ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF EMERGENCY MEDICINE

ASSESSMENT OF DISEASE BURDEN AND RISK FACTORS ASSOCIATED WITH THE DEVELOPMENT OF VENTILATOR ASSOCIATED PNEUMONIA AND ITS OUTCOME IN ADULT INTENSIVE CARE UNIT OF TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, 2018

BY: GOITOM MOLALIGN (candidate Msc. EMCCN)

RESEARCH THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY, DEPARTMENT OF EMERGENCY MEDICINE AS A REQUIREMENT FOR THE PARTIAL FULFILLMENT OF MASTERS OF SCIENCE DEGREE IN EMERGENCY MEDICINE AND CRITICAL CARE NURSING

JUNE 11, 2018

ADDIS ABABA, ETHIOPIA

ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF EMERGENCY MEDICINE

ASSESSMENT OF DISEASE BURDEN AND RISK FACTORS ASSOCIATED WITH THE DEVELOPMENT OF VENTILATOR ASSOCIATED PNEUMONIAIN AND ITS OUTCOMEIN AT ADULT INTENSIVE CARE UNIT OF TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA

ADVISORS: Dr. Muluwork Tefera (MD. Pediatrician)

Mr. Andualem Wubete (Bsc. Msc.EMCCN)

Approval by the board of examiners

This thesis by Goitom Molalign is accepted in its present form by the board of examiners as satisfying thesis requirement for the degree of Master of Science in Emergency Medicine and Critical Care Nursing.

Examiner:

Full Name	Rank	Signature	Date
_____	_____	_____	June11, 2018

Research Advisor/Supervisor:

Full Name	Rank	Signature	Date
Dr. Muluwork Tefera	MD	_____	June11, 2018
Mr. Andualem Wubete	BSc, MSc	_____	June11, 2018

Chair of Department:

Full Name	Rank	Signature	Date
_____	_____	_____	June11, 2018

Acknowledgement

First, I would like to thank the almighty God, and I would like to say thank you to Addis Ababa University, College of Health Science, Department of Emergency Medicine for the opportunity.

My appreciation also extends to my advisors, Dr. Muluwork Tefera and Mr. Andualem Wubete for their grateful advice to make and realize this final thesis.

Table of Contents

Acronyms and Abbreviations

AICU - Adult Intensive Care Unit

ARDS – Acute Respiratory Distress Syndrome

Bsc. – Bachelors of sciences

CDC – Center for Disease Control and

prevention CVC – Central Venous

Catheterization Dr. – Doctor

ICU – Intensive Care Unit

INICC – International Nosocomial Infection Control Consortium

Mr. – Mister

Msc. – Masters of sciences

MV – Mechanical Ventilator

NHSN – National Healthcare Safety Network NNIS

– National Nosocomial Infection Surveillance SPSS

– Statistical Package for Social Sciences TASH –

Tikur Anbessa Specialized Hospital USA – United

States of America

VAP – Ventilator Associated Pneumonia

Vs – Versus

List of tables

List of figures

Abstract

Background: Ventilator-associated pneumonia (VAP) is the second most common nosocomial infection in the ICU. Since no study were conducted, determining the incidence and factors associated with the development of VAP is important for implementing any preventive measures.

Objective: To assess the disease burden and factors associated with the development of ventilator associated pneumonia and its outcome in Adult Intensive Care Unit(AICU) of Tikur Anbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia,2018

Methodology: A retrospective cross-sectional study was conducted by using consecutive sampling method. All adult patients who were ventilated for >48 hours were included and patients with prior diagnosis of pneumonia. Secondary data was collected from patient card using structured information extracting tool. Binary and multiple logistic regression was employed to assess presence of any significant association between VAP and selected predictor variables. Continuous and categorical variables were compared using Student's *t* test and Chi square. Where the P - value of <0.05 was considered significant.

Result: From the 164 patient VAP occurred in 40 (24.3%) patients. On multiple logistic regression analysis, the identified risk factors were; Tracheostomy (AOR: 5.898, 95% CI: 1.312 - 26.525), re-intubation (AOR: 4.529, 95% CI: 1.337 – 15.337), admission to the medical ICU (AOR: 5.154, 95% CI: 1.524 - 17.428), coma (AOR: 7.283, CI: 1.950 – 27.201), transportation out of the ICU(AOR; 3.563, CI: 1.009 – 12.364), and continuous IV sedation use (AOR: 6.444, 95% CI: 1.791 – 23.186). Accinobacter and klebssiela pneumonia were the identified causative microorganisms. ICU length of stay was higher in patient with VAP than Non-VAP35.2 ± 27.5 vs 12.5 ± 12.16 days.

Conclusion and recommendation: the disease burdenof VAP in this study was found to be higher. Further prospective study is recommended to validate these outcomes and implementation of VAP bundle of prevention may decrease the incidence of VAP.

Key words: Incidence, Risk factor, TASH, Ventilator associated pneumonia

1. Introductions

1.1. Background

Ventilator-associated pneumonia (VAP) is a type of nosocomial pneumonia that occurs in patients who receive mechanical ventilation support. VAP occurs 48–72 hours or thereafter following endotracheal intubation, characterized by the presence of a new or progressive infiltrate, signs of systemic infection (fever, altered white blood cell count), changes in sputum characteristics, and detection of a causative agent (1). It is the most frequent type of device-associated infection diagnosed in developing countries and has been firmly associated with an increased mortality, a longer hospital stay and additional healthcare costs (2).

Ventilator-associated pneumonia is divided into two early onsets VAP defined as pneumonia that occurs within 5 days and this is usually attributed to antibiotic sensitive pathogens, whereas late onset VAP is more likely caused by multidrug resistant bacteria and emerges after 5 days of intubation. The importance of segregating VAP into early and late is that, the pathogenesis, the microorganisms responsible and outcome in these two groups is different and so the therapeutic implications also differ (3, 4).

VAP arises when there is bacterial invasion of the pulmonary parenchyma in a patient receiving mechanical ventilation. Inoculation of the formerly sterile lower respiratory tract typically arises from aspiration of secretions, colonization of the aero-digestive tract, or use of contaminated equipment or medications. The pathogenesis of ventilator-associated pneumonia usually requires two important processes to take place: bacterial colonization of the aero-digestive tract and the aspiration of contaminated secretions into the lower airway (4).

The risk factors for VAP can be classified into three categories: host related, device related, and personnel related. The following procedures: reintubation, tracheostomy, transfusion, transport out of the Intensive Care Unit (ICU), the presence of a central line, multiple central venous catheters, bronchoscopy, thoracentesis, and burn debridement, prone positioning, nasal intubation, duration of mechanical ventilation, level of consciousness, and paralytic agents or continuous intravenous sedation and antibiotics has been associated with the development of VAP (5-8).

Now, there is no universally accepted, the gold standard diagnostic criterion for VAP. The American Thoracic Society and the Infectious Diseases Society of America guidelines recommend obtaining lower respiratory tract samples for culture and microbiology (3). The clinical pulmonary infection score takes into account clinical, physiological, microbiological and radiographic evidence to allow a numerical value to predict the presence or absence of VAP. Scores can range between zero and 12 with a score of ≥ 6 showing good correlation with the presence of VAP (9).

Beside the treatment of VAP different prevention methods i.e. VAP-bundle 5-element includes: Head of bed elevation, oral care with chlorhexidine, stress ulcer prophylaxis, deep venous thrombosis prophylaxis, and daily sedation assessment and spontaneous breathing trials, and the implementation of the International Nosocomial Infection Control Consortium multidimensional approach for ventilator-associated pneumonia has been implemented and showed good improvement (10-13).

1.2. Statement of the problem

Given the high incidence of healthcare-associated infection, especially in resource-limited countries, infection-control practices and surveillance systems play an important role in improving patients' safety and decreasing the effect of life-threatening adverse events on health care systems. Healthcare-associated infections are usually underestimated in such countries (14).

VAP contributes to approximately half of all cases of hospital-acquired pneumonia (15). It is the second most common nosocomial infection in the intensive care unit (ICU) and the most common in device associated nosocomial infections in mechanically ventilated patients (16). In National Nosocomial Infection surveillance hospitals, the pooled mean ventilator-associated pneumonia rate was 8.25/1000 ventilator days on average across all ICU (17).

The incidence of device associated infections in critically ill patients was found to be from 2-19-fold higher in low and middle low-income countries compared to the USA and Germany (15). VAP is a serious problem that is associated with high mortality rates and increased in ICU length of stay, which may represent an additional burden on the scarce resources in developing countries (13).

VAP can also impose another problem on top of the low resource ICU set up of developing countries with increased broad-spectrum antibiotic usage (17). In studies assessing economic burden of ventilator associated pneumonia in a developing country found that the total cost for VAP patients was about threefold higher than for non-VAP patients (18)and which even become more costly approximately fivefold higher in another retrospective study conducted in Turkey (8). In several studies VAP has been associated with different risk factors; length of stay in ICU (prolonged ventilation), Older age (≥60 years), Emergency intubation, coma, re-intubation, tracheostomy, prior antibiotic therapy, bronchoscopy, transfusion, transport out of the ICU, the presence of a central line, and multiple central venous catheters (5, 19-24).

Ethiopia is a developing country with her health care services including ICU setting is still not advanced and VAP also is the most common in ICU acquired nosocomial infection mostly in developing than developed countries. Although disease burden and consequences of VAP have shown to reduce to its minimum level, using different preventive measures in both developing

and developed countries but in Ethiopia, particularly in TASH the prevalence and the effectiveness of any preventive measures are still unknown.

With the growing number of tertiary and university hospitals, the numbers of ICUs were also increasing rapidly. The disease burden of VAP varies according to the patient group and hospital setting. Since no study were conducted to assess disease burden and factors associated with VAP in Tikur Anbessa specialized hospital this study will help to have baseline information over all on disease burden as well as the factors associated with VAP and identifying these associated factors helps to intervene on the preventive aspects.

1.3. Significance of the study

Since knowledge of disease burden and proper identification of risk factors is essential for establishing effective strategies to prevent VAP, so this study will provide baseline data on the disease burden and risk factors associated with VAP in AICU of TASH. The findings of this study will be used as baseline or supplementary data for hospital administration and significant others to improve quality of intensive care unit service. This study will serve as a reference for further researches related to this topic.

2. Literature review

Different literatures have discussed about the disease burden, causative microorganism, risk factors and outcomes of ventilator associated pneumonia, but still there are differences among study setting, study types and study populations. Here we will see those literatures of different studies.

2.1. The disease burden of ventilator associated pneumonia

Ventilator-associated pneumonia (VAP) is the most frequent intensive-care-unit (ICU)-acquired infection (3, 16). It's has been shown to have a real difference between the developed and developing countries. Relative to the incidence rate in a systematic review conducted in 8 developing countries, for instance with an incidence ranging from 10 to 41.7 per 1000 ventilator-days, which was high compared to that of developed countries. According to the report of NHSN in America the incidence was 2.9/1000 ventilator days and a report from Krankenhaus Infections Surveillance System (KISS) in Germany it was 5.1/1000ventilator days (15). In 3 year prospective observational study conducted in Turkey the incidence of VAP was 22.6% and similarly in another systematic review of 195 studies in main land china showed that the overall cumulative VAP was 23.8% (19).

According to different studies conducted in Africa; a single study in Morocco which studies incidence device associated infections in the ICU found that the incidence of VAP was higher 43.16 per 1,000 mechanical ventilation days. Another study in Egypt, which analyzes different studies, found that the incidence of VAP can range from 16% to 75% (33). Finally, small sample size (32 patients) study conducted in South Africa the incidence was 25%(22).

2.2. Onset of ventilator associated pneumonia

Related to the timing of onset VAP is classified as early and late onsets. In India the Incidence of early-onset VAP (within 96 h) was found to be 27%, while later-onset type (>96hours) was 73%. (1) On the contrary a study from 20 countries found the opposite with 83% of them had early onset pneumonia and 17% had late-onset pneumonia. The median time of onset of VAP was 4 days (inter-quartile range, 3-5) (25).

2.3. Etiologic agents of ventilator associated pneumonia

There are many common identified microorganisms which are etiologic factors for the development of VAP among these the most identified organisms in a study conducted in India were Enterobacteriaceae, Haemophilus influenzae, Staphylococcus aureus, Streptococcus pneumonia, and Candida species were more common in early-onset VAP, while Pseudomonas species were significantly associated with late-onset VAP (13, 21, 26, 27). Similarly Pseudomonas species is also the most commonly identified organism in Spain (28).

2.4. Factors associated with ventilator associated pneumonia

Ventilator associated pneumonia has been understood to have different risk factors. Among the commonly documented risk factors are; tracheostomy, re-intubation, aspiration of gastric content, prior antibiotic administration, stress ulcer prophylaxis, coma, older age >60 years old, surgery, transportation out of the hospital, and surgery. For instance, In a 6month prospective study involving four multidisciplinary ICUs in Athens, Greece VAP occurred in 56 patients (32%) and univariate analysis indicated that tracheotomy, bronchoscopy, enteral feeding, duration of mechanical ventilation ≥5 days, and mean duration of central vein catheterization were significantly associated with VAP (7).

Meta-analyses of 195 studies conducted in mainland China with the pooled mean of VAP 23% identifies that VAP occurred more frequently in patients who received a tracheotomy, were re intubated and were mechanically ventilated for more than two weeks. In addition, older (≥60 years of age) and comatose patients were also at greater risk of developing VAP (19).

A retrospective analysis of a database of a prospective, multicenter, international cohort studies at 361 ICUs from 20 countries, 2897 patients were mechanically ventilated for more than 48 hours 439 patients 15% were diagnosed with VAP. The crude incidence of VAP was 15 episodes per 1000 ventilator-days. This study also identified that patients with chronic pulmonary obstructive disease, aspiration of gastric contents, ARDS, and sepsis as a precipitating cause of mechanical ventilation are the most common risk factors for VAP (25).

In 15 months' prospective study conducted in Jawaharlal Institute of Postgraduate Medical Education and Research, a tertiary care hospital in Pondicherry India, indicated that impaired

consciousness, tracheostomy, re-intubation, emergency intubation, and naso-gastric tube were significantly associated with VAP. Emergency intubation (26.7%) and intravenous sedatives (40.0%) were found to be the specific risk factors for early onset VAP, while tracheotomy (52.4 %) and re-intubation (14.3%) were the independent predictors of late-onset VAP by multivariate logistic regression analysis (15).Another cohort study over 1.5 year conducted in other tertiary hospital where 37 patients had developed VAP. The major risk factors associated were duration of ventilator support more than 15 days of mechanical ventilation where 75% had developed VAP, re-intubation, advanced age and altered consciousness. Incidence of VAP in stupors (62.5%) and comatose (50%) patients is significantly higher (P=0.0023) than that in conscious (35.75%) and drowsiness (18.42%) patients (6).

In Egypt on the analysis of 37 studies conducted on VAP concerned with the incidence, etiology and risk factors showed that nasal endotracheal intubation, re-intubation, prior-antibiotic use, and contaminated ICU environment with lack of infection control measures, use of antacids and H2 blocker, corticosteroids use, and coma has been identified to have strong association with the development of ventilator associated pneumonia (29).

3. Objective

3.1. General objective

- To assess the disease burden and factors associated with the development of ventilator associated pneumonia and its outcome in adult ICU of Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia February 2016 – March 2018.

3.2. Specific objective

- To determine the disease burden of ventilator associated pneumonia
- To identify the causative organisms of ventilator associated pneumonia
- To identify factors associated with the development of ventilator associated
- pneumonia To determine the outcome of patients with ventilator associated pneumonia

4. Methodology

4.1. Study area

The study was conducted in TASH, which is the largest referral and comprehensive hospital in the country with a total of 700 beds capacity. The study area specifically is in adult ICU, which provides intensive care for critically ill patients. The unit of study includes medical ICU and surgical ICU. TASH adult ICU has a total of 12 beds, 6 medical and 6 surgical beds. The adult ICU unit is staffed with 37 Bsc.Nurses and 5 Msc. inEmergency and critical care Nurses, residents and specialists of internal medicine and anesthesiology (in the adult medical and surgical ICU). Each night and day shift are staffed with 9 nurses i.e. There are three nurses for four patients divided into each three rooms (with almost 1:1 nurse to patient ratio) and residents of Internal medicine, Anesthesia, Emergency and critical care medicine, surgery, and senior physicians are also the care givers. Based on the record from the past two years showed that the ICU gave care for 967 patients. (TASH, ICU patient record book)

4.2.Study period: The study was conducted from February 2016 – March 2018.

4.3.Study design: Cross sectional study design with retrospective chart review was employed.

4.4. Population

4.4.1. Source and study population

4.4.1.1.Source population:all patients who get admitted to AICU from February 2016 – March 2018.

4.4.1.2. Study population:all patients on mechanical ventilator support in AICU who met the inclusion criteria.

4.5. Inclusion and Exclusion Criteria

4.5.1. Inclusion Criteria:all patients on mechanical ventilator support in AICU, who were on mechanical ventilation for more than 48 hours during the study period.

4.5.2. Exclusion criteria

- Age less than or equal to 13 years old (pediatric patients)
- Previous diagnosis of pneumonia before 48 hours of mechanical ventilation

4.6. Sample size determination

All 164 patients who were on mechanical ventilation for more than 48 hours in adult ICU during the study period and met the inclusion criteria were the study sample.

4.7. Sampling method and sampling procedure

Consecutive type of sampling method was used. Over the past two years from January 2016-December 2018 a total of 967 patients were admitted to the adult ICU in Tikur Anbessa specialized hospital. Where 580 and 387 patients had received ICU care, in medical and surgical ICU respectively. Out of these 967 patients 535 (55%) of them were mechanically ventilated or have used mechanical ventilator and only 164 of them have fulfilled the inclusion criteria.

4.8. Data collection tool

A structured English version of information extraction format developed from a review of previously done literatures on the identification of risk factors associated with ventilator-associated pneumonia was utilized (7) . The format contains closed-ended type of questions i.e.

1) Age, sex, clinical characteristics of the patient like, admission diagnosis, indication for mechanical ventilation, admitting ward, source of admission, length of stay in the ICU, the primary indication for mechanical ventilation, length of mechanical ventilation, onset of VAP, presence of co-morbidity, and place of intubation. 2) Possible risk factors. 3) Outcome of the patient.

4.9. Data collection procedure

First a review of patient record for the past two years from February 2016 – March 2018was done. This was followed with retrospective chart review. Data was collected by 3 nurses who were trained for 1 day. Data were collected from the patient record card, laboratory results and daily flow chart. The data were collected from those who were admitted in the ICU and met the inclusion criteria.

4.10. Data quality control

The Data quality was controlled by designing proper data collection materials. Training was also given to data collectors. Then the collected data were checked for completeness on a daily basis

by the supervisor and records with incomplete basic information were re-recorded with the missing information by reviewing the patient chart again and records that can't be traced back were discarded. The data were then cleaned, coded, and entered by trained data clerks and principal investigator before analysis. Ten percent double data entry into Epi data was performed for data accuracy, and no difference was found on the outcome of double entered data.

4.11. Data Analysis and presentation

Data was entered into EPI data 3.1and exported to SPSS version 21 for analysis. Results were expressed as mean ± SD for continuous variables or as a frequency (percentage) of the group they were derived from (categorical variables). Descriptive statistics was calculated to assess the overall prevalence of VAP and frequency of variables. Continuous variables were compared using Student's *t* test and categorical variables were compared using chi square test. Additionally, binary and multiple logistic regression analysis were carried out to examine the existence of a relationship between the outcome variable (VAP) and predictors variable. Multiple logistic regression analysis was performed with checking the model fit of highest Hosmer and Lemeshow test of significance. This was necessary to avoid producing spurious (confounding variables effect) significant results with multiple comparisons. The results of the logistic regression analyses are reported as adjusted odd ratios with their 95% confidence intervals. All p values <0.05 were considered statistically significant. Finally, the result is presented in the form of text, using tables, & figures.

4.12. Study Variables

4.12.1. Dependent Variable

- Ventilator associated pneumonia
- Outcome of the patient

4.12.2. Independent Variables

- Socio-demographic (age and sex)
- Admitting unit
- Duration of mechanical ventilation
- Admission diagnosis

- Presence of co-morbidity
- Place of intubation
- Indication for mechanical ventilation
- Possible risk factors

4.13. Operational definition

- Disease burden – the percentage of patient who developed VAP.
- Doctors diagnosis of Ventilator associated pneumonia was with clinical symptoms such as fever temperature of $>38^0$c, tachycardia, leukocytosis or leucopenia, purulent tracheal secretion, and radiologic evaluation of chest x-ray (presence of new or progressive infiltrate) and absence of Previous diagnosis of pneumonia or within 48 hours of mechanical ventilation.
- Transport out of the AICU was defined as the physical movement of the patient out of the AICU to locations such as the operating room, endoscopy, dialysis or radiology.

4.14. Ethical clearance

First, ethical clearance was obtained from the Addis Ababa University Department of Emergency Medicine. Then this Official letter was submitted to the Tikur Anbesa specialized hospital AICU head nurses, outpatient department office, and record keeping unit officer to obtain a list of patients record numbers (medical registration number), permission for access to patient's card and the review of charts respectively.Confidentiality was ensured by not mentioning patients' names in the questioner and unauthorized individuals was not be allowed to access to the data which was kept by using a password protected computer.

4.15. Dissemination of the Results

The results of this study will be submitted to Addis Ababa, University College of Health Sciences Department of Emergency Medicine. The copies of this study will also be given to the respective health institutions, Tikur Anbesa specialized hospital critical care unit so that they can use the results for planning and implementation of intervention programs, attempts will be made to present in different workshop and to publish my work on scientific journals.

5. Result

5.1. Socio-demographic and clinical characteristics

Among the 164 study patients, 91 (55.5%) of them were admitted to the medical ICU and 73 (45.5%) of them to the surgical ICU [Table 1]. Of the 164 study patients, 84 (51.2%) were men and 80 (48.8%) were women. The mean ± SD age was 36.74 ± 16.50 years (range 14-80 years). The most common causes of ICU admission were neurological diseases 45 (27.4%), and cardiovascular diseases 24 (14.6%). Regarding place of intubation majority 80(48.8%) of them were intubated in the ICU and the major source of ICU admission was from emergency department 62 (37.8%) see below in **[Table 1]**.

The duration of mechanical ventilation and length of stay in the ICU (mean ± SD days) were longer among patients who suffered VAP compared to those of Non-VAP, 26.9 ± 19.85 vs 10.87 ± 13.83 days and 35.2 ± 27.5 vs 12.5 ± 12.16 days respectively see **[Table 1]**.

Table 1 socio-demographic and clinical characteristics with their binary logistic regression analysis of patients in AICU at TASH, Addis Ababa, Ethiopia, February 2016 – March 2018 (n=164)

Variables		VAP (n=40)	Non VAP(n=124)	P- VALUE
Age (mean ± SD year)		38.25±17	36.26±16.38	0.506
Sex	Male	19(47.5%)	63(50.8%)	0.852
Female		21(52.5%)	61(49.2%)	Ref.
Admitting ward	Medical ICU	31(77.5%)	60(48.4%)	**0.002***
	Surgical ICU	9(22.5%)	64(51.6%)	Ref.
Place of intubation	Emergency room	6(15%)	23(18.5%)	0.719
	ICU	27(67.5%)	53(42.7%)	0.844
	Operating room	6(15%)	45(46.5%)	0.458
	From other hospital	1(2.5%)	3(2.4%)	Ref.
Cause of ICU admission				
Trauma		3(7.5%)	20(16.1%)	0.108

Respiratory diseases	6(15%)	16(12.9%)	0.750
Neurological diseases	15(37.5%)	30(24.2%)	0.068
Cardiovascular diseases	4(10%)	20(16.1%)	0.345
Intra-abdominal diseases	4(10%)	14(11.3%)	0.930
Others **	8(20%)	24(19.4%)	Ref.
Admitted to ICU from Medical ward	11(27.5%)	23(18.5%)	0.831
Emergency room	15(37.5%)	47(37.9%)	0.662
Operative room	9(22.5%)	42(33.9%)	0.514
Others***	5(12.5%)	12(9.7%)	Ref.
Duration of MV (mean ± SD days)	26.9±19.85	10.87± 13.83	**<0.0001***
Comorbidity Hypertension	10(25%)	15(12.1%)	0.076
Diabetes	4(10%)	8(6.5%)	0.384
AIDS	1(2.5%)	5(4%)	0.769
Chronic kidney diseases	1(2.5%)	7(5.6%)	0.999
Cancer	1(2.5%)	9(7.3%)	0.399
Chronic liver disease	1(2.5%)	1(.8%)	0.375
HTN & DM	6(15%)	18(10.6%)	0.480
None	17(42.5%)	61(49.2%)	Ref.
Acute respiratory distress syndrome	7(17.5%)	19(15.3%)	0.743
Pulmonary edema/CHF	3(7.5%)	16(12.9%)	0.395
Sepsis/septic shock	9(22.5%)	25(20.2%)	0.751
Coma/impaired consciousness	21(52.5%)	26(21%)	**<0.0001***
Neuromuscular disorder (GBS)	3(7.5%)	4(3.2%)	0.258

VAP: ventilator associated pneumonia, **IV**: intravenous **SD**: standard deviation, *p-value <0.005 ** intraabdominal, poisoning, metabolic and renal *** surgical ward, gynecology ward, transfer from other hospital,**Ref**.: reference.

5.2. Disease burden of VAP

Among the 164 study patients admitted to both medical and surgical ICU unit 40 of them developed ventilator associated pneumonia, which is 24.3% and 6 of them had a second episode of VAP during their stay. Most of them were from medical ICU 31 (77.5%) and 9 (22.5%) were from surgical ICU.

5.3. Causative microorganisms

Most of the cases of VAP were diagnosed clinically without a culture. Among the 46 VAP, culture of tracheal aspiration was done to diagnose only 10 cases. From the identified micro-organisms ***Acinetobacter*** species were 6 (60%) and the rest were ***klebsiela pneumonia*** species.

5.4. Onset of VAP

Regarding their onset, majorities of them were late onset 39 (85%) and the rest 7(15%) were early onset. Most of the cases 31 (67%) of them happened to occur during the first two weeks of admissionand ranges from 3 - 45 days.

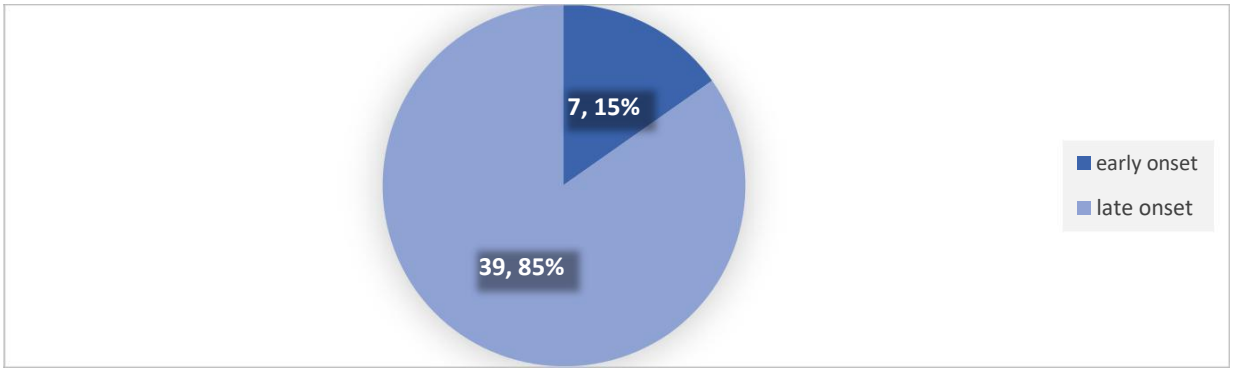

Figure 1 Onset of VAP among patients in AICU of TASH, Addis Ababa, Ethiopia, February 2016 – March 2018.

5.5. Possible risk factors

As shown below in **[Table 2]** out of the 40 patients who developed VAP, 25(62.5%) of them had tracheostomy, 18 (45%) were re-intubated, 31 (77.5%) had at least one transportation out of the ICU within the hospital during their stay in the ICU, and 26(65%) who aspirated their gastric content.

Table 2 Binary logistic regression analysis of potential risk factor variables among patients in AICU of TASH, Addis Ababa, Ethiopia, February 2016 – March 2018 (n=164)

Potential risk factors		VAP	Non-VAP	COR	p-value
Tracheostomy	No	15(37.5%)	109(87.9%)	**Ref.**	
	Yes	25(62.5%)	15(12.1%)	12.1	**<0.0001***
Bronchoscopy	No	37(92.5%)	121(97.6%)	Ref.	
	Yes	3(7.5%)	3(2.4%)	3.27	0.157
Tube-thoracostomy	No	36(90%)	117(94.4%)	Ref.	
	Yes	4(10%)	7(5.6%)	1.85	0.345
Re-intubation	No	22(55%)	103(83.1%)	Ref.	
	Yes	18(45%)	21(16.9%)	4.01	**<0.0001***
Aspiration of gastric content	No	14(35%)	95(76.6%)	Ref.	
	Yes	26(55%)	29(23.4%)	6.08	**<0.0001***
Corticosteroid	No	4(10%)	30(24.2%)	Ref.	
	Yes	36(90%)	94(75.8%)	2.87	0.063
Presence of central venous or arterial catheter	No	35(87.5%)	117(94.4%)	Ref.	
	Yes	5(12.5%)	7(5.6%)	2.38	0.158
NGT and enteral feeding	No	2(5%)	2(1.6%)	Ref.	
	Yes	38(95%)	122(98.4%)	0.31	0.251
Prior use of antibiotics	No	1(2.5%)	5(4%)	Ref.	
	Yes	39(97.5%)	119(96%)	0.65	0.631
Transport out of hospital	No	9(22.5%)	63(50.8%)	Ref.	
	Yes	31(77.5%)	61(49.2%)	3.55	**0.002***
Surgery	No	18(45%)	54(43.5%)	Ref.	
	Yes	22(55%)	70(56.5%)	0.94	0.872
Surgical drainage mainly thoracic and thoraco-abdominal	No	36(90%)	105(84.7%)	Ref.	
	Yes	4(10%)	19(15.3%)	0.61	0.403
Continuous IV Sedative	No	17(42.5%)	87(70.2%)	Ref.	
	Yes	23(57.5%)	37(29.8%)	3.18	**0.002***
Stress ulcer prophylaxis	No	0	4(3.2%)		
	Yes	40(100%)	120(96.8%)		0.999
Traumatic or emergency intubation	No	39(97.5%)	121(97.6%)	Ref.	
	Yes	1(2.5%)	3(2.4%)	1.03	0.977
Dialysis	No	35(87.5%)	117(94.4%)	Ref.	
	Yes	5(12.5%)	7(5.6%)	2.38	0.158
Ionotropic medication	No	22(55%)	71(57.3%)	Ref.	
	Yes	18(45%)	53(42.7%)	1.09	0.802

VAP: ventilator associated pneumonia, **IV**: intravenous **COR**: crude odd ratio, *p-value <0.005

Ref.: reference, **NGT**: naso-gastric tube

Possible Risk factors believed to have an association with the development of VAP were entered in to binary logistic regression analysis and the following variables; Admission to the medical ICU, patients in coma or impaired consciousness, tracheostomy, re-intubation, aspiration of gastric content, transportation out of the ICU, continuous IV sedation, and duration of mechanical ventilator were found to have significant association as shown in**[Table 3].**

Table 3 Variable associated on binary logistic regression among patients in AICU of TASH, Addis Ababa, Ethiopia, February 2016 – March 2018

Variables	VAP(n=40)	Non-VAP(n=124)	COR	P-value
Admitting ward to Medical ICU	31(77.5%)	60(48.4%)	3.674	**0.002***
Aspiration of gastric content	18(45%)	21(16.9%)	4.013	**<0.0001***
Tracheostomy	25(62.5%)	15(12.1%)	12.1	**<0.0001***
Re-intubation	26(65%)	29(23.4%)	6.084	**<0.0001***
Transportation out of the ICU	31(77.5%)	61(49.2%)	3.557	**0.002***
Continuous IV Sedative	23(57.5%)	37(29.8%)	3.181	**0.002***
Coma or impaired consciousness	21(52.5%)	26(21%)	4.166	**<0.0001***
Duration of MV (mean ± SD days)	26.9±19.85	35.2±27.5	27.24	**0.001***

VAP: ventilator associated pneumonia, **IV**: intravenous **COR**: crude odd ratio, *p-value <0.005, **SD**: standard deviation **MV:** mechanical ventilation

Those variables that showed significant association on binary logistic regression analysis were subjected to multiple logistic regression analysis. Six variables were found to have significant association i.e. Tracheostomy, re-intubation, admission to the medical ICU, coma or impaired consciousness, transportation out of the ICU, and continuous IV sedation were found to have strong association with the development of VAP see below **[Table 4]**.

Table 4 Variables associated with the development of VAP on Multiple logistic regression analysis among patients in AICU of TASH, Addis Ababa, Ethiopia, February 2016 – March 2018

Variables	AOR	95 % CI Lower – Upper	P-value
Tracheostomy	5.898	1.312 - 26.525	0.021*
Coma	7.283	1.950 – 27.201	0.003*
Re-intubation	4.529	1.337 – 15.337	0.015*
Continuous iv sedation	6.444	1.791 – 23.186	0.004*
Admission to medical ICU	5.154	1.524 - 17.428	0.008*
Transportation out of the ICU	3.563	1.009 – 12.364	0.040*

VAP: ventilator associated pneumonia, **IV**: intravenous **AOR**: Adjusted odd ratio, *p-value <0.05, **CI:** confidence interval.

5.6. Outcome of the patient

In this study the mortality rate of patients with VAP was 15 (37.5%) almost similar compared to those without VAP 50 (40.3%) but their ICU length of stay was higher in VAP patients compared to those of Non VAP(mean ± SD days)35.2±27.5 vs 12.5 ± 12.16.Independent t-test result also showed that there is significant difference in ICU length of stay (mean difference: 22.6 days, 95% CI: 13.6 – 31.7 days, p <0.0001) between VAP and Non-VAP groups.

.

6. Discussion

Ventilator associated pneumonia is the most common device associated ICU infection, which has an effect on patient outcomes and hospital services especially in developing countries with limited resources.

This study found that the disease burden of VAP was 24.3% of the admitted patients had developed VAP. This rate was comparable to different studies, in the study conducted in South Africa, 25%, (22) in South America, Colombia 22.2% (30) a study from eight developing countries incident rate can range from 10-47.1%, (13) in Asia 23% in mainland china (19) and one study from India found the incident to be15% (25). On the opposite compared to the incidence rate of USA hospital in Utah, Germany and Qatar the burden was higher (31).

The disease burden of VAP in different literatures varies accordingly ranging from 10 – 70%. This was reasoned to be because of the difference in the diagnostic criteria, and difference in the patient population (medical, surgical, or both combined) (29). As Amede Ego et al. Found that the incidence of VAP can range from4-42% after using six different diagnostic criteria and concluded, applying different diagnostic criteria to the same patient population can result in wide variation in the incidence of VAP (29, 32, 33).

The onset of VAP in this study was majorly early onset and 31 (67.4%) of the cases happened to occur in the first two weeks of admission similar to the Greece study (85%) of the cases were late onset (7). In contrary study done by Praveen Charles et al. found that majority 72.2% of them were early onset of VAP (15). The increased risk during the first two weeks of MV is mainly attributed to the interaction of several risk factors during the initial days of MV(7).

The causative microorganisms identified were Acinobacter species and Klebsiela pneumonia, which are similar to other studies (20, 41-43).Although those findings match with other studies, the etiological agents of VAP vary depending on patient profile, duration of mechanical ventilation, prior antibiotic exposure and nature of the ICU. The main epidemiological patterns may not only vary from unit to unit, but also in a given unit over the course of time and this is true for their associated susceptibility patterns. Thus, reported differences can frequently be explained by local specificities (1). Majority of the VAP cases was late onset in which multidrug resistant bacteria are known to be most prevalent (34). Even though, many of the cases in our

study were managed without isolation of causative microorganisms, the etiologic data collection and interpretation provides vital information on most likely causative organisms and resistance patterns. This assists clinicians in directing their choice of empirical treatment if VAP is suspected (22).

On patient outcome, even though, there is no significant association between development of VAP and mortality, this study found that patients who developed VAP have longer ICU stay and duration of mechanical ventilation than those who did not, which is consistent with other reports (35-37).There are some controversies on whether development VAP leads to longer ICU stay and longer duration of mechanical ventilation or vice versa but, in this study most of the cases happened in the first two weeks of ventilation and could be the reason for the prolonged length of stay and ventilation.

With the Possible risk factors in this study tracheostomy was found (AOR: 5.898, P = 0.021, 95% CI: 1.312 - 26.525), to have a significant association with development of VAP on multiple logistic regression analysis of risk factors. Which is supported by the finding of other studies(7, 19, 21, 26, 38). On the contrary Nseir et al. found that early tracheotomy shorten duration of mechanical ventilation and stay in an intensive care unit, and lower rates of ventilator-associated pneumonia and mortality as compared with late tracheostomy (39, 40).

In accordance to other studies (6, 19, 21, 27, 29, 38) re-intubation was documented as independent risk factor for development of VAP. Similarly, this study has also found re-intubation as a risk factor (AOR: 4.529, P = 0.015, 95% CI: 1.337 – 15.337). As to this study most of the re intubation were performed either after failed weaning mode or accidental dislodgement of the endotracheal tube, so clinicians and nurses should be aware of these risk factors and as much as possible they should reduce these risks.

Coma is the commonly identified as an independent risk factor similarly with (AOR: 7.283, P = 0.003, 95% CI: 1.950 – 27.201) this study also agreed with those studies (6, 8, 19, 27, 29, 41). As a patient in a coma had impaired consciousness and inadequate cough and gag reflexes which predisposed them to develop VAP. Which implies coma care in line with VAP prevention should be taken seriously.

Transportation out of the ICU was also found as independent risk factor (AOR; 3.563, CI: 1.009 – 12.364, p=0.040) which correlate with a prospective cohort study conducted Kollef et al. with 531 mechanically ventilated patients, showed that 52% of the patients had to be moved at least once and 62 (24%) of the transported patients developed VAP compared with 11 (4%) of the patients confined to the ICU. Multiple logistic regression analysis confirmed that transport out of the ICU was independently associated with VAP (AOR:3.8, CI: 2.6-5.5, p: <0.001) (42). And another cohort study conducted by Bercault Nicolas et al. also found that intra hospital transportation to be associated with the development of VAP, where the rate was 26% in exposed patients compared with 10% in the matched unexposed patients(odds ratio, 3.1; 95%,CI: 1.4–6.7) (43). When an intra hospital transport is needed, very cautious measures must be taken before and during intra hospital transport to prevent ventilator-associated pneumonia. In addition, in the few days after intra hospital transport, intensive search for ventilator-associated pneumonia is justified.

Another rare risk factor identified is Admission to the medical ward (AOR: 5.154, P = 0.008, 95% CI: 1.524 - 17.428). In our study majority of the patient who developed VAP were from the medical ICU this might be due to their duration of mechanical ventilation were higher (it was also the independent risk factors for development of VAP) (6, 8) compared to those admitted to surgical ICU patients.

Most of the time patient on a mechanical ventilator receives continuous IV sedatives to calm the patient from the different discomforts caused by mechanical ventilation. Paralytic agents or use of continuous IV sedatives had an association with VAP (AOR: 6.466, P =0.005, 95% CI: 1.746 – 23.950) as it was found in other studies too (15, 21). So, daily sedation assessment may be warranted to decrease the risk of development of VAP.

Prior antibiotic exposure and stress ulcer prophylaxis were a risk factor for VAP (29, 39). In almost all of the study patients had received antibiotics, and stress ulcer prophylaxis, so we could not evaluate these variables as potential risk factors. Prophylactic use of antibiotics (broad spectrum) is not recommended and exposure to antibiotics is a significant risk factor for colonization and infection with nosocomial multi drug resistant bacteria (34). Cautious use of antibiotics may decrease patient colonization and infection with multi drug resistant bacteria (44).

7. Conclusion

In conclusion the disease burden of VAP in our ICU was found to be higher. The most commonly identified causative microorganisms were Acinobacter species and Klebssiela pneumonia. The risk factors identified with the development of VAP were Tracheostomy, re-intubation, coma or impaired consciousness, continuous IV sedative, transportation out of the ICU, and admission to the medical ICU unit. On outcome there was no significant difference on mortality between VAP and non – VAP patients and there was no association between development of VAP and mortality, but ICU length of stay was longer in patients with VAP.

8. Limitation and strength of the study

Strengths: this study is the first of its kind in our hospital and can serve as a baseline reference for ICU department, further researchers and any preventive interventions. Multiple logistic regression analysis of factors was executed to avoid any confounding effect of variables.

Limitations: since this was a retrospective study design there are charts with an incomplete recording which are discarded could have an effect if they were complete and included in the study. There were variables which could not be studied in retrospective study. The study is limited to one center and could not generalize to other setting.

9. Recommendation

For TASH ICU administration:

- Initiation of VAP prevention Bundle of care could help in decreasing the disease burden of ventilator associated pneumonia.

For TASH, ICU staff physicians and Nurses:

- As patients with tracheostomy, those on coma, those who were transported at least once, those who were admitted to medical ICU and patient taking continuous intravenous sedation are at risk of developing VAP and they should be followed and frequently assessed for VAP.

For researchers:

- Further, prospective multicenter study for validation of disease burden and risk factors identified in this study is necessary.
- Additional studies on risk factors for VAP, combined with the knowledge of the causative pathogens, may guide development of more effective preventive strategies for VAP.

10. References

1. Rello J, E. D. Pneumonia in the intensive care unit. Crit Care Med. 2003;31:2544-51.

2. Barbier F AA, Wolff M, Bouadma L Hospital-acquired pneumonia and ventilator-associated pneumonia:recent advances in epidemiology and management. Curr Opin Pulm Med. 2013;19:216-28.

3. American Thoracic Society IDSoA. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J Respir Crit Care Med. 2005;171:388-416.

4. T.A. Abdel-Gawad et al, 13 (2009) R164,. Gastroesophageal reflux in mechanically ventilated pediatric patients and its relation to ventilator associated pneumonia. Pediatric Department, Faculty of Medicine, Ain Shams University. Crit Care. 2009;13:167.

5. Charles MVP KA, Easow JM, Joseph NM, Ravishankar M, Srinivasan S, Kumar S, Umadevi S.. Ventilator-associated pneumonia. AMJ. 2014;7(8): 334–44.

6. Gadani H VA, Kar AK. . A study of ventilator-associated pneumonia: Incidence, outcome, risk factors and measures to be taken for prevention. Indian J Anaesth. 2010;54:535-40.

7. Eleni Apostolopoulou PB, Theophanis Katostaras and Leonides Gregorakos. Incidence and Risk Factors for Ventilator-Associated Pneumonia in 4 Multidisciplinary Intensive Care Units in Athens, Greece. RESPIRATORY CARE. 2003;48(7).

8. Riza Hakan Erbay ANY, Mehmet Zencir, Simay Serin and Habip Atalay. Costs and risk factors for ventilator-associated pneumonia in a Turkish University Hospital's Intensive Care Unit: A case-control study. BMC Pulmonary Medicine 2004, 4:3. 2004 4(3).

9. Pug in J AR, Mili N, Janssens JP, Lew PD, Suter PM:. Diagnosis of ventilator-associated pneumonia by bacteriologic analysis of bronchoscopic and nonbronchoscopic ―blind‖ bronchoalveolar lavage fluid. Am Rev Respir Dis. 1991;143:1121-9.

10. Rosenthal VD RC, Álvarez--Moreno C, et al. Effectiveness of a Multi--faceted Approach for Prevention of Ventilator--Associated Pneumonia in Adult Intensive Care Units from 14 Developing Countries: Findings of the International Nosocomial Infection Control Consortium (INICC). . Critical Care Medicine. 2012;40(12).

11. Caserta et al. . A program for sustained improvement in preventing ventilator associated pneumonia in an intensive care setting. BMC Infectious Diseases. 2012;12:234.

12. N Jaggi PS, E Narayan. Reduction in ventialator associated pnermonia rates in an Indian ICU as an outcome of prevention bundle implementation. BMC Proceedings. 2011;5(6):69.

13. Yaseen Arabi NA-S, Ziad Memish, Antonio Anzueto. Ventilator-associated pneumonia in adults in developing countries: a systematic review. International Journal of Infectious Diseases) ,. 2008;12: 505—12.

14. Becerra MRT, J.A.; Suárez, V.J.; Alvarado, M.C.; Candela, J.L.; Urcia, F.C. . Epidemiologic surveillance of nosocomial infections in a Pediatric Intensive Care Unit of a developing country. BMC Pediatrics 2010;10:66.

15. Allegranzi B, N. S., Combescure C, et al. (2010). "Burden of endemic healthcare--associated infection in developing countries: a systematic review and meta--analysis." Lancet In Press.

16. Hunter JD:. 2012. Ventilator associated pneumonia. BMJ Open. 2012;344:3325.

17. Denise Cardo TH, Mary Andrus, Margaret Dembinski, Jonathan Edwards, James Tolson, Debra Wagner, . Am J Infect Control 2004;32:470-85.

18. E Alp GK, R Coskun, M Sungur, M Guven, M Doganay. Economic burden of ventilator associated pneumonia in a developing country. BMC Proceedings. 2011; 5((Suppl 6)):65.

19. Ding C ea. Incidence, temporal trend and factors associated with ventilator-associated pneumonia in mainland China: a systematic review and meta-analysis. BMC Infectious Diseases. 2017;17:468.

20. E. Alp GK, R. Coskun, M. Sungur, M. Guven, M. Doganay. Economic burden of ventilator-associated pneumonia in a developing countryq. Journal of Hospital Infection 2012;81:128-30.

21. Noyal Mariya Joseph1 SS, Tarun Kumar Dutta2, Ashok Shankar Badhe3, Subhash Chandra Parija1. Ventilator-associated pneumonia in a tertiary care hospital in India: incidence and risk factors. J Infect Dev Ctries 2009;3(10):771-7.

22. A Awath Behari, Kalafatis N. Incidence and outcome of ventilator-associated pneumonia in Inkosi Albert Luthuli and King Edward VIII Hospital surgical intensive care units. S Afr J Crit Care 2015;31(1):16-8.

23. Liu B LS, Zhang SM, Xu P, Zhang X, Zhang YH, Chen WS, Zhang WH. . Risk factors of ventilator-associated pneumonia in pediatric intensive care unit: a systematic review and metaanalysis. J Thorac Dis. 2013;5(4):525-31.

24. Alexis M. Elward DKW, and Victoria J. Fraser,. Ventilator-Associated Pneumonia in Pediatric Intensive Care Unit Patients: Risk Factors and Outcomes. Pediatrics. 2002;109:758 – 64;.

25. Tejerina E ea. Incidence, risk factors, and outcome of ventilator-associated pneumonia. Journal of Critical Care 2006;21:56-65.

26. Noyal Mariya Joseph SS, Tarun Kumar Dutta, Ashok Shankar Badhe, Desdemona Rasitha, Subhash Chandra Parija. Ventilator-associated pneumonia in a tertiary care hospital in India: role of multi-drug resistant pathogens. J Infect Dev Ctries. 2010;4(4):218-25.

27. Noyal Mariya Joseph SS, Tarun Kumar Dutta, Ashok Shankar Badhe, Subhash Chandra Parija. Ventilator-associated pneumonia in a tertiary care hospital in India: incidence and risk factors. J Infect Dev Ctries 2009; 3(10):771-777. 2009;3(10):771-7.

28. de Miguel-Díez J ea. Decreasing incidence and mortality among hospitalized patients suffering a ventilatorassociated pneumonia. Medicine. 2007; 96(30).

29. Amal Fathy RA, Abdel-Hady EL-Gilany , Sayed Ahmad Abd Elhafez Analysis of ventilator associated pneumonia (VAP) studies in Egyptian University Hospitals. Egyptian Journal of Chest Diseases and Tuberculosis (2013) 62, 17–25. 2013;62:17-25.

30. Fabian Jaimesa b, , Gisela De La Rosaa, Emiliano Go´meza, Paola Mu´neraa,, Jaime Ramı´reza SnCn. Incidence and risk factors for ventilator-associated pneumonia in a developing country. Elsevier. 2007;101, (2007):762–7.

31. Sundar KM, David Nielsen , M. PS. Comparison of ventilator-associated pneumonia (VAP) rates between different ICUs: Implications of a zero VAP rate. Journal of Critical Care (2012) 27, 26–32. 2012;27:26-32.

32. Amedee Ego, Jean-Charles Preiser, Vincent L-l. impact of diagnostic criteria on the incidence of ventilator associated pneumonia. chest. 2015;147(2):347-55.

33. Kaushik B, Rav; K, Stuart; B, Dennis. M. incidence of Ventilator associated pneumonia using two different diagnostic criteria. critical care medicine. 2012;40(12):321-8.

34. al IEme. incidence, etiology, and antibiotic resistance patterns of gram negative microorganisms isolated from patient with VAP in a medical-surgical ICU unit of a teaching hospital in Istanbul, Turkey (2004-2006). Jpn J infect Dis,. 2008;61:339-42.

35. Ashu Sara Mathaia, Atul Phillips, Paramdeep Kaur,Rajesh Isaac. Incidence and attributable costs ofventilator-associated pneumonia (VAP) ina tertiary-level intensive care unit (ICU)in northern India. Journal of Infection and Public Health 2015;8:127-35.

36. al. HMA-De. The results of a 6-year epidemiologic surveillance for ventilator-associated pneumonia at a tertiary care intensive care unit in Saudi Arabia. American Journal of Infection Control 2012;40:794-9.

37. John G. Muscedere MD CMMM, Daren K. Heyland MD, MSc. The impact of ventilator-associated pneumonia on the Canadian health care systemB Journal of Critical Care 2008;23:5-10.

38. Jubin John SMT, Ashu Sara Mathai, Arti Rajkumar. a prospective study on incident and microbiological profile of ventilatory associated pneumonia in the intensive care unit of a teritiary care center. international journal of contemporary medical research. 2017;4(9):1840-3.

39. S. Nseir*, C. Di Pompeo , E. Jozefowicz, B. Cavestri, H. Brisson, M. Nyunga, et al. Relationship between tracheotomy and ventilator-associated pneumonia: a case–control study. Eur Respir J 2007;30(314-320).

40. T. Szakmany PR, A.R. Wilkes, J. E. Hall. effect of early tracheostomy on resource utilization and clinical outcomes in critically ill patient; meta-analysis of randomized controlled trials. BJA. 2015;114(3):396-405.

41. Sanjay Melville Masih, Shewtank Goel, Abhishek Singh, Rakesh Tank, Sanjeev Kumar Khichi, Singh S. Incidence and risk factors associated with development of ventilator-associated pneumonia from a tertiary care center of northern India. Int J Res Med Sci. 2016;4(5):1692-7.

42. al. KMe. patient transport from ICU increase the risk of developing. Ventilator-Associated Pneumonia:. chest. 1997;112(3):765-73.

43. Bercault N, Wolf M, Runge I, Fleury J-C, Boulain T. Intrahospital transport of critically ill ventilated patients: A risk factor for ventilator-associated pneumonia—A matched cohort study. Critical Care Medicine 2005;33(11):2471-8.

44. al. Re. Epidemiology and outcomes of ventilator-associated pneumonia in northern Brazil: an analytical descriptive prospective cohort study. BMC Infectious Diseases. 2013;13(119).

11. Information extraction format

Patient card number_____

I. <u>Characteristics of patients with ventilator associated pneumonia</u>

1. Sex

   A. Male B. Female

2. Age (years)_____

3. Presence of VAP A. No B. Yes

4. Duration of mechanical ventilation _____(days)

5. Onset of VAP after intubation _____(days)

6. Admitting ward

   A. Medical ICU

   B. Surgical ICU

7. Admitted to ICU from

   A. Medical ward

   B. Surgical ward

   C. Emergency OPD

   D. Operative room

   E. Gynecologic ward

8. On set of VAP

9. Causative microorganism

   _____

10. Primary indication for mechanical ventilation

    A. Acute respiratory failure

I. ARDS
II. acute pulmonary edema/CHF,
III. aspiration,

V. trauma,

B. Coma or impaired consciousness
C. Neuro-muscular diseases (GBS, myasthenia gravis)

11. Causes of ICU admission were classified as either
    A. Trauma
    B. respiratory disease,
    C. neurologic disorder,
    D. cardiovascular disorder,
    E. intra-abdominal disorder (GI),
    F. Poisoning (usually attempted suicide), or intoxications
    G. Metabolic or renal
    H. Others
12. Place of intubation
    A. ICU
    B. Emergency
    C. Operating room
    D. Other hospital
13. Presence of Co-morbidity

A. Hypertension

B. Diabetes
C. Immunocompromised (AIDS)
D. Chronic kidney disease
E. Presence of malignancy (cancer)
F. Chronic liver disease
G. Others

II. Potential risk factors

S.N.	*Risk factors*	*Yes*	*No*
1	Tracheostomy		
2	Bronchoscopy		
3	Tube thoracostomy		
4	Aspiration of gastric content		
5	Re-intubation		
6	Corticosteroid		
7	Presence and duration of central venous and arterial catheters,		
8	NGT and enteral feeding		
9	Prior use of antibiotics		
10	Transportation out of the hospital (ICU) after intubation		
11	Surgery		
12	Surgical drainage(mainly thoracic)or thoraco-abdominal surgery		
13	Paralytic agents, continuous intravenous sedation		
14	Stress ulcer prophylaxis		
15	Traumatic intubation (Emergency intubation)		
16	Dialysis		
17	Ionotropic medication		

III. Outcomes of the patient

14. Outcomes of the patient

A. Improved B. died C. other (left against medical advice, transferred to other hospital)

15. Length of stay in the ICU _____(days)