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'Incidence of VAP in tertiary care hospital and impletation of VAP bundle

Ranjeeta Kumari[1], Dr. Prakash Chand Choudhary[2] and Dr. Bhanwar Lal Jat[3]*

[1]Department of Biotechnology, Mewar University, Gangrar, Chittorgarh, Rajasthan.India
[2]Department of Chemistry, Mewar University, Gangrar, Chittorgarh, Rajasthan India
[3*]Department of Agriculture Biotechnology, Bhagwant University Ajmer, Rajasthan India

Abstract: Study the incidence rate of VAP in tertiary care hospital. Implementation of VAP bundle. To decrease the incidence rate of VAP & Mortality associated with it. This prospective study was conducted in medical ICU of tertiary hospital. Prospective, observational, study was conducted in ICU for duration 1 year and 1 month. All the patients who required intubation and mechanical ventilation for> 48 hrs were eligible. VAP diagnosis was based on clinical radiographic and quantitative microbiologic of criteria. Seven major guidelines by CDC followed for daily observation of mechanically ventilated patients. Various strategies implemented too reduce VAP rates.The incidence rate of VAP in tertiary care hospital was 80% initially but after implementation it got reduce to 61.2% Overall compliance rate of VAP bundle (CDC) was found 88.5% after implementation of several preventive strategies. The result shows that motality rate can be reduce from 100% to 77.8% .We found that VAP rate can be reduced by implementing various preventive strategies. Though, it is difficult to implement all strategies in a specific hospital set up, but efforts can lead to save life of patients receiving mechanical ventilation. Implementation can reduce the infection by 12.2%.

Keywords:- VAP, Staphylococcus, Ebugs, Acinetobacter, mechanical ventilation, mortality

Introduction

The importance of Ventilator associated pneumonia (VAP) is a type of pneumonia which develops after 48hrs or longer mechanical ventilation by means of endotracheal tube. VAP is the most common noscomial infection at present. It is mostly experienced by critically illed patients, like trauma patient, burn cases and surgical unit patient. The causes of VAP are many and its vary .Now a days, VAP pathogen is becoming antimicrobial resistant, which increase. The VAP is clearly related with mortility rate, it includes prolonged duration of mechanical ventilation, which markedly increase health care rate.

Epidemology:-The chances of increase in VAP increase with the duration of mechanical ventilation VAP is noticed in 27% of patients who received mechanical ventilation. Each year 86% of nosocomial infection is caused due to mechanical ventilation. The incidence of vap has been estimated 10.20% and the estimation of mortality rate is 15-50% respectively. Pseudomonos and Acinetobacter pneumonia is associated with increase mortally rate as compared to other associated organism generally, the rates of vap in medical ICU. It depends on the population of patients, which type of surgerical disorder, the proportion of patient that needed mechanical ventilation and the duration of ventilation.

Classification of VAP on the basis of the duration of mechanical ventilation:- (i) Early onset:-Within 96 hours (4 days) of patients admission to the ICU or the patients intubation for mechanical ventilation on,

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developement of pneumonia is early onset. (ii) Late onset:- Pneumonia develops after the admission of patient more the 96hours (4days) in the ICU or intubation for mechanical ventilation. (iii) Very early onset:- Penumonia develops within 48 hours after intubation.

Clinical presentation of VAP:-It is defined by four criteria:- (i) The Radio graphic appearance of progressive pulmonary infiltrates (ii) Fever (iii) Leukocytosis (iv) Purulent tracheobronchial secretion.

Risk Factors:-Risk factors for vap are numerous and are divided into (i) modifiable factors (ii) Non-modifiable factors

Table-1. Risk factors for ventilator –associated pneumonia

Modifiable factors	Non –modifiable factors	
Supine position	Head injury with intracranial pressure monitoring	male gender
Gastric distension	subjects older then 60	coma
Contamination of ventilator tubing	Acute respiratory distress syndrome in adults	Tracheotomy
Frequent transfers of the patient	Multi organ failure	Reintubation
Low tracheal cuff pressure	chronic obstructive pulmonary	Neurosugery

However, the most important risk factor for VAP is tracheal I ntubation, associated with a 3 to 21 fold risk. It increases the risk by:- (i) causing sinusitis and trauma to nasopharynx (nasotracheal tube) (ii) Impairing swallowing of secretions (iii) Acting as a reservoir (iv) Increasing bacterial adherence and colonization of airways (v) Requiring the presence of foreign body that traumatizes the orophryngeal epithelium (vi) causing ischemia secondary to cuff pressure, (vii) impairingciliary clearance and cough, (viii) causing leakage of secretions around the cuff, and (ix) Requiring suctioning to remove secretions

- The duration of mechanical ventilation increases the risk of infection.
- Need for reintubation , urgent intubation and documented massive aspiration are also associated with incidence of VAP

The most common pathogens are the ESKAPE bugs:- (E.S.K.A.P. Ebugs refer to (i) Enterococcus faecium, (ii) Staphylococcus aureus, (iii) Klebsiella pneumonia, (iv) Acinetobacter baumanii (v) Pseudomonas aeruginosa and (vi) Enterobacter species.

Periods of risk of duration of mechanical ventilation (Fig.-1) shows the causal agent according to the length of stay or number of days in ICU.

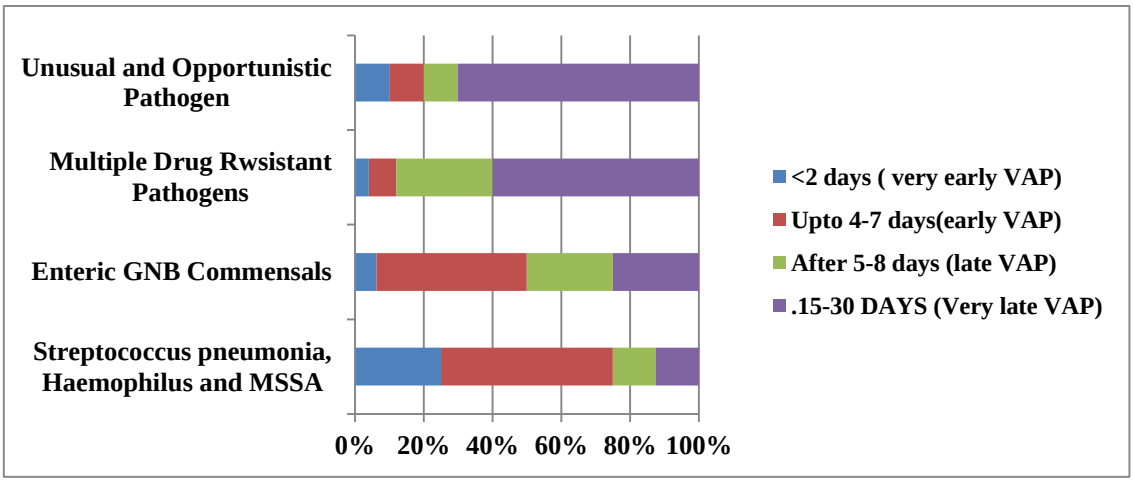

Fig.- 1 – Periods of risk by duration of mechanical ventilation.

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Table.-2 Pathogens expected in diseased condition

Streptococcus pneumoniae	**Smoking, COPS, absence of antibiotic therapy**
MSSA	Younger age, traumatic coma, Neurosurgery
MRSA	COPD, Steroid therapy, longer duration of MV, prior antibiotics
Pseudomonas aeruginosa	COPD, Steroid therapy, longer duration of MV, prior antibiotics
Acinetobacter species	ARDS, headtrauma, neurosurgery

Research design:-This study was conducted by using a retrospective design. This is an observational design which is based on data from the local ventilation associated pneumonia (VAP) results or data. This design provides information with the research objective as this is an efficient way to study the exposure and captures the incident events. A patient must endure a trauma or critical event such as accident, brain hamerhage, cardiac arrest or sufficient trauma for the intubation of the patient in the hospital. These patients are then cared by emergency department and further move to intesive care unit. If patient was endure on the ventillator more than 48 hrs than we test for the VAP. The patient enter the cohert, if he /she is diagnosed of vap is made. The inherent assumption made with this design is that patient is severly ill to requires the prolonged intubation and must remain alive in the ICU for prolong to endure the VAP. Each patient was followed by time to determine the length of stay.

Material and methods

This study was conducted in medical ICU of tertiary care hospital for 1 year. The study was approved by the hospital infection control members. We enrolled patients from 24 to 80 yrs, who required ventilator support for the preceding 48 hrs for each patient prevention ventilator bundle checklist by CDC was followed, which include 7 strategied to reduce VAP incidence and mortality rate. Also for each patient below parameters recorded:- (i) Age (ii) Gender (iii) Primary diagnosis on admission (iv) Reason of ventilation (v) Comorbid conditions(COPD, cardiac respiratory disease disease, alcholoism etc) (vi) Duration of mechanical ventilation (vii) Antibiotic received before sampling (viii) Radiographic (X- Ray report)

In each patient only invasive sample (ETT Lavage) were collected by junior residents or by staff nurses.

Sample collection:-Procedure:- (i) The ETT sample lavage sample were collected via a sputum suction trap (ii) A sterile suction catheter inserted (iii) Then normal saline was instilled into distal airways (iv) Aspirate was collected in sterile container (v) Samples were transported for bacteriological examination and cultures in microbiology laboratory.

Further processing was done in laboratory by us.

Sample processing:-Procedure (for gram negative organism):- (i) 10 microliter (loopful) of sample transferred on to dehydrated media plates on mc conkey agar plate. (ii) Make smear of sample for gram staining. (iii) Streaked with sterile inoculation loop. (iv) Plates then inoculated at 37^0C for 24 hrs. (v) After 24 hrs of inoculation see the growth on mc conkey agar plates, if significant growth found then passed colonies into peptone water [Perform oxidase test of colonies if colonies are NLF (non lactse fermenting)] (vi) Incubate the tubes of peptone water at 37^0C for 4 hrs. (vii) Apply biochemicals and incubate for 24 hrs at 37^0C. (viii) Next day add reagents of biochemicals like kovac's reagent (indole), biurret reagent (vogesproskaeur)

Procedure (for gram positive organism):- (i) 10 microliter (loopful) of sample transferred on to dehydrated media plates on blood agar. (ii) Make smear of sample for gram staining. (iii) Streaked with sterile inoculation loop. (iv) Plates then incubated at 37^0C for 24 hrs. (v) After 24 hrs of incubation see the

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growth on blood agar plates, if significant growth found then passed colonies into glucose broth (perform catalase and coagulase test when white opaque colonies present) (vi) Incubate the tubes of glucose broth at 37^0C for 4 hrs.(vii) Apply sensitivity on mullerhinton agar.

Observation:-

Table-3. Total number of patients showing VAP

Points (Total Number of Patient)	Count (48)
Sample received	48
Positive culture	34
Sterile	14
Positive case for VAP	19
Expired in total	32

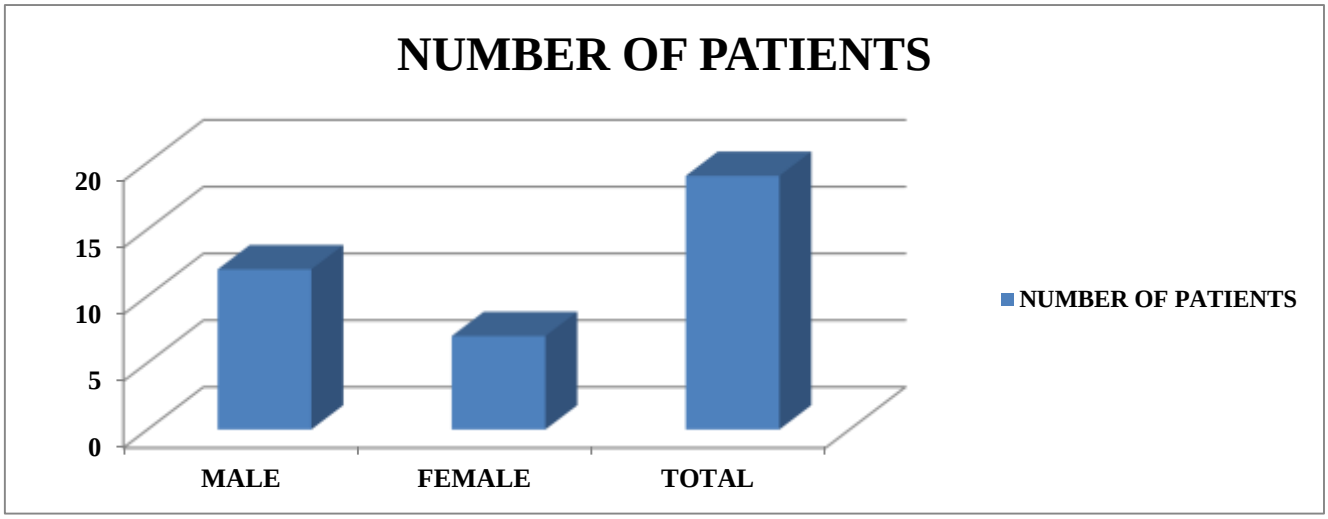

Fig.3– Total number of patients showing VAP.

Table 4: Number of patients in months of study showing VAP.

Months	Total	Male	Female
January 2013	4	3	1
February 2013	4	3	1
March 2013	2	1	1
April 2013	2	1	1
May 2013	1	0	1
June 2013	0	0	0
July 2013	2	1	1
August 2013	1	1	0
September 2013	1	1	0
October 2013	0	0	0
November 2013	0	0	0
December 2013	0	0	0
January 2014	2	1	1
Total	**19**	**12**	**7**

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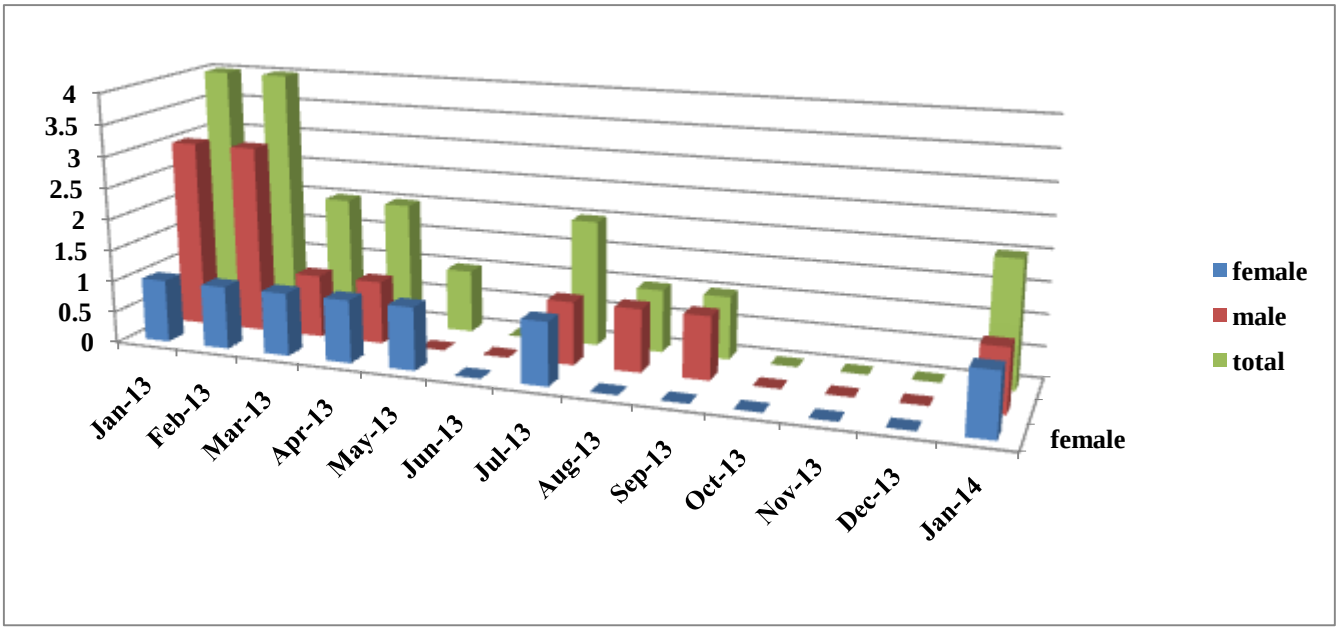

Fig.- 4.– Showing total no. of patients, male and female present in the time period of study.

Site of sample – Site from which the sample is taken from the patients for the study.

Table 5 – Site of sample in VAP showing patients

Site of sample	Number
ET Secretion	17
ET tip	2
BAL	1
Total	**20**

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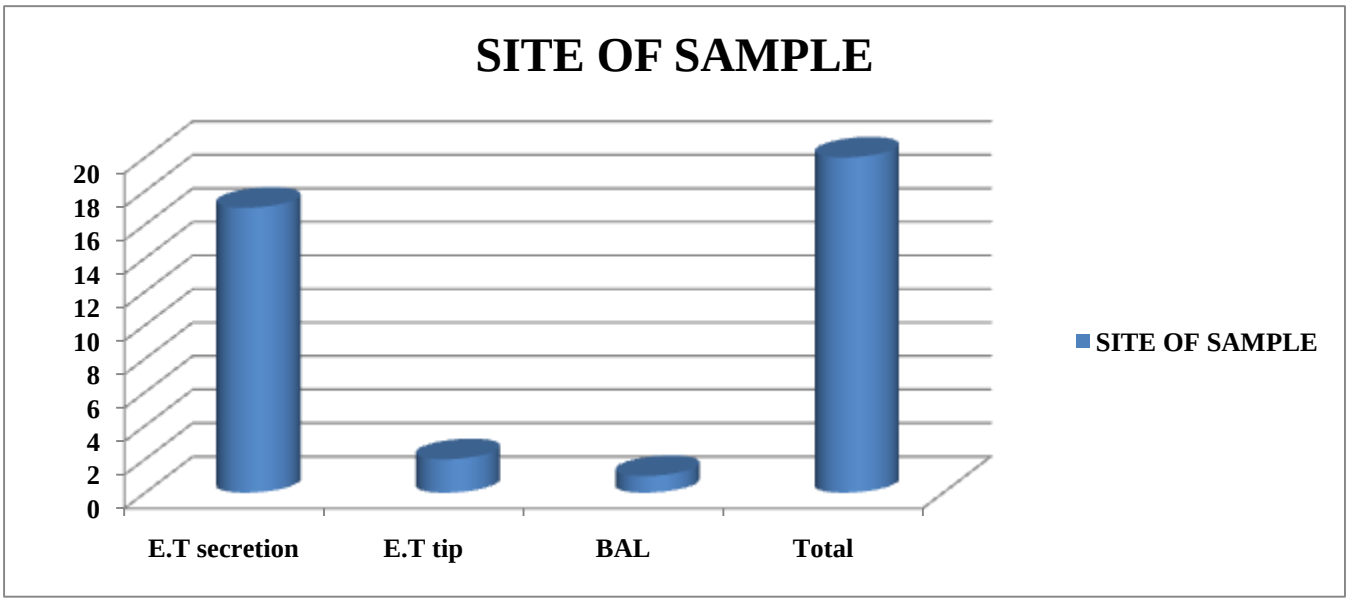

Fig. 5– Site of sample in VAP patients.

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Table 6 – Number of microorganisms causing VAP in patients and their total.

Organism	Count
Klebsiella	11
E. Coli	2
Acinetobacter	7
Pseudomonas	3
Total	**23**

Micro organisms causing VAP to the patients present in study are given below.

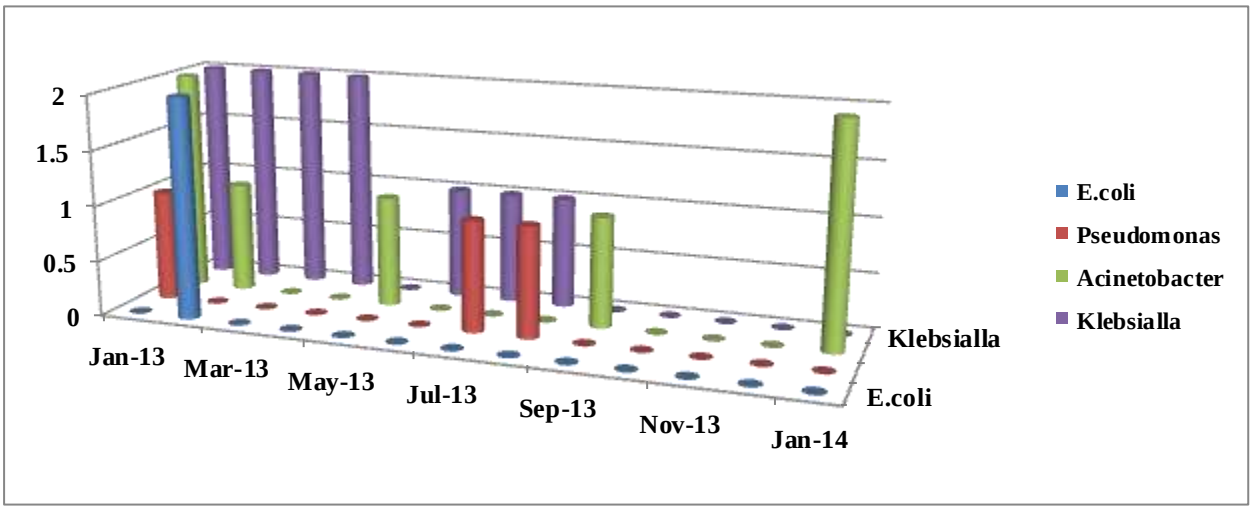

Fig. 6 – Number of bacteria causing VAP (E. coli, Pseudomonas, Acinetobacter, Klebsiella) in the study in every month.

Results

This chapter addresses the secondary objective of this project to describe the difference in ventilator – associated pneumonia (VAP) etiology and microbiology of diseases between prehospitalendotracheal intubation (ETI) patient and emergency department ETI patients two characteristics will be explored in this analysis are : time to VAP diagnosis ;and primary pathogen associated with VAP. This chapter begins with the descriptive and comparative statistics for time to VAP diagnosis followed by a detailed stratified and linear regression analysis. The second half of this chapter is devoted to the exploration of the primary microbial pathogen associated with VAP among the study sample.

Time to ventilator –associated pneumonia diagnosis:- Descriptive and comparative statistics :-In the previous description , it was determined that there was no difference in time to VAP diagnosis between emergency department ETI and prehospital ETI patients. Additionally, for patients intubated in the prehospital setting there was no difference in time to VAP diagnosis between those who lived and those who died. However, for patients intubated in the emergency department, the time to VAP diagnosis was significantly different between those who lived and those who died. To further described the characteristics of patients with early and late on-set VAP a basic comparative analysis was completed (table5.1). Among emergency department ETI patients who developed early VAP, a higher proportion were older, and a lower proportion were male than their prehospital ETI counterparts.

Time to event analysis:-Time to event analysis was to compare the difference in the timing of death for patient intubated in the emergency department to the timing of death for patient incubated in the pre hospital

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setting. The results of the previous comparative analysis indicate that the length of stay for patient who remained alive is significantly longer than the length of stay for patient who died regardless of ETI setting this means that patient who die do so earlier in the hospital stay. Furthermore the timing of death is different for patient intubated in the prehospital setting in comparison to those intubated in the emergency department the stratified analysis concluded that among survivors prehospitalintubated patient 28% more likely to stay 40days than those intubated in the emergency department however among deceased patient prehospitalintubated patient are 86% less likely to stay 40 days compared to those intubated in the emergency department this result can also for both the prehospitalnd emergency department ETI groups clearly declining regardless of pathogen type as time progresses. The calculated time in vap diagnosis for several types of patients. This table is including showing the numerical values of the mean time to vap diagnosis as calculated by this model, for seceral different scenarios. For example, the mean time to vap diagnosis for a female patients who is admitted without trauma is nearly the same for both the emergency department (6.65days) and prehospital setting (6.68) the biggest defference in mean time to diagnosis is among elderly (88years old) females who are intubated in the prehospital setting; those who experience trauma acquire vap approximately 2.75days sooner than their non-traumtic counterparts.

Table-7- mean time to ventilator – associated pneumonia diagnosis for various patient groups.

Patients group				
No trauma			**Trauma**	
Age (years)	**Female**	**Male**	**Female**	**Male**
18	6.68	6.39	4.70	4.53
28	6.97	6.71	4.93	4.74
38	7.32	7.04	5.19	4.97
48	7.64	7.38	5.42	5.21
58	8.45	7.75	5.69	5.47
68	8.87	8.53	6.27	6.02
78	9.31	9.35	8.99	6.32

Primary pathogen:-To further describe the vap etiology for the study sample, the primary microbial pathogen associated with vap diagnosis was described and copared, followed by a stratified analysis.

Descriptive and comparative statistics:-The distribution and frequency of pathogen type is important to understanding his burden of disease. Figure 5.2depicts the number and pathogen type of vap cases per year by intubation location for the four most frequent pathogens.

Table- 8. – Means and proportion of VAP pathogen of patients incubated.

	Klebsiella	E. Coli	Pseudomonas	Acinetobacter
Age Mean ± Sd	11	2	3	7
Gender				
Female	4	1	1	3
Male	7	1	2	4
Admission by primary diagnosis				
Medical	4	1	1	2
Surgical	6	1	2	5
Pedritian	1	0	0	0

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The relative proportion of each pathogen type by year is demonstrated stayphylococcusaureus represented the largest burden of disease as it has the highest propotion for both emergency department ETi and prehospital ETI group the average proportion of diseases caused by staphylococcus aureus over the five year time frame is 35%for the emergency department ETI patient which is slightly lower for the proportion of diseases caused by stayphylococcusaureus for the PHETI patient the second most frequent pathogen is haemophilusinfluenzae over the five year study period the average proportion of diseases caused by haemophilusinfluenzae is slightly higher for the emergency department ETI than the prehospital ETI. Patient although the relative proportion of gram negative bacteria is higher than that of haemophilusinfluenzae it contains a mixture of many pathogen which cannot be separately analyzed the fourth most common pathogen is the group streptococcal species. Previous analysis indicated that there was no significant difference in pathogen isolated for the emergency department ETI patient compared to the prehospital ETI patient a lower proportion of prehospital patient died when a gram negative bacteria was isolated compared to emergency patient (Table 4.5 ED alive =26% vs deceased=22% p=0.65 table PH alive =36% vs deceased =6% p=0.02). The previous stratified analysis that odds of mortality for intubation location indentified a significant difference between the gram negative bacteria strata.

Conclusion

VAP in ICU is the biggest drain on health and economic resources. VAP in the ICU can not be totally eradicated, however by meticulous planning and execution of practices, they incidence and severity can be drastically reduced. In the study of our set up, males predominated (62%). Although the incidence of VAP was also high in males, it was statistically not significant. The incidence of VAP in our setting was 37%. In the era of advanced diagnosis and early management of possible complications, the incidence tends to be lower. In recent studies, the reported incidence is very low, ranging from 15 to 30%. The high incidence in our study may be due to a lower number of cases (i.e., 100) and lack of adequate nursing staff (which should ideally be 1:1 as compared to 4:1 in our institute) which may have adversely affected the quality of care given to the patients. The most common organism associated with VAP is Pseudomonas (43.24%), followed by Klebsiella (18.91%). Also, the overall mortality rate was high in the Pseudomonas group (62.5%). In other studies, isolation of Pseudomonas ranges from 15 to 25%. Susceptibility testing could not be studied in all patients due to a lack of clinical microbiologic support as it is not done routinely and sending samples outside is not allowed by the hospital authority except in special cases. Hand washing is widely recognized as an important but underused measure to prevent nosocomial infections. According to the 2004 CDC (Center for Disease Control) guidelines, hands should be washed before and after patient contact and also in between patient contact. Chlorhexidine has been shown to be effective in the control of ventilator-circuit colonization and pneumonia caused by antibiotic-resistant bacteria. Oropharyngeal decontamination with Chlorhexidine solution has also been shown to reduce the occurrence of VAP in patients undergoing cardiac surgery. VAP, although often preventable, has a large impact on morbidity and mortality. Together with other health-care providers, nurses play a key role in preventing VAP. Many of the interventions are part of routine nursing care. Education for all healthcare providers should focus on the risk factors for VAP and on preventive measures. In order to further decrease the incidence of VAP, protocols and monitoring tools must be developed. VAP is not a new diagnosis, but education and research on the prevention of this life-threatening problem are ongoing.

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