

# Cost and Antibiotic Utilization of Pneumonia Patients in Intensive Care Unit

Ramya Kateel, Prabha Adhikari\*, Sheetal Rajm

Department of Medicine, Kasturba Medical College, Mangalore, India.

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## ABSTRACT

Objective of this study is to evaluate the cost and antibiotic utilization of pneumonia patients admitted in intensive care unit. It was a retrospective study. Details required for antibiotic utilization and cost analysis were acquired from hospital files. Out of 320 cases evaluated 110 cases were of pneumonia. 28.2% of people had pneumonia as their primary diagnosis and 71.8% had hospital acquired/aspiration pneumonia. The mean length of ICU stay was  $3.30 \pm 1.91$  days. 21.8% patients were put on ventilator. The mortality rate was 34.5%. Betalactam along with betalactamase inhibitor antibiotics were prescribed for 91% patients, Carbapenams for 20%, anti-staphylococcal antibiotic for 51% of patients and macrolides and miscellaneous antibiotics were prescribed in 25.5% and 36.4% patients respectively. Betalactam antibiotic along with betalactamase inhibitor and clindamycin combination was most commonly prescribed antibiotic. Average cost per patient who was not put on ventilator was Rs 27,123 where as ventilated patient per cost was Rs44, 812. This study showed that one third of ICU admissions was due to pneumonia. Highest numbers of pneumonia were hospital acquired/aspiration pneumonia. Cost of ventilator supported pneumonia was two times more than non-ventilated pneumonia. Ventilator support was the most expensive intervention adding to the cost of care followed by cost of antibiotics and investigations.

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## INTRODUCTION

Pneumonia is one of common cause of economic burden worldwide which involves significance utilization of health resources. It continues to be one of common cause of morbidity and mortality especially in geriatric group making it a major health problem worldwide (Richard et al, 2014; Garibaldi et al, 1985). It is one of the commonly diagnosed infections in intensive care unit with an incidence of 57.14% (Marrie, 1990; Pinner, 1996). Infectious Diseases Society of America/American Thoracic Society Consensus guidelines on the management of community-acquired pneumonia in adult suggest following antibiotic in intensive care unit, Betalactam antibiotic along with either azithromycin or respiratory fluoroquinolones, for Pseudomonas infection antipseudomonas betalactam along with either macrolides or fluoroquinolones and for methicillin resistant staphylococcus infection addition of vancomycin or linezolid is recommended (Lionel, 2007). Intensive care unit admission is the major cost determinant entity among pneumonia

patients. Based on above data this study was planned to evaluate the antibiotic and cost utilization of pneumonia patients in Intensive Care Unit of Kasturba Medical College Hospital Mangalore.

## MATERIALS AND METHODS

### Methodology

Patient admitted to intensive care unit of Kasturba medical college hospital who had pneumonia during their stay in ICU were evaluated retrospectively for demographic data, indications, duration of ICU stay, drug utilized for pneumonia and status of patient when shifted out from ICU. Patients who were admitted in ICU during December 2013 to October 2014 were analyzed retrospectively. The study was approved by institutional ethics committee of Kasturba medical college Mangalore. To study antibiotic utilization all antibiotics were divided into 5 groups as shown in table 1. For Cost utilization ICU bed and nursing cost, ventilator cost, supportive cost, antibiotic cost, investigational cost, steroids and bronchodilator cost, organ support cost and miscellaneous cost were calculated.

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\* Corresponding Author  
Email: [prabha.raghuveer@gmail.com](mailto:prabha.raghuveer@gmail.com)

Costs per patient were calculated separately for ventilated/non ventilated patient and community acquired/ aspiration and hospital acquired pneumonia. Cost of pneumococcal and influenza vaccine was also calculated. All the results were expressed in percentage.

**Table 1:** Antibiotics Classification.

Antibiotic	
Group I	Betalactum antibiotic along with betalactamase inhibitor
GROUP II	Carbapenems
GROUP III	Antistaphylococcal antibiotics
GROUP IV	Macrolides
GROUP V	Miscellaneous

## RESULTS AND DISCUSSION

Out of 320 consecutive cases of ICU evaluated 110 cases were of pneumonia. Indicating that nearly one third of admissions to ICU are due to Pneumonia their details are given in table 2.

92.45% of patients had other co morbidities. The important ones are given below in table 3.

**Table 2:** Patient details.

Age (median)	65(44,74)
Sex	Male 63.6%(70) Female 36.4(40)
Ventilator support	21.8%(15)
Mortality	33.9%(38)
Mean length of ICU stay	3.30± 1.91 days
Community acquired pneumonia	28.2%(31)
Hospital acquired/ aspiration pneumonia	71.8%(79)

**Table 3:** Co Morbidities.

Cardiovascular disease	45%
Diabetes mellitus	40%
COPD	25%
HIV/AIDS	25%
Carcinoma	10%
Chronic kidney injury	12%
Others	28%

Mortality was observed in 33.9 % ( 38) patients out of which 18.6% (21) had aspiration pneumonia/ hospital acquired pneumonia and 15.2% (17) had community acquired pneumonia. . Pneumonia was primary cause of death in 36.8 % ( 14) of patients, it was antecedent cause of death in 55.26 % ( 21) patients, in 7.89 % ( 3) of patients it contributed as other significant cause of death with other co morbidity being primary cause. Both groups had organ failure which was 19.4% in community acquired and 27.8% in aspiration/ hospital acquired pneumonia.

Antibiotics utilized in Intensive Care Unit for pneumonia patients are as given in table 4. Betalactum antibiotic along with a betalactamase inhibitor was used in 91% of patient. Combination of this with anti-staphylococcal antibiotic was common regimen. Another important combination was betalactum antibiotic with macrolides. Mean cost of pneumonia treatment per patient for an average stay of 3 days in ICU in this study is given in table 5. Cost utilization in each category was calculated separately for community acquired and hospital/aspiration pneumonia. Total cost of pneumonia treatment was categorized into 6 categories and percentage utilization was calculated in each category. It was

calculated separately for community acquired pneumonia, hospital/ aspiration pneumonia, ventilated pneumonia and for non-ventilated pneumonia patients. Details are given in graph 1 and graph 2.

**Table 4:** Antibiotic Utilization.

Group	Antibiotic	Utilization
GROUP I	Betalactum antibiotic + betalactamase inhibitor	91% (100)
GROUP II	Carbapenems	20%(22)
GROUP III	Anti Staphylococcal Antibiotic	51%(56)
GROUP IV	Macrolides	25.5%(36)
GROUP V	Miscellaneous	36.4% (40)

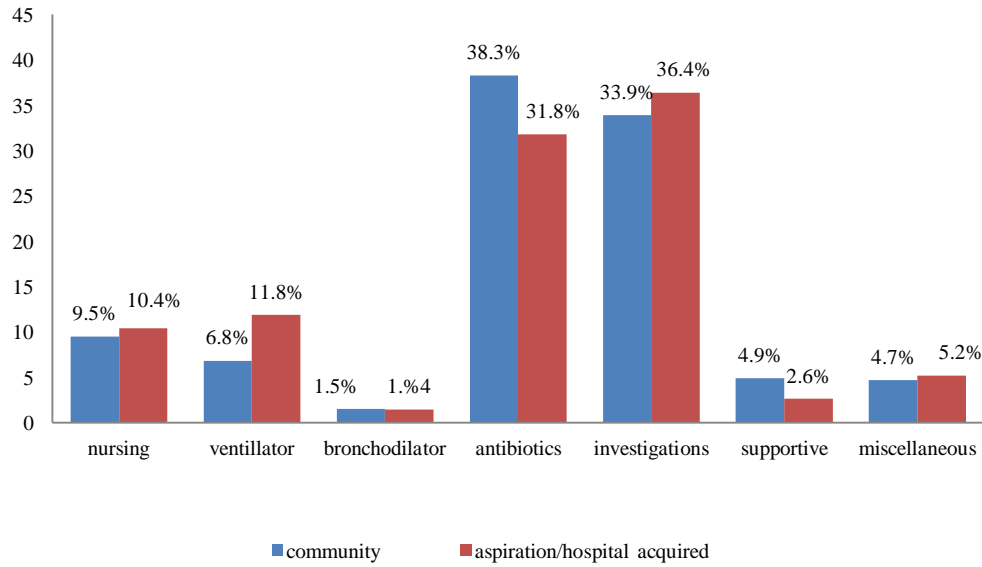
**Table 5:** Mean cost of pneumonia treatment.

Type of pneumonia	Per patient cost
Community acquired pneumonia	Rs. 35573/-
Aspiration/ hospital acquired pneumonia	Rs. 31129/-
Ventilated pneumonia	Rs.44812/-
Non ventilated pneumonia	Rs. 27123/-

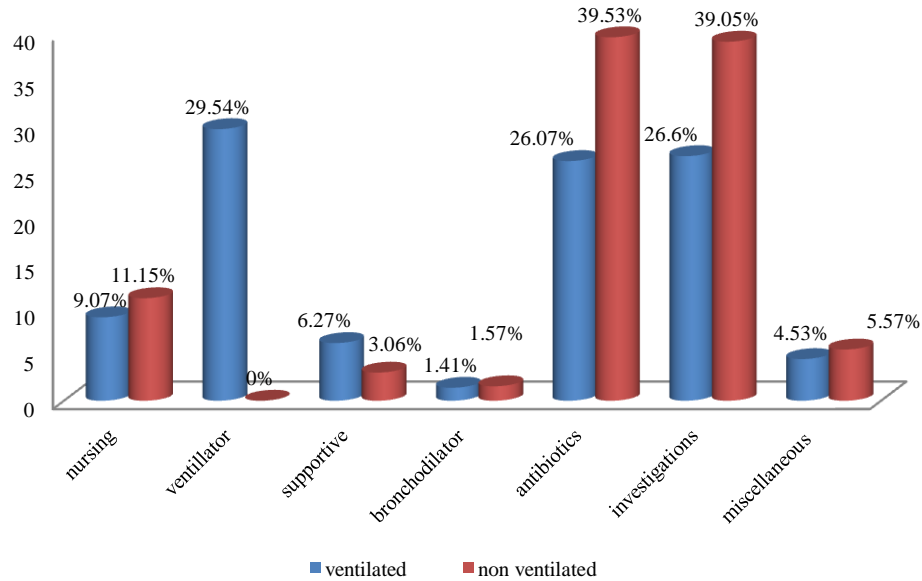
Pneumonia is a serious and widespread infection due to its high incidence, morbidity, mortality and increased health care costs. It is one of the commonly diagnosed infections in intensive care unit with an incidence of 57.14% ( Almirall, 1995). In this study out of 320 cases admitted to intensive care unit 110 patients had pneumonia. 28.2 % ( 31) patients had community acquired pneumonia whereas aspiration/hospital acquired pneumonia was seen in 71.8 % ( 79) patients. Total of 85% of patients presented with other co morbidities. 45% of patient had cardiovascular disease, 40% had diabetes mellitus, 25% had COPD and HIV/AIDS, 10% had carcinoma, 12% had chronic kidney injury, and 28% had other miscellaneous co morbidities. The mortality rate was 33.9% it was more in aspiration/ hospital acquired pneumonia (18.6%) compared to community acquired (15.2%). It was observed that in 36.8% of patients pneumonia was primary cause for death and in 55.26% patients it was an antecedent cause of death and in 7.89% of patients pneumonia was other significant cause of death. Both groups had Organ failure, 19.4% in community acquired and 27.8% in aspiration/ hospital acquired pneumonia. Mortality rate was high in our study since median age of patients was 65 and was presented with many other co morbidities.

Betalactum antibiotic along with a betalactamase inhibitor was used in 91% of patient. Combination of this with anti-staphylococcal antibiotic was common regimen, in few patients addition of macrolides were done. These were in accordance with Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults (Lionel, 2007). Carbapenams was costliest antibiotic which was used in 20% patients; dose escalation was seen in 15.2% of patients.

Pharmacoeconomic studies of pneumonia have shown that intensive care unit is the one of the major cost determinant in pneumonia patients (Raymond, 2003). Hence in this study we evaluated the cost utilization of pneumonia patients in Intensive Care Unit. Cost for ventilated and non-ventilated patients was calculated separately.



**Graph 1:** Cost utilization (%) in community and aspiration/ hospital acquired pneumonia.



**Graph 2:** Cost utilization (%) of ventilated/ non ventilated pneumonia patient.

Per patient cost of ventilated patient (Rs.44812/) was almost two times more than non-ventilated patient (Rs. 27123/). Ventilator support was the major cost drawing entity in ICU. In the absence of ventilator, antibiotics were highest cost utilization group but total cost of this was almost 40% less in patients without ventilator. So use of Costlier antibiotics in ICU may be justified as cost effective since Cost of investigations and antibiotics were higher in non-ventilated patients indicating the early use of higher antibiotics and investigations may reduce the need for ventilator provided it prevents patient undergoing ventilation. Cost for community and aspiration/hospital acquired pneumonia were similar. Per patient cost of community acquired pneumonia

was Rs. 35573/ and for aspiration/ hospital acquired pneumonia was Rs. 31129/. In both the groups highest cost was utilized for antibiotics i.e. 38.3% and 31.8% in Community acquired pneumonia and Aspiration pneumonia/Hospital Acquired Pneumonia respectively followed by investigational charges which were 33.9% and 36.4% of total cost. Community acquired pneumonia can be prevented by vaccination with pneumococcal and influenza vaccine, even though there is contradictory data regarding its efficacy in preventing Community acquired pneumonia (Nichol, 1996; Kwetkat, 2015) it is still recommended by Center for Disease Control and prevention (CDC, 2015) to have pneumococcal vaccine one dose and influenza vaccine once in a

year after 65 years of age. The cost of these vaccine may come around Rs. 4810/ which is much lesser than cost of Community Acquired Pneumonia i.e. Rs. 35573. Since the median age of our study population was 65, vaccinating them would be an appropriate measure (Dirmesropian, 2015).

Since the median age of our study population is 65 and most of them were present with comorbidities such as cancer, diabetes, HIV/AIDS increasing the risk of aspiration in the hospital. Simple measures like bed positioning, dietary changes and oral hygiene etc. may prevent aspiration (Ottosen, 2014; DiBardino, 2015). This may require appointment of a special trained nurse which is cost effective compared to total cost of pneumonia.

## CONCLUSION

This study showed that one third of ICU admissions were due to pneumonia out of which 28.2% was the primary diagnosis and in 71.8% patients Aspiration pneumonia secondary to co morbid conditions were seen. Mortality in both community acquired pneumonia and hospital acquired pneumonia or aspiration pneumonia was very high due to age and other co morbidity. Betalactum antibiotic along with a beta lactamase inhibitor was used in 91% of patient. Combination of this with anti-staphylococcal antibiotic was common regimen used. Cost of care for both community and aspiration pneumonia in the ICU were approximately same. Cost of ventilator supported pneumonia was two times more than non-ventilated pneumonia. Ventilator support was the most expensive intervention in ICU followed by cost of antibiotics and investigations.

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