcher applied from Hospital accreditation ideal, that corporate all 24 nursing personnel to solve problem and improve quality of job which operated to process of plans, improving and setting standard of nursing, including comparing pre and post test for 6 months, that would be improve prevention pneumonia to all patients

who used ventilator will nursing personnel in intensive care unit of Fort Suranaree General Hospital, which collected data in 12 months.

### **Research instruments**

You will take about 5 minutes to fill up the questionnaire, to observe about 6 parts of nursing care as follows:

Part 1: General characteristics of 24 nursing personnel in intensive care unit of Fort Suranaree Hospital.

Part 2: The level scores, mean scores on pre and posttest nursing quality improvement on prevention of patient's ventilator associated pneumonia as follows:

1. Mouth care.
2. Patient positions.
3. Enteral feeding.
4. Suction.
5. Respiratory care and respiratory circuits.

Part 3: General characteristics of all patients who used ventilator in intensive care unit of Fort Suranaree General Hospital with 216 patients before and after nursing quality improvement on prevention of patient's ventilator associated pneumonia.

Part 4: The incidence of all patients who used ventilator in intensive care unit of Fort Suranaree with 216 patients before and after nursing quality improvement on prevention of patient's ventilator associated pneumonia.

Part 5: The factors of general characteristics, i.e., age, underlying diseases, major surgery, level of consciousness, duration of intubation and using ventilators with the incidence rate of ventilator associated pneumonia pre and post nursing quality improvement on prevention of patient's ventilator associated pneumonia.

Part 6: The factors of nursing care, i.e., mouth and teeth care, patient position, enteral feeding, suction of sputum, respiratory care and respiratory circuits with the incidence rate of ventilator associated pneumonia pre and post nursing quality improvement on prevention of patient's ventilator associated pneumonia.

Answer the questions based on what you really do or feeling. You can refuse to answer any question you do not want to answer without any obligation.

**Ethical considerations**

The research protocol was approved by an ethical committee of Faculty of Public Health, No identifying information will be taken (such as name), individual questionnaire results will be kept completely confidential to the researcher. Individual questionnaires will be destroyed and all results will be grouped together for analysis by the researcher. Consent to participate is voluntary.

\*\*\*\*\*



## APPENDIX C

### INFORMED CONSENT FORM

**Project Title:** Effects of nursing quality improvement on reduction of patient's ventilator associated pneumonia.

**Investigator:** Maj. Wannakor Kamdech Address: 75 Moo 1 Post Fort Suranaree Road, Pokklang Sub-district, Muangnakhonratchasima District, Nakhon Ratchasima Province 30000 Tel. 01 – 9670202

Date of consent:..... (day / month/year)

I have read and understood all statements in the consent form. I also have been given explanation regarding the objectives and methodology of the study, possible risk and benefit that may occur to myself upon the participation in the study.

I understand that:

1. The purposes of the study are to improve nursing quality improvement on reduction of patient's ventilator associated pneumonia and assess service behaviors. Furthermore, to identify the association between factors of general characteristics i.e., age, underlying diseases, major surgery, level of consciousness, duration of intubation and using ventilators related to incident of ventilator associated pneumonia, nursing care on prevention of patient's ventilator associated pneumonia with incident of ventilator associated pneumonia;
2. The results of the study will be useful to Fort Suranaree General Hospital, Nakhon Ratchasima Province for improving the prevention of patient's ventilator associated pneumonia and provide better health services;
3. No identifying information will be taken (such as name), individual questionnaire results will be kept completely confidential to the researcher;

- 4. Individual questionnaires will be destroyed and all results will be grouped together for analysis by the researcher;
- 5. My consent to participate is voluntary. I can stop the interview/answer the question at any time and I do not have to give a reason for the withdrawal of my consent.

I have read this consent sheet and all my questions had answered to my satisfaction.

Signature .....(Respondent/information).  
 (Mr./Mrs./Ms. ....)

Signature .....(Witness).  
 (Mr./Mrs./Ms. ....)

Signature .....(Witness).  
 (Mr./Mrs./Ms. ....)

I cannot read but before signing my consent hereby, the investigator/ interviewer had read and explained me about the study, the details in information sheet and informed consent form. In addition, all my question had answered to my satisfaction.

Signature .....(Respondent/information).  
 (Mr./Mrs./Ms. ....)

Signature .....(Witness).  
 (Mr./Mrs./Ms. ....)

Signature .....(Witness).  
 (Mr./Mrs./Ms. ....)

## Appendix D

### Questionnaire

Questionnaires of the prevention of patient's ventilator associated pneumonia

**Instructions:** Please fulfill contents in the blank or record symbol ✓ in parenthesis of the true points.

1. Age.....years
2. Education
  1. ( ) Bachelor's degree
  2. ( ) Diploma/certificate of PN
  3. ( ) Diploma/certificate of NCO
  4. ( ) The others
3. Occupation status
  1. ( ) Nurses
  2. ( ) Practical nurses
  3. ( ) Non – commission officers
  4. ( ) Nurse aide
4. Working experience in ICU.....years .....months.
5. Ever received training for respiratory care.
  1. ( ) No
  2. ( ) Yes, By .....
6. Ever received training for VAP care.
  1. ( ) No
  2. ( ) Yes The number ..... times  
By .....

### Observation forms

Observation forms on practice of nursing care of nursing personnel in preventing of patient's ventilator associated pneumonia.

#### Part 1 Mouth and teeth care.

Names					Notes
Date	..... / ..... / .....		..... / ..... / .....		
Standard practices (scores)	1	0	1	0	
1. Position on the bed					
2. Hand washing and sterile gloves					
3. Forceps or cotton buds or tooth brush for the mouth care					
4. Mouth cares with dry cotton or sterile gauze					

#### Part 2 Patient position .

Names					Notes
Date	..... / ..... / .....		..... / ..... / .....		
Standard practices (scores)	1	0	1	0	
1. Position on the bed					
2. Check plaster and tapes on endotracheal tube					
3. Changes patient position every two hours					

Part 3 Enteral feeding.

Names					Notes
Date	..... /...../.....		..... /...../.....		
Standard practices (scores)	1	0	1	0	
1. Hand washing and Sterile gloves					
2. Position on the bed					
3. Suction in endotracheal tubes					
4. Test naso gastric tube					
5. Check gastric content					
6. Slowly enteral feeding					
7. Stop enteral feeding when patients coughs					
8. Stop enteral feeding when patients aspirated and clear airway					
9. Feeding water 50 cc. after the enteral feeding and clean NG tube by 70 % alcohol					
10. Fowler s Position on the bed after the feeding within 1 hour					
11. No suction after the enteral feeding within 1 - 2 hours					

## Part 4 Suctioning of sputum.

Names					Notes
	Date	...../...../.....	...../...../.....	...../...../.....	
Standard practices (scores)	1	0	1	0	
1. To assess signs and symptoms					
2. Position on the bed					
3. Hand washing					
4. Surgical mask on the face					
5. Sterile gloves					
6. To prepare sterile tubes for suction					
7. Insert suction tubes in the suction monitor by aseptic technique					
8. Open suction pressure 80 – 180 mmHg					
9. Assistant help for removing the endotracheal tube					
10. Assistant clean tube and resuscitating bag by 70 % alcohol					
11. Assistant help for ventilation by 100 % oxygen					
12. Suctions in the endotracheal tube by quickly soft and tender (10 – 15 sec.)					
13. Insert sterile normal saline 1 - 2 cc. in the endotracheal tube on cases of sticky secretion					

Part 4 Suctioning of sputums (continued).

Names					Notes
Date	..... /...../.....		..... /...../.....		
Standard practices (scores)	1	0	1	0	
14. Assistant help for ventilation by 100 % oxygen after the suction					
15. Cleaned in the endotracheal tube by 70 % alcohol and inserted tube to ventilator					
16. Cleaned the resuscitating bag by 70 % alcohol and cover by sterile cloths					
17. Release the suction tubes in the infectious rubbish					
18. Record characteristics of secretion					
19. Change secretion container within 24 hours or ¾ of container					
20. Only one resuscitating bag for one patient and clean every 24 hours					

## Part 5 Respiratory care and respiratory circuits.

Names					Notes
Date	..... /...../.....	..... /...../.....	..... /...../.....	..... /...../.....	
Standard practices (scores)	1	0	1	0	
1. Take care the endotracheal tube to the correct position					
2. Rinsed off water in the respiratory circuit					
3. Changed the respiratory circuit every 72 hours					
4. Add sterile water to the nebulizer jar by aseptic technique and changed nebulizer jar every 24 hours					
5. Only one aerosal nebulizer for one patient					
6. Changed the aerosal nebulizer every 24 hours					

## APPENDIX E

### แบบสอบถามข้อมูลทั่วไป

แบบสอบถามเกี่ยวกับการป้องกันปอดอักเสบจากการใช้เครื่องช่วยหายใจ

คำชี้แจง : โปรดเติมข้อความในช่องว่าง หรือทำเครื่องหมาย ✓ ลงในวงเล็บหน้าข้อที่ตรงกับความเป็นจริงเกี่ยวกับตัวท่าน

1. อายุ ..... ปี
2. ระดับการศึกษา
  1. ( ) ปริญญาตรีทางการแพทย์พยาบาลหรือเทียบเท่า
  2. ( ) ประกาศนียบัตรผู้ช่วยพยาบาล
  3. ( ) ประกาศนียบัตรนายสิบพยาบาล
  4. ( ) อื่นๆ .....
3. ตำแหน่ง
  1. ( ) พยาบาลวิชาชีพ
  2. ( ) ผู้ช่วยพยาบาล
  3. ( ) นายสิบพยาบาล
  4. ( ) พนักงานช่วยการพยาบาล
4. ประสบการณ์การปฏิบัติงานในหอผู้ป่วยวิกฤต ..... ปี ..... เดือน
5. ท่านเคยได้รับความรู้เรื่องการดูแลผู้ป่วยที่ใช้เครื่องช่วยหายใจหรือไม่
  - 1 ( ) ไม่เคย
  - 2 ( ) เคย โดยใคร .....
6. ท่านเคยได้รับการอบรมเรื่องการป้องกันปอดอักเสบจากการใช้เครื่องช่วยหายใจหรือไม่
  - 1 ( ) ไม่เคย
  - 2 ( ) เคย จำนวน ..... ครั้ง  
โดยใคร .....

แบบบันทึกการสังเกตการปฏิบัติของบุคลากรทางการแพทย์พยาบาลเพื่อป้องกันปอดอักเสบจากการใช้เครื่องช่วยหายใจ

แบบบันทึกการสังเกตหมวดที่ 1 การดูแลความสะอาดภายในช่องปากและฟัน

วัน เดือน ปี / เวน				
ผู้ปฏิบัติ				
วิธีปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือไม่ปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือไม่ปฏิบัติ
1. จัดทำให้ผู้ป่วยนอนศีรษะสูง ตะแคงหน้าไปด้านใดด้านหนึ่ง				
2. ล้างมือให้สะอาด และ สวมถุงมือสะอาดก่อนการ ทำความสะอาดภายในช่อง ปากและฟันให้ผู้ป่วย				
3. ใช้ปากกิบจับสำลีหรือใช้ไม้พัน สำลีชุบน้ำยาบ้วนปากหรือใช้ แปรงสีฟันชนิดขนอ่อนถูทำ ความสะอาดให้ทั่วภายในช่อง ปากและฟันของผู้ป่วย				
4. ชับน้ำลายและน้ำในปากด้วย สำลีแห้งหรือผ้าก๊อศที่ สะอาดหรือใช้วิธีดูดเสมหะ ช่วยดูดระบายออก				

**แบบบันทึกการสังเกตหมวดที่ 2 การดูแลจัดท่านอนและการพลิกตัว**

วัน เดือน ปี / เวน				
ผู้ปฏิบัติ				
วิธีปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือ ไม่ปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือ ไม่ปฏิบัติ
1. ดูแลจัดท่านอนให้ผู้ป่วยอยู่ในท่าศีรษะสูงประมาณ 30 – 45° ถ้าไม่มีข้อห้ามทางการแพทย์				
2. ตรวจสอบเช็ทพลาสติกหรือเทปผ้าที่ติดต่อทางเดินหายใจให้อยู่ใน ตำแหน่งที่กำหนด เปลี่ยน เมื่อพบว่าเปียก และดูแลสายต่อเข้าเครื่องช่วยหายใจ ไม่ให้เกิดการดึงรั้งในขณะที่จัดท่านอนและพลิกตัวให้ผู้ป่วย				
3. เปลี่ยนท่านอนให้ผู้ป่วยอย่างน้อยทุก 2 ชั่วโมง				

## แบบบันทึกการสังเกตหมวดที่ 3 การดูแลให้อาหารทางสายยาง

วัน เดือน ปี / เวน				
ผู้ปฏิบัติ				
วิธีปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือไม่ปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือไม่ปฏิบัติ
1. ล้างมือให้สะอาดก่อนการให้อาหารทางสายยางให้อาหาร				
2. ดูแลจัดท่านอนให้ผู้ป่วยอยู่ในท่าศีรษะสูงประมาณ 30 – 45° ถ้าไม่มีข้อห้ามทางการแพทย์				
3. ดูแลเสมหะให้ทางเดินหายใจโล่งก่อนให้อาหาร				
4. ทดสอบตำแหน่งสายให้อาหาร โดยดูด gastric content หรือ ดันลม				
5. วัดหรือประเมินอาหารที่เหลือค้างในกระเพาะอาหาร				
6. ยกกระบอกอาหารให้สูงเหนือไหล่ผู้ป่วยประมาณ 1 ฟุตปล่อยให้อาหารไหลเข้าสู่กระเพาะอาหารช้าๆ ตามแรงโน้มถ่วงของโลกหรือให้อาหาร โดยวิธีการหยดช้าๆ ตามอัตราที่กำหนด				
7. หยุดให้อาหารขณะผู้ป่วยมีอาการไอโดยหักพับสายให้อาหารและดูแลให้อาหารต่อเมื่อผู้ป่วยหยุดไอ				

วัน เดือน ปี / เวน				
ผู้ปฏิบัติ				
วิธีปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือไม่ปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือไม่ปฏิบัติ
8. เมื่อผู้ป่วยล้มและมืออาหาร ออกมาจากท่อทางเดินหายใจ และ/หรือทางปากและจมูกหยุด ให้อาหารตะแคงหน้าผู้ป่วยไป ด้านใดด้านหนึ่งใช้เครื่องดูด เสมหะดูดอาหารในท่อทางเดิน หายใจและช่องปากออกให้หมด				
9. เมื่อให้อาหารครบแล้วให้น้ำ ตาม 50 ซีซี หรือตามแผนการ รักษาจากนั้นจึงปลดกระบอกให้ อาหารแล้วเช็ดปลายสายด้วยสำลี ชุบแอลกอฮอล์ 70 % แล้วปิดฝา จุกสายให้อาหาร				
10. หลังให้อาหารจัดให้ผู้ป่วย นอนท่าศีรษะสูงอย่างน้อย 1 ชั่วโมง				
11. งดการดูดเสมหะภายหลังการ ให้อาหาร 1 – 2 ชั่วโมง ถ้าจำ เป็นต้องดูดเสมหะให้ทำด้วย ความนุ่มนวล และรวดเร็ว				

## แบบบันทึกการสังเกตหมวดที่ 4 การดูแลหะ

วัน เดือน ปี / เวน				
ผู้ปฏิบัติ				
วิธีปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือ ไม่ปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือ ไม่ปฏิบัติ
1. ประเมินอาการและอาการแสดงที่บ่งบอกว่าผู้ป่วยต้องการให้ดูแลหะก่อนการดูแลหะ				
2. จัดทำให้ผู้ป่วยนอนหงายหรือนอนหงายศีรษะสูงหันหน้าไปด้านตรงข้ามกับหลอดเลือดหรือปอดข้างที่ต้องการดูแลหะ				
3. ล้างมือให้สะอาดก่อนการดูแลหะ				
4. สวมผ้าปิดปาก - จมูกขณะดูแลหะ				
5. สวมถุงมือปราศจากเชื้อขณะดูแลหะ				
6. ใช้สายยางปราศจากเชื้อในการดูแลหะ				
7. หยิบและต่อสายดูแลหะเข้ากับ เครื่องดูแลหะด้วยเทคนิคปลอด เชื้อ				
8. เปิดเครื่องดูแลหะที่ระดับประมาณ 80 – 180 mmHg				
9. ผู้ช่วยปลดสายต่อเข้าเครื่องช่วยหายใจและหุ้มหัวต่อด้วยผ้าก๊อสปราศจากเชื้อแล้วแขวนไว้ที่เครื่องช่วยหายใจ				

วัน เดือน ปี / เวน				
ผู้ปฏิบัติ				
วิธีปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือ ไม่ปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือ ไม่ปฏิบัติ
10. ผู้ช่วยเช็ดหัวต่อถุงบีบลมและ ข้อต่อของท่อทางเดินหายใจ ด้วยสำลีชุบแอลกอฮอล์ 70% ก่อนที่จะบีบลม เข้าปอดผู้ป่วย				
11. ผู้ช่วยเพิ่มการระบายอากาศให้ ปอดผู้ป่วยโดยใช้ถุงบีบลมต่อ กับ ออกซิเจนอัตราการไหล 10 ลิตร/นาที				
12. สอดสายดูดเสมหะเข้าไปใน ท่อทางเดินหายใจอย่างรวดเร็ว นิ่มนวลระมัดระวังไม่ให้สายดูด เสมหะครูดกับผิวหนังของท่อ ทางเดินหายใจครั้งหนึ่งๆ ไม่นาน เกิน 10 – 15 วินาที				
13. กรณีเสมหะเหนียวมากให้ หยดน้ำเกลือปราศจากเชื้อไม่เกิน ครั้งละ 5 ซีซี เข้าท่อช่วยหายใจ				
14. หลังการดูดเสมหะแต่ละครั้ง ผู้ช่วยบีบลมเข้าปอดผู้ป่วย 3 – 5 ครั้ง จึงทำการดูดเสมหะต่อ				
15. ต่อท่อทางเดินหายใจเข้ากับ เครื่องช่วยหายใจโดยเช็ดหัวต่อ ด้วยสำลีชุบแอลกอฮอล์ 70%				

วัน เดือน ปี / เวน				
ผู้ปฏิบัติ				
วิธีปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือ ไม่ปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือ ไม่ปฏิบัติ
16. เช็ดหัวต่อของถุงบีบลมด้วย ผ้าชุบแอลกอฮอล์ 70% ก่อน หุ้มด้วย ผ้าก๊อซหรือผ้าที่ ปราศจากเชื้อจัดเก็บบนหัวเตียง				
17. สายคาดเข็มที่ใช้ครั้งเดียว ทิ้งหลังใช้แล้วทิ้งลงถัง น้ำยาทำลายเชื้อ				
18. บันทึกสี จำนวน และลักษณะ เสมหะ				
19. เปลี่ยนขวดรองรับเสมหะ ภายใน 24 ชั่วโมงและ / หรือ เมื่อเกือบใกล้เต็มขวด				
20. แยกถุงบีบลมเข้าปอด (Ambu bag) ในผู้ป่วยแต่ละราย และทำความสะอาดทุก 24 ชั่วโมง				

แบบบันทึกการสังเกตหมวดที่ 5 การดูแลท่อทางเดินหายใจและส่วนประกอบของเครื่องช่วยหายใจ

วัน เดือน ปี / เวน				
ผู้ปฏิบัติ				
วิธีปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือไม่ปฏิบัติ	ปฏิบัติถูกต้อง ทั้งหมด	ปฏิบัติถูกต้อง บางส่วน หรือไม่ปฏิบัติ
1. ดูแลท่อทางเดินหายใจให้อยู่ในตำแหน่งที่กำหนดและดูสายต่อเข้าเครื่องช่วยหายใจไม่ให้มีการคั้งรั้ง/ ป้องกันการขยับไปมา อย่างน้อยเแวระละ 1 ครั้ง				
2. เทน้ำที่รวมตัวและค้างอยู่ภายในสายต่อเข้าเครื่องช่วยหายใจทิ้ง เมื่อพบว่ามึน้ำค้างอยู่ในสายต่อเข้าเครื่องช่วยหายใจ				
3. เปลี่ยนสายต่อเข้าเครื่องช่วยหายใจทุก 72 ชั่วโมง				
4. เติมน้ำกลั่นปราศจากเชื้อลงในเครื่องทำความชื้นตามระดับน้ำที่กำหนดด้วยเทคนิคปลอดเชื้อ เมื่อพบว่ามึน้ำในเครื่องทำความชื้นน้อยกว่าที่กำหนดและเปลี่ยนเครื่องทำความชื้นทุก 24 ชั่วโมง				
5. ในรายที่ใช้ชุดเครื่องทำละอองฝอยให้แยกใช้ในผู้ป่วยแต่ละราย				
6. ในกรณีทีผู้ป่วยใช้ชุดทำละอองฝอยให้เปลี่ยนทุก 24 ชั่วโมง				

## BIOGRAPHY

<b>NAME</b>	Major Wannakorn Kamdech
<b>DATE OF BIRTH</b>	2 February 1959
<b>PLACE OF BIRTH</b>	Siriraj Hospital, Bangkok, Thailand
<b>INSTITUTION ATTENDED</b>	The Royal Thai Army Nursing College, 1980-1982: Diploma of Nursing Mahidol University, 1993- 1994: Bachelor of Nursing Mahidol University, 2002-2005: Master of Science (Infectious diseases and Epidemiology)
<b>POSITION &amp; OFFICE</b>	1982- 1984: Fort Surasinghanart Hospital Prachinburi, Thailand POSITION: Nurse 1984-Present: Fort Suranaree Hospital Nakhon Rachasima Province, Thailand POSITION: Head Nurse