School of Nursing

Ventilator-Associated Pneumonia and its associated factors among intubated adult patients admitted in public hospitals in Addis, Ababa, Ethiopia.

By: ***Estibel Mengist (BSc, MSc. Candidate)***

A research Thesis submitted to the department of Emergency and Critical Care School of nursing, St. Paul Hospital Millennium Medical College Presented in Partial Fulfillment of the Requirements for the Degree of Masters in Critical Care Nurse Practitioner

August 21, 2024 GC.

Addis Ababa, Ethiopia

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By*: Estibel Mengist (BSc, MSc. candidate)*

Advisors:

1. ***Dr Dereje Bayisa (BSc, MSc/MRH, PMA, PhD, Associate professor)***
2. ***Mr Birhanu Chekol (BSc, MSc)***

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Abstract

Background: Ventilator-associated pneumonia is Pneumonia that develops after 48 hours of endotracheal intubation or tracheostomy. It leads to prolonged mechanical ventilation, extended stays in intensive care units, higher healthcare costs, the emergence of antibiotic-resistant bacteria, and increased morbidity and mortality. Whereas, limited studies, conducted on magnitude and associated factors of VAP in Ethiopia.

Objectives: This study aimed to determine the magnitude of ventilator-associated pneumonia and associated factors among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, in 2024.

Methods: A facility-based retrospective cross-sectional study design was conducted among 341 randomly selected intubated ICU admitted adult patients' cards from January 1st, 2021, to December 30th, 2023 GC. Variables with a bi-variable analysis value of $P < 0.25$ were sent straight to a multivariable analysis. On multivariable analysis P- Values <0.05 were considered statistically significant at a 95% confidence interval using SPSS version 26 software.

Result: A total of 335 patient charts were enrolled in the study with a response rate of 98.2%. More than half of the participants 191 (57%) were male. The median age of patients was 40 years (IQR of 26–56 years). This study determined that the magnitude of Ventilator-Associated Pneumonia (VAP) was 31.3% (95% CI: 26.3 % - 36.4 %). The study revealed that age ≥60 (AOR: 3.2, 95% CI: 1.51-7.12), re-intubation (AOR: 4.8, 95% CI: 2.4-9.4), duration of patient on mechanical ventilator (AOR: 3.2, 95% CI: 1.4-7.2), tracheostomy (AOR: 2.5, 95% CI: 1.2-5.2) and emergency intubation (AOR: 2.4, 95% CI: 1.3-4.6) were identified factors significantly associated with VAP.

Conclusion: This study determined the magnitude of VAP was 31.3% among patients who were admitted to the adult intensive care unit, with identified factors increasing odds of VAP being advanced age, re-intubation, duration of patient on mechanical ventilator, tracheostomy, and emergency intubation. Therefore, policymakers and health planers should address these identified factors to improve patient outcomes and healthcare costs.

Keywords: Associated factor, Ethiopia, Magnitude, Ventilator-associated pneumonia

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Acronyms

AaBET	Addis Ababa Burn Emergency and Trauma
AICU	Adult Intensive Care Unit
AOR	Adjusted Odds Ratio
ARDS	Acute Respiratory Distress Syndrome
CHF	Congestive Heart Failure
COPD	Chronic Obstructive Pulmonary Disease
COR	Crude Odds Ratio
ESBL	Extended Spectrum ß-lactamase
H2 Antagonist	Histamine 2 antagonist
ICU	Intensive Care Unit
IQR	Inter Quartile Range
LOS	Length of Stay
MRSA	Methicillin-Resistant Staphylococcus aurous
MV	Mechanical Ventilator
RR	Relative Risk
SPHMMC	St. Paul's Hospital Millennium Medical College
SPSS	Statistical Package for the Social Sciences
VAP	Ventilator-Associated, Pneumonia

1. Introduction

1.1 Background

Ventilator-associated pneumonia (VAP) is Pneumonia that develops more than 48 hours following endotracheal intubation or tracheostomy and for which there was no indication of pneumonia during intubation, admission, or tracheostomy (1, 2).

Ventilator-associated pneumonia (VAP) is a new onset of pneumonia in ventilated patients, occurring between 48 hours after mechanical ventilation and 48 hours after extubation. It can be classified as early or late onset, with early onset occurring within the first four days and late onset occurring after five days (3).

A high level of clinical suspicion, along with a bedside examination, radiographic examination, and microbiologic investigation of respiratory secretions, are necessary for the diagnosis of VAP (4). Infectious Diseases Society of America and American Thoracic Society clinical practice guidelines from 2016 state that ventilator-associated pneumonia is diagnosed when a chest x-ray shows a new or changing lung infiltrate and at least two of the following clinical features: fever (≥ 380c), increased white blood cell count (≥ 12*109 WBC/ml), purulent tracheobronchial secretions and new onset hypoxia (1).

VAP was linked to a higher risk of hospital death and continues to be the most common infection among patients admitted to the intensive care unit (ICU). It is also associated with higher economic costs, longer lengths of stay attributable to the hospital, and higher mortality, particularly when lung infections are brought on by high-risk pathogens like Methicillin-Resistant Staphylococcus aurous (MRSA), Gram-negative bacteria that produce Extended Spectrum ß-lactamase (ESBL), Multiple Drug Resistance (MDR) P. aeruginosa, and A. baumannii. Certain host, environmental, or pharmaceutical factors may increase a patient's risk of developing VAP (5-8).

VAP bundles of preventative actions need to be administered to patients who are at risk for VAP. The magnitude and burden of ventilator-associated pneumonia are significantly reduced when the ventilator-associated pneumonia bundle is followed. Peptic ulcer prevention, deep vein thrombosis prophylaxis, daily sedation breaks and extubation assessment, and head of bed

elevation greater than 30° were the components of ventilator-associated pneumonia prevention bundles (9).

1.2 Statement of the problem

Globally, the prevalence of ventilator-associated pneumonia is 15.6% (10). According to the 2016 clinical guidelines published by the American Thoracic Society (ATS) and the Infectious Diseases Society of America (IDSA), the death rate from VAP in the US could have reached up to 13% (11). A multi-center prospective study conducted in Europe found that the 30-day mortality rate of ventilator-associated pneumonia (VAP) was 29.9%, the early VAP mortality rate was 19.2%, and the late VAP mortality rate was 31.4% (12).

VAP patients spent an average of 8–24 days in the intensive care unit (ICU), while non-VAP patients spent 2.5–13 days there. Crude mortality rates for individuals with ventilator-associated pneumonia ranged from 16% to 94%, whereas those without the condition had a crude death rate of 0.2% to 51%. Additionally, the duration of ICU stay was significantly more prolonged in patients who developed late-onset VAP, with an average of 21.04 days compared to 10.82 days in early-onset VAP cases. The length of stay (LOS) in the intensive care unit (ICU) was 10 days longer for patients with ventilator-associated pneumonia (VAP) and they also had a higher death rate. Patients with ventilator-associated pneumonia may experience a variety of consequences, such as MDR organism infection, atelectasis, acute respiratory distress syndrome (ARDS), and severe sepsis/septic shock. These issues increase the likelihood of cost and death (13-15).

Patients with VAP had higher mean costs for hospitalization, nursing services, antibiotics, anesthesia, ventilator support, respiratory therapy, and chest x-rays, which increased the cost by 40% or more, and the total cost for VAP patients was about threefold higher than for non-VAP patients, in which this cost was probably associated with prolonged hospitalization of VAP patients (16, 17).

The magnitude of VAP can be significantly decreased by implementing easy and affordable measures like hand washing, handling respiratory tract secretions properly, using chlorhexidine for oral hygiene, and having health workers wear gloves. These studies have been conducted in developing nations (18, 19).

Despite major advances in techniques for the management of ventilator-assisted patients and the routine use of effective procedures to disinfect respiratory equipment, VAP can make it difficult for patients to stop using their mechanical ventilators and extend their hospital stays, which puts a significant financial strain on them and increases the demand for medical resources. VAP also makes the course of treatment for patients using these ventilators more complicated (20).

A deliberate investigation is necessary to lower the morbidity and death rate of ventilator-associated pneumonia, a significant nosocomial infection among intubated ICU patients. Good knowledge of VAP and its associated factors is an important way to decrease its consequences and mortality (21).

Studies have been conducted to assess the knowledge of VAP prevention among critical care nurses in Ethiopia .These studies suggest that there is a need of training and education for critical care nurses to improve their knowledge of VAP prevention (22).

Other studies have highlighted the importance of implementing evidence-based strategies to decrease VAP, such as hand washing, proper handling of respiratory tract secretions, oral hygiene, head of bed elevation, daily sedation break, and assessment for extubation (23).

However, limited studies conducted in Ethiopia show the magnitude of ventilator-associated pneumonia and its associated factors. This study is crucial to determine the extent and contributing factors of ventilator-associated pneumonia.

1.3 Significant of the study

The result of this study will provide adequate and valuable information on the magnitude and associated factors of ventilator-associated pneumonia in the Ethiopian context, and it will benefit the patient and their families directly or indirectly. Healthcare professionals will utilize the study's insights to improve VAP prevention and decrease magnitude of ventilator associated pneumonia. Additionally, the research will serve as a valuable source for researchers to further explore VAP, and for the Federal Ministry of Health the result of this study will serve as a source for further meta-analysis study and will address the identified factors that increased VAP.

2. Literature Review

2.1. Prevalence of ventilator-associated pneumonia

One-fourth of infections in critically ill ICU patients and half of antibiotic prescriptions for patients on mechanical ventilation are related to ventilator-associated pneumonia (24). A point-prevalence survey was carried out in a selection of acute care hospitals in the United States and Determined that of the 427 healthcare–associated infections identified pneumonia was the most common infection with 32% of those being ventilator associated (25).

According to a meta-analysis involving 8282 patients from 20 Chinese provinces, the cumulative incidence of VAP in mainland China between 2006 and 2014 was 23.8% (26). Previous studies in Iran, Brazil, Tehran, Saudi Arabia, India, and Turkey have reported the magnitudes of ventilator-associated pneumonia revealed that 11%, 26.2%, 21.6%, 35.4%, 35%, and 15.4%, respectively (13, 27-31).

Another study conducted in twenty-seven European ICUs found that 103 middle-aged patients (14.6%), 104 elderly patients (17.0%), and 73 very old patients (12.8%) had developed ventilator-associated pneumonia (32).

According to a nested case-cohort study conducted at Al-Hussein university hospital in Cairo city, Egypt the magnitude of VAP was 57.5% (33). According to a retrospective follow-up study conducted in Bahir Dar, the magnitude of VAP was 27.9% (95% CI: 23–33%) (34).

2.2. Factors associated with ventilator-associated pneumonia

There are numerous risk factors that can lead to VAP development. The factors associated with patients' characteristics, increased mechanical ventilation time and prolonged mechanical ventilation, disorders of consciousness, burns, co-morbidities, prior antibiotic therapy, invasive operations, risks due to intervention, and enteral feeding are the globally recognized factors of ventilator-associated pneumonia (35, 36).

2.2.1. Socio-demographic factors of ventilator-associated pneumonia

Males and older patients (60 years or older) had higher odds of getting VAP (14, 26, 36-40). With every year of age increase, the risk of developing VAP increased by more than 1.15 times, and chronic diseases such as chronic heart failure, possible respiratory disorders, chronic kidney failure, diabetes, hypertension, and an increased incidence of non-metastatic malignancies were more common in the elderly (36).

However, a number of studies showed that there was no statistically significant difference in the age and sex of patients between the VAP and non-VAP groups (13, 21, 32).

2.2.2. Intervention related factors of ventilator-associated pneumonia

The duration of patient on mechanical ventilation or ventilator dependency days, the length of the ICU stay, the use of H2 blockers, the supine head position of patients, reintubated patients, and mechanically ventilated patients for more than two weeks, and tracheostomy use were independent risk factors for the development of ventilator-associated pneumonia (13, 26, 41-44).

The respiratory system's natural function is to expel secretions from the larynx and pharynx through cough reflex action or mucociliary action. Patients on mechanical ventilation do not remove their secretions from the oropharynx and are unconscious. Prolonged mechanical ventilation can lead to an increased risk of ventilator-associated pneumonia and a variety of complications (36).

The incidence of ventilator-associated pneumonia may vary depending on where intubated patients are positioned. Supine patient positioning blood transfusion , is independently associated with the development of ventilator-associated pneumonia, possibly because of an increased risk for gastro esophageal reflux and aspiration (34).

According to a meta-analysis done in Greece, the odds of developing clinically diagnosed VAP were significantly higher among patients positioned supinely compared to patients positioned semi-recumbently at 45°. Intubated patients are at higher risk for pulmonary aspiration of gastric pathogens when placed in the fully supine position (0 degrees), as compared with a semi-recumbent position (45°). Thus, intubated patients should be managed in a semi-recumbent position, particularly during enteral feeding (45-47).

Stress ulcer prophylaxis medications that alter the gastric pH, like H2 antagonists and antacids, may increase organism counts and increase the risk for ventilator-associated pneumonia; therefore, sucralfate should be used instead of H2 antagonists for stress ulcer prophylaxis in gastro-esophageal bleeding risk patients (48).

Mechanically ventilated patients receiving enteral feedings often have substantial gastric volume, which may increase their risk for gastro esophageal reflux, aspiration, and ventilator-associated pneumonia. Small-intestinal feeding or the use of motility agents, such as metoclopramide, may therefore protect patients against ventilator-associated pneumonia (49).

Enteral nutrition has been considered a risk factor for the development of VAP, mainly because of the resulting alkalinization of gastric content, gastro esophageal reflux, and gastro-pulmonary aspiration (45).

Those who require extended mechanical ventilation due to severe respiratory failure or who are unable to protect their airway due to facial injuries or other conditions often have tracheostomy procedures (35, 50).

Frequent reintubation has been found to be a risk factor for VAP. The main cause of pneumonia associated with frequent reintubation is the aspiration of gastric contents. During reintubation, these patients' nasogastric tubes are in place, and their stomach contents are aspirated (33, 35, 51, 52).

The frequency of VAP is significantly influenced by the degree of consciousness. It was found that the incidence of VAP is 50% in comatose patients. This may be due to the higher chances of aspiration in comatose patients (53).

Emergency intubation of patients resulted in a very high incidence of VAP and proved to be an independent risk factor for ventilator-associated pneumonia (42).

Of the 100 patients in a trial, 35 underwent a quantitative culture of endotracheal aspirates as part of the preceding antibiotic therapy; this method was based on clinical diagnosis. According to risk factor assessments, hospital stays longer than five days and prior antibiotic medication were independent risk factors for drug resistance in VAP pathogens (30).

Prophylactic antibiotic exposure and multiple inadequate antibiotic therapies as independent risk factors for multidrug-resistant VAP, use of >= 3 antibiotics and steroid treatment were independent risk factors for the development of VAP (54).

2.2.3. Admission diagnosis-related factors of ventilator-associated pneumonia

The risk of ventilator-associated pneumonia is significantly higher among patients with a primary admitting diagnosis of burn, trauma, central nervous system disease, respiratory disease, and cardiac diseases (31).

A Glasgow coma score was found to be considerably lower in the VAP group than in the non-VAP group in a study conducted at Zagazig University including 100 patients. A substantial correlation was found between the prevalence of early VAP and consciousness issues (55-57).

In a retrospective analysis of 314 adult burn patients who needed mechanical ventilation, it was shown that 18% of the patients had VAP, which accounted for 74% of all cases of pneumonia (58). On the other hand, there was no statistically significant difference between VAP and non-VAP groups regarding underlying co-morbidities like diabetes, COPD, and CHF (13).

2.3. Conceptual framework

This conceptual framework is Adapted from different literature (13, 31, 32, 34-36). This framework conceptualizes ventilator-associated pneumonia as the result of interactions between various factors. In this study, this conceptual framework looks at the relationship between dependent and independent variables.

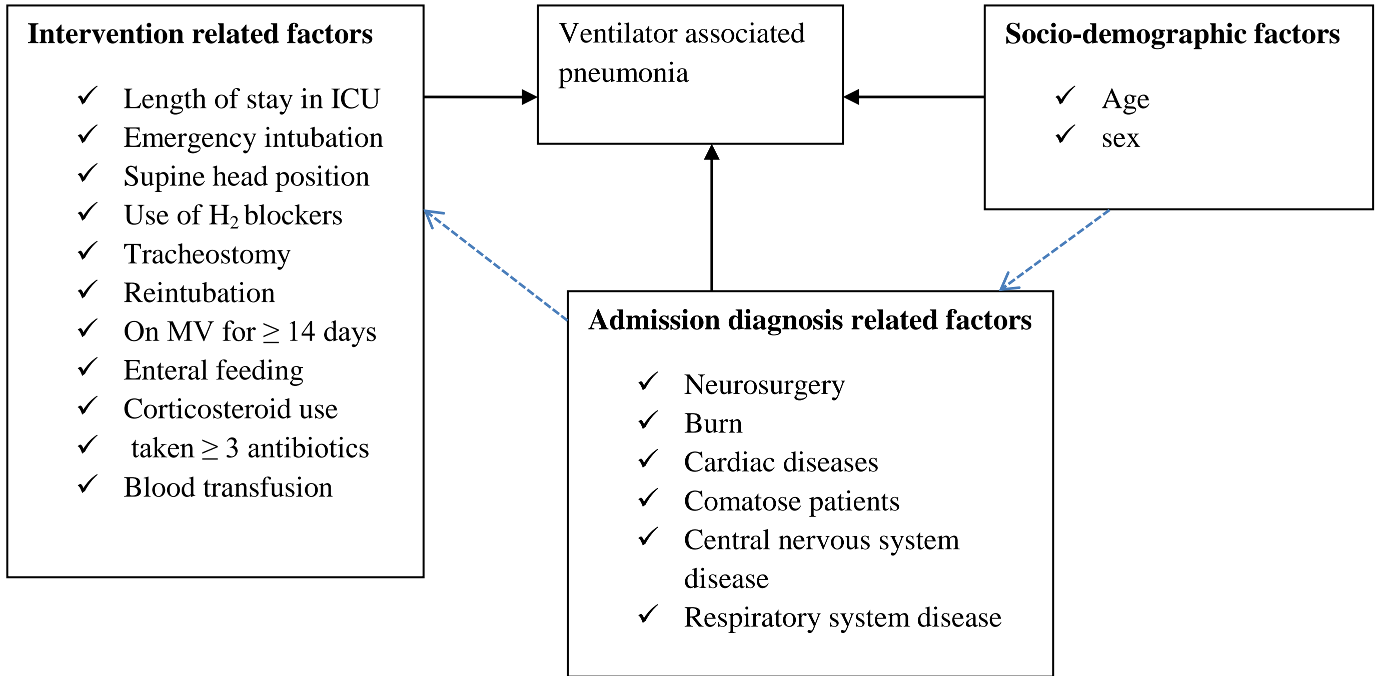

Figure 1: Conceptual framework of ventilator-associated pneumonia and associated factors among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024 GC.

3. Objectives

3.1. General objective

- ✓ To determine the magnitude of ventilator-associated pneumonia and identify factors associated with ventilator-associated pneumonia among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, in 2024.

3.2. Specific objectives

- ➢ To determine the magnitude of ventilator-associated pneumonia among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, in 2024.
- ➢ To identify factors associated with ventilator-associated pneumonia among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, in 2024.

4. Methods

4.1. Study Setting

The study was conducted in selected public hospitals in Addis Ababa, including St. Paul's Hospital Millennium Medical College, AaBET Hospital, and Yekatit 12 Hospital Medical College and Zewditu memorial Hospital selected by lottery method.

St. Paul's Hospital was established in 1969, with the help of the German Evangelical Church, to serve the poor. The school opened and became a higher education institution in 2007 under the Ethiopian Federal Ministry of Health (EFMOH), which is the largest specialized hospital in Ethiopia. It provides a tertiary-level referral hospital with over 700 beds and serves as the training center for undergraduate and postgraduate students. It has 13 adult intensive care unit (AICU) beds with a total 3year admission of 1431 patients, of whom 941 were on mechanical ventilation (59).

AaBET is an affiliate hospital of SPHMMC, and it was opened by the FMOH in August 2015. Annually, it serves 5,000 to 7,000 patients. Have 14 departments and 250 beds (13 ICU beds) with a total 3year admission of 738 patients, of whom 591 were on mechanical ventilation (60).

The Y12HMC, established in 1915, began its service with 25 beds. Since 1987, this hospital has been governed by the Addis Ababa City Administration Health Bureau; in 2003, it was named the Y12 Hospital Medical Science College and served more than 5 million people in the catchment area. It has 10 adult intensive care unit (AICU) beds with a total 3year admission of 1240 patients, of whom 866 were on mechanical ventilation (59).

Zewditu memorial Hospital is Ethiopia's leading hospital in the treatment of RVI patients and currently treats over 6,000 each month. . It has 10 adult intensive care unit (AICU) beds with a total 3year admission of 1368 patients, of whom 537 were on mechanical ventilation.

4.2. Study Design and Period

A facility-based retrospective cross-sectional study design was conducted from May 15 to May 30th 2024GC.

4.3. Source and Study population

4.3.1. Source population

The source population were all admitted adult patients card who were put on a mechanical ventilator in the intensive care units of public hospitals in Addis Ababa.

4.3.2. Study population

The study population were all admitted adult patients card who were put on a mechanical ventilator in the intensive care units of selected public hospitals in Addis Ababa from January 1st, 2021 GC, to December 30th, 2023 GC.

4.3.3. Study unit

The study unit were all randomly selected admitted adult patients card who were put on a mechanical ventilator in the intensive care units of selected public hospitals in Addis Ababa from January 1st, 2021 GC, to December 30th, 2023 GC.

4.4. Eligibility Criteria

4.4.1. Inclusion Criteria

All patients from the age of 15 years and older are intubated and on a mechanical ventilator for at least 48 hours in the intensive care units of selected public hospitals in Addis Ababa from January 1st, 2021 GC, to December 30th, 2023 GC (61).

4.4.2. Exclusion criteria

Patients with pneumonia before mechanical ventilation, those who died within 48 hours of starting Mechanical Ventilation, incomplete charts were excluded from the study.

4.5. Sample size and sampling procedure

4.5.1. Sample size determination

The sample size of this study was determined by using a prevalence of 27.9% (34) from a study conducted at Bahir Dar University, and the target sample size was 341 patients, calculated by using a single population proportion formula:

N = (Z α/2)2 p (1-p) / d2

Where N = sample size

Z = the standard normal deviate

P = prevalence of the previous study characteristic 95% confidence interval

d = degree of precision or accuracy 5% degree of precision

α = significance level 5% Significance level

N = (1.96)2 (0.279 * 0.721) / (0.05)2

N = 309.109 ≈ 310

N = 310 + 10% non-response rate

N = 341 participants

To determine the required sample size for both specific objectives by calculated on open Epi info version 7.2 software using factors associated with ventilator-associated pneumonia among intubated adult patients admitted with the following assumptions: 95% confidence interval, 5% margin of error, and a power of 80% by taking study findings from **(Table 1).**

Table 1: Sample size calculation with different variable factors that are associated with ventilator-associated pneumonia among intubated adult patients admitted in the intensive care units of public hospitals in Addis Ababa, 2024 GC.

Variables	Confidence interval	Power by %	OR/ RR	Ratio of exp to unexpect	% of outcomes inunexposed	Sample size	Final Sample size with 10% non respose rate	p-value	Fefe rence
Tracheostomy	95%	80	OR 3.24 RR 2.59	1:1	11.36	176	194	0.019	(42)
Reintubation	95%	80	OR 3.25 RR 2.41	1:1	15.56	144	159	0.031	(42)
Supine head position	95%	80	OR 4.66 RR 3.44	1:1	9.67	110	121	0.0349	(21)
Use of H_2 blocker	95%	80	OR 5.64 RR 4.16	1:1	7.7	98	108	0.0375	(21)
Emergency intubation	95%	80	OR 5.32 RR 2.08	1:1	36.05	60	66	0.023	(42)

Finally, the required sample size for this particular study was decided by taking the largest sample size, **341,** was included in the study.

4.5.2. Sampling procedure

Among public hospitals in Addis Ababa four hospitals were selected by using lottery method. A simple random sampling technique was used, and the sampling frame was prepared by selecting patients on mechanical ventilator support using the patient registration book. Then, from the prepared sampling frame, the required number of samples was drawn using computer-generated methods.

Proportional allocation of patient charts in selected hospitals based on the number of patient on MV from January 1st 2021 GC to December 30th 2023 GC.

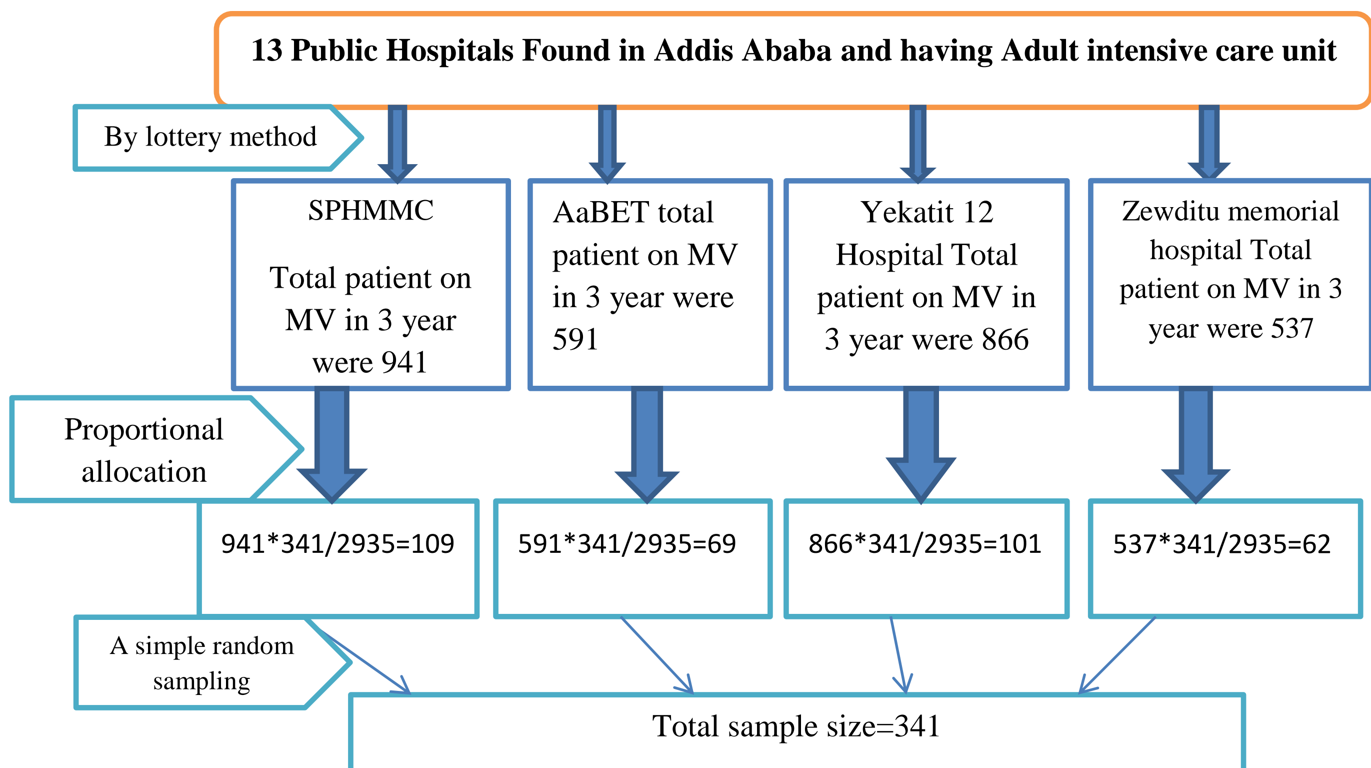

Figure 2: Schematic presentation of sampling procedure on ventilator-associated pneumonia and its associated factors among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024.

4.6. Variables

4.6.1. Dependent variable

Ventilator-associated pneumonia

4.6.2. Independent variables

There were different associated variables like socio-demographic factors (age, sex), admission diagnosis-related factors (neurosurgery, burn, cardiac diseases, comatose patients, central nervous system disease, respiratory system disease), and intervention-related factors (emergency intubation, supine head position, uses of H2 blockers, tracheostomy, reintubation, on MV for ≥ 14 days, enteral feeding, corticosteroid use, taken ≥ 3 antibiotics, blood transfusion).

4.7. Operational definitions

Ventilator-associated pneumonia (VAP): patients who were admitted to an adult intensive care unit and on a mechanical ventilator or tracheostomy and had a diagnosis of ventilator-associated pneumonia by the treating physician on their cards.

Early onset VAP: Ventilator associated pneumonia occurring within the first 4 days of mechanical ventilation.

Late onset VAP: Ventilator associated pneumonia occurring after 5 days of mechanical ventilation.

Low GCS: patients having less than nine GCS during admission to the ICU.

Incomplete chart: considered when 5% of the independent variable and/or the dependent variable's indicator are not recorded.

4.8. Data collection tools and techniques

Data was extracted through a data abstraction checklist from the patient's registration book and selected medical records of all patients who were intubated. Then the charts of the selected patients were reviewed in detail. The abstraction checklist was adapted from previously studied literature (13, 31, 34, 36). It contains socio-demographic characteristics, patient admission

diagnosis conditions, and ICU intervention conditions. First, the letter of permission was distributed to ICU of each hospitals and the principal investigator was communicating with hospital administrator and briefly describe the aim of the study in order to obtain permission to conduct the study. The data was collected by 2 trained BSc Nurses with 1 MSc nurse supervisor using kobo collect software from chart review. Eligible patients were identified by data collectors.

4.9. Data Quality Control

One-day training was given to the data collectors by principal investigator on how to collect data, and the collected data was checked for completeness and accuracy on the same day of collection. A pretest was employed in 5% of the sample size of intubated ICU patient cards in each selected hospital, and based on the pretest findings; there were some modification of data extraction checklists. Reliability and internal consistency were cheeked by Cronbach's alpha (0.72).

4.10. Data processing and analysis methods

The data were filled by the data collectors using kobo collect software and were exported to SPSS version 26 for data processing and analysis. During the analysis and description of the study, variables were identified using frequency tables, proportions, percentages, graphs, and numerical summary measures. Association between each independent and dependent variables were assessed by using binary logistic regression. The first association between each independent variable and dependent variable were assessed in bivariate analysis. Then, those independent variables with P-value <0.25 were transported to multivariate logistic regression to control the confounders. Hosmer-Lemeshow goodness-of-fit test was used to check the model fitness (0.797) and Multicollinearity was assessed using the variance inflation factor (VIF= 1.26). A P-value of <0.05 in the multivariate analysis were used as a criterion for the statistically significant association. The strength of the association was measured using the Odds ratio with corresponding 95% confidence intervals (CI).

4.11. Ethical clearances

This study was approved by the Institutional Review Board of SPHMMC (Ref.No.pm23/1126), and ethical clearance was obtained from the board. Ethical clearance was submitted to selected hospital medical directors. Then written permission was obtained from selected hospital clinical directors. To ensure confidentiality of the patients' information, the names and addresses of the patients were not recorded during the data collection. No one other than the investigator have accessed to the collected data. The investigator used the collected data only to answer the stated objectives.

4.12. Dissemination of the result

The final report of this thesis will be present to the Department of Emergency and Critical Care Nursing and SPHMMC. The result of the study will be disseminated to the Federal Minister of Health, Addis Ababa public health research and emergency management core processes, and Addis Ababa town governmental hospitals. Hard and soft copies will be available in the library of SPHMMC for graduate students as well as for other concerned readers. An effort will be made to present the result in locally or internationally held seminars, workshops, conferences, and meetings. For publication purposes, the abstract of this thesis will be submitted to national or international peer-reviewed publishers.

5. Result

5.1 Socio-Demographic Characteristics

From the total 341 samples, 335 patient charts were enrolled in the study with a response rate of 98.2%. The remaining 6 (1.8%) patient charts were excluded due to mechanical ventilation for less than 48 hours. more than half of the participants 191 (57%) were male. The age of the patients was found to be between 15 and 83 years and almost 271(80.9%) of the participants' age were held <60 years. The median age of patients was 40 years (inter-quartile range of 26–56 years). **(Table 2)**

Table 2:Socio-demographic factors of VAP among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024 GC (n=335).

Variable	Category	Ventilator-Associated Pneumonia (VAP)		
		Yes (%)	No (%)	Total (%)
Sex	Male	68(64.8%)	123(53.4%)	191(57%)
	Female	37(35.2%)	107(46.6%)	144(43%)
Age	<60	65(61.9%)	206(89.6%)	271(80.9%)
	≥60	40(38.1%)	24(10.4%)	64(19.1%)

Magnitude of Ventilator-Associated Pneumonia (VAP)

The magnitude of Ventilator-Associated Pneumonia (VAP) was 31.3% with (95% CI: 26.3 % - 36.4 %). Early onset VAP occurred in 25 (23.8 %), while late onset VAP was occurred in the remaining 80 (76.2%) patients. **(Figure 3)**

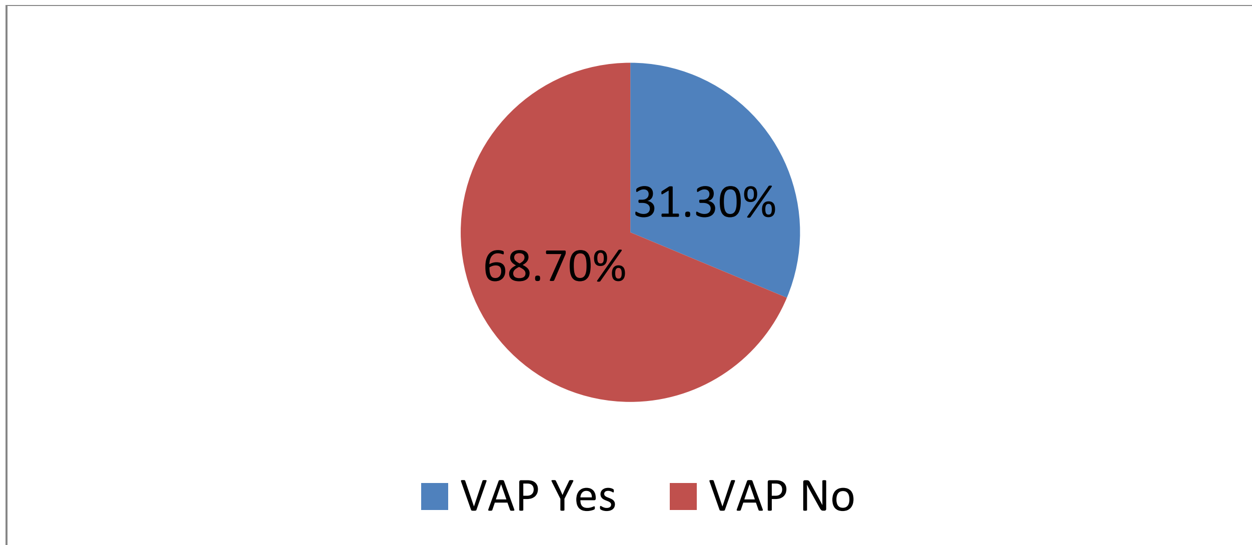

Figure 3: Magnitude of VAP among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024 GC (n=335).

5.2 Intervention Related Factors

The median lengths of patients on the mechanical ventilators were 15 days with an inter-quartile range of 8–21 days. The median lengths of stay of patients in the intensive care unit were 20 days and inter-quartile range of 12–31 days. Around 113(33.7%) of the participants have re-intubation, from these (64.6%) have develop VAP, 207(61.8%) participants have used H2 blockers, while 98(29.3%) of the participants have tracheostomy; from these (64.2%) develop VAP**. (Table 3)**

Table 3: Intervention related factors of VAP among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024 GC (n=335).

Variable	Category	Ventilator-Associated Pneumonia (VAP)		
		Yes (%)	No (%)	Total (%)
Re-intubation	Yes	73(69.5%)	40(17.4%)	113(33.7%)
	no	32(30.5%)	190(82.6%)	222(66.3%)
H2 blockers	Yes	57(54.3%)	150(65.2%)	207(61.8%)

	No	48(45.7%)	80(34.8%)	128(38.2%)
Tracheostomy	Yes	63(60%)	35(15.2%)	98(29.3%)
	No	42(40%)	195(84.8%)	237(70.7%)
Emergency intubation	Yes	57(54.3%)	70(30.4%)	127(37.9%)
	No	48(45.7%)	160(69.6%)	208(62.1%)
Supine head position	Yes	17(16.2%)	45(19.6%)	62(18.5%)
	No	88(83.8%)	185(80.4%)	273(81.5%)
Corticosteroid use	Yes	77(73.3%)	178(77.4%)	255(76.1%)
	No	28(26.7%)	52(22.6%)	80(23.9%)
Taken ≥ 3 antibiotics	Yes	39(37.1%)	83(36%)	122(36.4%)
	No	66(62.9%)	147(64%)	213(63.6%)
Blood transfusion	Yes	41(39%)	91(39.6%)	132(39.4%)
	No	64(61%)	139(60.4%)	203(60.6%)

5.3 Admission diagnosis related factors

From the total patient chart reviewed 137(40.9%) were admitted with the diagnosis of pulmonary disease, from these 49(35.6%) develop VAP, 135(40.3%) were admitted with the diagnosis of head trauma from these 48(35.5%) develop VAP while only 4(3.8%) patients admitted with the diagnosis burn. **(Figure 4)**

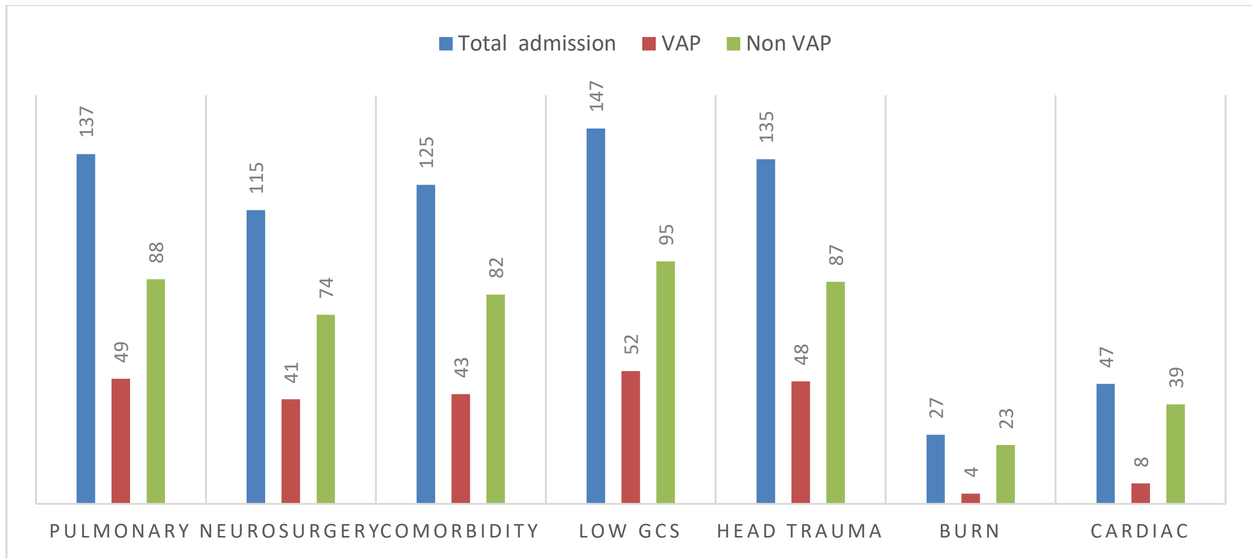

Figure 4:VAP status with their common underlying comorbidity diseases among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024 GC(n=335).

Patient outcome

From total 335 patient charts reviewed 97 (29%) were death and 105 patients who were develop VAP of which 38 (36.2%) were died. And also of total respondents about 230 patients not developed VAP 59 (25.6%) were died. **(Figure 5)**

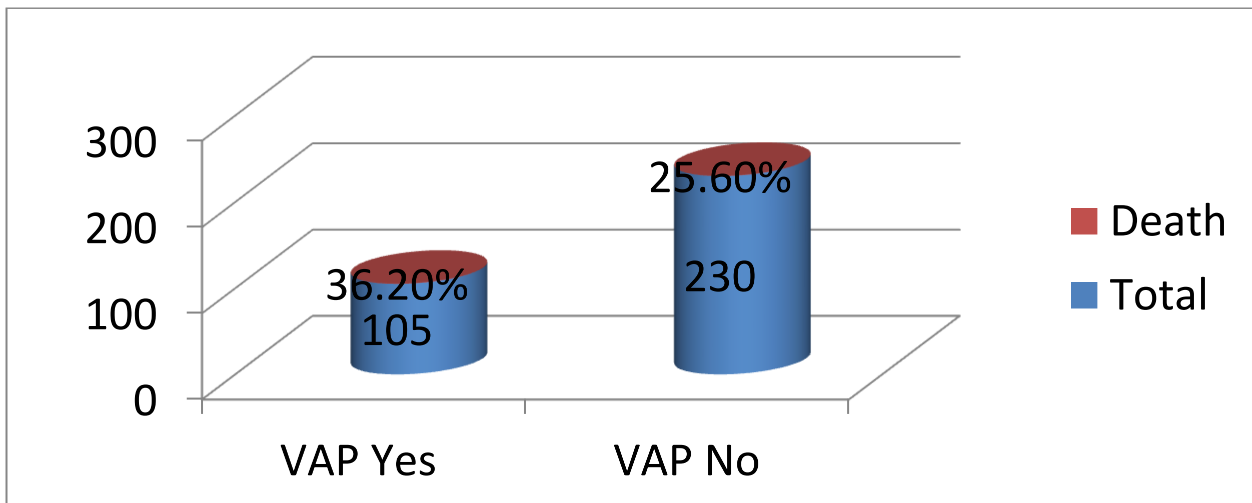

Figure 5 : patient outcome among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024 GC (n=335).

Bi-Variable Logistic Regression Analysis

Table 4: Bi-Variable Logistic Regression Analysis to determine the magnitude and identify factors of VAP among adult intensive care unit admitted patients in public hospitals in Addis Ababa, Ethiopia, 2024.

Variable	category	Ventilator-Associated Pneumonia (VAP)				
		Yes	No	COR	95%CI	P-value
Age	<60	65(61.9%)	206(89.6%)	1	1	
	>=60	40(38.1%)	24(10.4%)	5.282	2.964- 9.413	.000
sex	Male	68(64.8%)	123(53.4%)	1.599	.992- 2.576	.054
	Female	37(35.2%)	107(46.6%)			
Re-intubation	Yes	73(69.5%)	40(17.4%)	10.836	6.330- 18.548	.000
	No	32(30.5%)	190(82.6%)			
H2 blocker	Yes	57(54.3%)	150(65.2%)	.633	.396 -1.013	.057
	No	48(45.7%)	80(34.8%)			
Corticosteroid use	Yes	77(73.3%)	178(77.4%)	.803	.472-1.367	.419
	No	28(26.7%)	52(22.6%)			
Tracheostomy	Yes	63(60%)	35(15.2%)	8.357	4.914 -14.212	.000
	No	42(40%)	195(84.8%)			
Day on MV	>14	90(85.7%)	82(35.7%)	10.829	5.887-19.922	.000
	<=14	15(14.3%)	148(64.3%)			
Emergency intubation	Yes	57(54.3%)	70(30.4%)	2.714	1.687- 4.368	.000
	No	48(45.7%)	160(69.6%)			
Taken ≥ 3 antibiotics	Yes	39(37.1%)	83(36%)	1.047	.648-1.689	.852
	No	66(62.9%)	147(64%)			
Blood transfusion	Yes	41(39%)	91(39.6%)	.979	.610-1.570	.928
	No	64(61%)	139(60.4%)			
Supine head position	Yes	17(16.2%)	45(19.6%)	.794	.430-1.466	.461

	No	88(83.8%)	185(80.4%)			
Comorbidity	Yes	43(41%)	82(35.7%)	1.252	.780-2.010	.353
	No	62(59%)	148(64.3%)			
Pulmonary	Yes	49(46.7%)	88(38.3%)	1.412	.885-2.251	.147
	No	56(53.3%)	142(61.7%)			
Low GCS	Yes	52(49.5%)	95(41.3%)	1.394	.877-2.217	.160
	No	53(50.5%)	135(58.7%)			
Head trauma	Yes	48(45.7%)	87(37.8%)	1.384	.867-2.209	.173
	No	57(54.3%)	143(62.2%)			
Burn	Yes	4(3.8%)	23(10%)	.356	.120-1.058	.063
	No	101(96.2%)	207(90%)			
Cardiac	Yes	8(7.6%)	39(17%)	.404	.182-.898	.026
	No	97(92.4%)	191(83%)			

Multi-Variable Logistic Regression Analysis

The bi-variable logistic regression analysis identified 12 candidate factors for the multivariable logistic regression model. To be liberal a p-value of 0.25 as a cut off value was used to enter in to multivariable Logistic Regression Analysis. Finally five variables including age, re-intubation, duration of patient on mechanical ventilator, tracheostomy and emergency intubation have had a significant association with VAP on multivariate binary logistic regression.

Patient whose age ≥60 years were 3.2 times more likely to develop VAP (AOR: 3.2, 95% CI: 1.51-7.12). Patients who had re-intubation were 4.8 times at higher risk of developing VAP (AOR: 4.8, 95% CI: 2.4-9.4). The odds of having VAP among Patients who were on MV support of greater than 14 days were 3.2 times higher chance of developing VAP (AOR: 3.2, 95% CI: 1.4-7.2). Patients who had tracheostomy were 2.5 times more likely to develop VAP (AOR: 2.5, 95% CI: 1.2-5.2) as compared to who had not tracheostomy. The odds of having VAP among Patients who were intubated emergently were 2.4 times higher chance of developing VAP (AOR: 2.4, 95% CI: 1.3-4.6) as compared to not intubated emergently. **(Table 5)**

Table 5: Multivariable Analysis to determine the magnitude and identify factors of VAP among adult intensive care unit admitted patients in public hospitals in Addis Ababa, Ethiopia, 2024.

Variable	category	Ventilator-Associated Pneumonia (VAP)							
		Yes	No	COR	95%CI	P-value	AOR	95%CI	P-value
Age	<60	65(61.9%)	206(89.6%)	1			1		
	≥60	40(38.1%)	24(10.4%)	5.282	2.964- 9.413	.000	3.293	1.521-7.127	.002 *
sex	Male	68(64.8%)	123(53.4%)	1.599	.992- 2.576	.054	.946	.496-1.802	.865
	Female	37(35.2%)	107(46.6%)				1		
Re-intubation	Yes	73(69.5%)	40(17.4%)	10.836	6.330- 18.548	.000	4.808	2.439-9.478	.000 *
	No	32(30.5%)	190(82.6%)				1		
H2 blocker	Yes	57(54.3%)	150(65.2%)	.633	.396 -1.013	.057	.653	.338 -1.263	.205
	No	48(45.7%)	80(34.8%)				1		
Tracheostomy	Yes	63(60%)	35(15.2%)	8.357	4.914 -14.212	.000	2.510	1.208-5.213	.014 *
	No	42(40%)	195(84.8%)				1		
Day on MV	>14	90(85.7%)	82(35.7%)	10.829	5.887-19.922	.000	3.242	1.445-7.276	.004 *
	<=14	15(14.3%)	148(64.3%)				1		
Emergency intubation	Yes	57(54.3%)	70(30.4%)	2.714	1.687- 4.368	.000	2.452	1.305- 4.606	.005 *
	No	48(45.7%)	160(69.6%)				1		
Pulmonary	Yes	49(46.7%)	88(38.3%)	1.412	.885-2.251	.147	2.067	.567- 7.537	.271
	No	56(53.3%)	142(61.7%)				1		
Low GCS	Yes	52(49.5%)	95(41.3%)	1.394	.877-2.217	.160	.963	.467- 1.984	.918
	No	53(50.5%)	135(58.7%)				1		
Head trauma	Yes	48(45.7%)	87(37.8%)	1.384	.867-2.209	.173	3.968	.934- 16.860	.062
	No	57(54.3%)	143(62.2%)				1		
Burn	Yes	4(3.8%)	23(10%)	.356	.120-1.058	.063	.913	.146- 5.713	.922
	No	101(96.2%)	207(90%)				1		
Cardiac	Yes	8(7.6%)	39(17%)	.404	.182-.898	.026	.766	.184- 3.194	.715
	No	97(92.4%)	191(83%)				1		

Note: *Indicates statistically significant, 1= reference.

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; MV, mechanical Ventilator; GCS, Glasgow Coma Scale

6. Discussion

The aim of this study was to determine the magnitude and identify factors of VAP among intubated adult intensive care unit admitted patients in public hospitals in Addis Ababa, Ethiopia. Despite the mechanical ventilator being an essential feature of modern intensive care unit service, it is associated with a substantial risk of VAP. In this study, 31.3% (95% CI: 26.3%–36.4%) of patients developed VAP during their intensive care unit stay, with identified factors increasing the odds of VAP being advanced age, re-intubation, duration of patient on mechanical ventilator, tracheostomy, and emergency intubation, respectively.

This study found that the magnitude of VAP was 31.3% (95% CI: 26.3% - 36.4%). It is comparable with studies conducted in Bahir Dar (27.9%), Brazil (26.2%), Saudi Arabia (35.4%), and India (35%) (27, 28, 30, 34). but is lower than a study conducted in Egypt, 57.5% (33). This may be due to sociodemographic variation and the small sample size in the Egyptian study. In studies conducted in Iran, Tehran, and Turkey, the magnitude of VAP was 11%, 21.6%, and 15.4%, respectively (13, 29, 31). Which were lower than this study finding. This difference may be due to differences in health facility setups and VAP diagnosis criteria.

In this study Patient whose age ≥60 years were 3.2 times more likely to develop VAP (AOR: 3.2, 95% CI: 1.51-7.12) than patients age less than 60 years, which is similar to other study findings like study conducted in Canada ,mainland China and another study conducted in Kunming china (26, 38, 39) .The reason may be the decline of physiological function of respiration, the gradual atrophy of respiratory muscles, the gradual reduction of lung tissue elasticity, visibly weakened protective cough reflex and the decreased immune function in the elderly (40).

In current study Patients who had re-intubation were 4.8 times at higher risk of developing VAP (AOR: 4.8, 95% CI: 2.4-9.4) than patients who had not re-intubation, which is similar to other study findings like study conducted in Australia (35), Egypt , Pondicherry ,India (33, 51).

The possible justification might be an increased risk of aspiration of colonized oropharyngeal secretions into the lower airways by patients with subglottic dysfunction or impaired consciousness after several days of intubation and direct aspiration of gastric contents into the lower airways, particularly when a nasogastric tube is kept in place after extubation (52).

In this study the odds of having VAP among Patients who were on Mechanical Ventilator support of greater than 14 days were 3.2 times higher chance of developing VAP (AOR: 3.2, 95% CI: 1.4-7.2) than patients on MV support less than or equal to 14 days, which is similar to other study findings like study conducted in Bahir dar, Brazilian University Hospital, Egypt, Canada, (33, 34, 38, 41).The possible justification for this may be artificial airway established by mechanical ventilation changes the mucosal defense function of the normal airway and long-term ventilation increases the risk of infection, which is caused by humidifiers and ventilator loops that are the source of the pathogen due to exposure (35).

The current study found that Patients who had tracheostomy were 2.5 times more likely to develop VAP (AOR: 2.5, 95% CI: 1.2-5.2) as compared to who had not tracheostomy, which is similar to other study findings like study conducted in a tertiary care hospital in India, mainland China , northern India, southern Poland,(26, 42, 43, 50).The possible justification may be due to increased tracheal colonization around the tracheostomy tube into the trachea because of leakage of pooled secretions, which leads to VAP. However study conducted at university of Texas showed that early tracheostomy is independently associated with lower rate of VAP. Performing early tracheostomy is associated with less chance of VAP (44). Possible justification may be it reduces the duration of mechanical ventilation and ICU stay of the patient in comparison to the patient with late tracheostomy.

In this study the odds of having VAP among Patients who were intubated emergently were 2.4 times higher chance of developing VAP (AOR: 2.4, 95% CI: 1.3-4.6) as compared to not intubated emergently, which is similar to other study findings like study conducted in a tertiary care hospital in India, northern India (42, 43).The possible justification may be due to in emergency intubation there may be breach of sterility and patient at high risk of aspiration of secretions and GI contents.

However, in this study there was no significant association between low GCS and VAP. This study finding is contradicted with study conducted in Bahir dar (34) .The difference might be due to differences in the methods of data analysis; the log binomial method of analysis was used in Bahir dar studies while logistic analysis was executed in this study.

7. Strength and Limitation of the study

7.1. Strength of the study

- Multicenter study which enhances the generalizability of the result
- Low non response rate and adequate sample size
- The finding will serve as source of information for further studies

7.2. Limitation of the study

Since the study design was retrospective cross-sectional, which was based on chart review, it was difficult to measure other important variables like behavioral factors including smoking, alcohol abuse and nutritional status that are not available in the medical record. Study design was retrospective cross-sectional that does not show cause and effect relationship.

8. Conclusion and Recommendation

8.1. Conclusion

This study determined nearly one-third of study participants developed VAP, and identified factors that increased the odds of VAP were advanced age, re-intubation, duration of patient on mechanical ventilator, tracheostomy, and emergency intubation. Addressing these factors through targeted preventive strategies like precaution during emergency intubation, minimizing the occurrence of re-intubation, and optimizing ventilator weaning protocols could help reduce the substantial burden of VAP, enhance clinical practices, and improve patient outcomes and healthcare costs.

8.2. Recommendation

To the respective hospitals

- Special attention should be given to elderly patients
- Reduce patient length of stay on mechanical ventilation
- Precaution during emergency intubation
- Minimizing the occurrence of re-intubation, avoidance of tracheostomy as far as possible

To Federal Ministry of Health

- Policymaker and health planers should addressing these identified factors through targeted preventive strategies like strengthening VAP bundle implementation and optimizing ventilator weaning protocols could help enhance clinical practices and improve patient outcomes and healthcare costs

To researchers

- Since the study is conducted retrospectively further observational prospective study is batter to conduct on magnitude of VAP and its associated factors.
- Further research is warranted to explore additional risk factors and potential interventions for VAP prevention
- Consider this study as source for further meta-analysis study on magnitude of VAP and its associated factors

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10. Annexes

Annex I- Information sheet in English version

Title of the Research: Ventilator-Associated Pneumonia and its associated factors among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024 GC.

Name of Investigator: Estibel Mengist

Name of the Organization: St Paul's Hospital Millennium Medical College school of Nursing

Introduction: this information sheet is prepared for selected public hospitals in Addis Ababa, Ethiopia. The aim of the form is to make the concerned office clear about the purpose of research, data collection procedures and get permission to conduct the research.

Purpose of the Research: To determine ventilator-associated pneumonia and identify factors associated with ventilator-associated pneumonia among intubated adult patients admitted to public hospitals in Addis Ababa, Ethiopia, in 2024

Risk and/or Discomfort: Since the study will conduct by taking appropriate information from medical chart, could not inflict any harm on the patients. The name or any other identifying information will not record on the questionnaire and all information taken from the chart kept strictly confidential and in a safe place. The information extracted will be kept secured by locking with key. After the data entry in to the computer it will be locked by password. The information retrieved used only for the study purpose.

Benefits: the research has no direct benefit for those whose document/ record that will be included in this research. However, the indirect benefit of the research for the participant and other clients in the program is clear. This is because if program planners are preparing predicted plan, there is a benefit for clients in the program of getting appropriate case specific care and treatment services for ventilator- associated pneumonia and associated factors in the intensive care units patients. Of all, the research work has a paramount direct benefit for health care planners and managers, especially for those works in intensive care units association program planning and management

Confidentiality: to ensure confidentiality the data on the chart will be collected by those individuals who are health professionals working in the facility and information collected without the name of the clients. The information collected from this research project will be kept confidentially and will store in a file. In addition, it will not be revealed to anyone except the investigator and it will be keep by key and locked system with computer password. The research project will be reviewed and approved by the research review committee of School of Nursing, SPHMMC

Person to contact: If you have any question, you can contact the principal investigator.

Principal investigator address

Name: Estibel Mengist Phone: +251945534031 E-mail: estibel0945@gmail.com

Annex II-Data collection tool/questionnaire (English version)

Questionnaire/checklist serial number

Name of the hospital …………………………..

Name of data collector ……………………………

Supervisor's Name ………………………………..

Date of data collection:……………………………

A questionnaire prepared to assess Ventilator-Associated Pneumonia and its associated factors among intubated adult patients admitted in selected public hospitals in Addis Ababa, Ethiopia, 2024 GC.

S.no	**Questions**		
	Patient admission date	…………….....	
	Patient intubation date	………………	
	Does the patient developed ventilator-associated pneumonia	1-yes 2-no	If no skip to 101
	Date of VAP confirmation	……………….	
	Socio-demographic questionnaires		
101	Identification number	……………	
102	Age of patient	……………	
102	Sex of patient	1-male 2-female	
	Intervention related questionnaires		
201	Is there reintubation?	1-yes 2- no	
202	Is the patient using H2 blockers?	1-yes 2- no	

203	Is the patient on a tracheostomy?	1-yes 2-no	
204	How many days did the patient stay on the mechanical ventilator?	……………….	
205	Did the patient take a corticosteroid?	1-yes 2-no	If no skip to 207
206	For how many days does she or he take corticosteroids?	……………………	
207	Does the patient have an NG tube feeding?	1-yes 2-no	
208	For how many days did the patient stay in the ICU?	……………..	
209	Does the patient was on a supine head position?	1-yes 2-no	
210	Does the patient have a bronchoscopy procedure?	1-yes 2-no	
211	Does the patient have Intubated emergently?	1-yes 2-no	
212	Does the patient was taking ≥ 3 broad spectrum antibiotics?	1-yes 2-no	
213	Does patient have blood transfusion	1- yes 2- no	
Admission diagnosis-related questionnaires			
301	Does the patient admission diagnosis was pulmonary disease?	1-yes 2-no	
302	Is the patient admission diagnosis was neurosurgery?	1-yes 2-no	
302	Does the patient have	1-yes	

	comorbidity in addition to a primary problem?	2-no	
303	Does the patient was with low Glasgow coma scale?	1-yes 2-no	
304	Does the patient admission diagnosis was head trauma?	1-yes 2-no	
305	Is the patient admitted with a diagnosis of burn	1-yes 2-no	
306	Does the patient admitted with cardiac disease	1-yes 2-no	
307	Patient outcome	…………………	

Declaration

I declare that this Research thesis entitled **"Ventilator-Associated Pneumonia and its associated factors among intubated adult patients admitted in public hospitals in Addis Ababa, Ethiopia, 2024 GC** " is my own work that have not been addressed in the study area as far as my knowledge touched and all the sources I used has been indicated and acknowledged as complete reference.

Name of investigator Signature Date

_______________________________ _______________ ____________

Name of advisor/s

1. ______________________________________ __________________ _____________

2. ___________________________________ __________________ _____________

Name of invigilators

1.____ _______________ ____________

2.____ _______________ ______________