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**ANTI-MICROBIAL UTILIZATION PATTERN IN THE INTENSIVE  
CARE UNIT OF TEACHING HOSPITAL IN VIJAYAPURA,  
KARNATAKA**

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**ABSTRACT**

**Introduction:** The intensive care unit is an integral part of a Teaching hospital, for appropriate care of critically ill patients. Most of the patients admitted to ICU will have pre-existing infections and are prone to develop new infections. number of antimicrobials prescribed for patients in the ICU is approximately 10 times more than those prescribed for patients in other wards of the hospital.

**Objectives:** The present study evaluated the local prevalence of infections, and the pattern of antimicrobial utilization in an ICU of a teaching hospital in Vijayapura, Karnataka.

**Methods:** a prospective observational study conducted for the period of two months [01-06 -2019 to 31-07-2019]. The data were obtained from ICU of a teaching hospital in Vijayapura, Karnataka. Clinical and demographical information, antimicrobial agents probed, route of administration, mean duration of antimicrobials prescribed, duration of stay and the expenses incurred by the patient, associated co-morbidities etc. were collected. The utilisation of the class of anti-microbial agents was performed as per WHO-ATC classification.

**Results:** The present study included a total of 40 ICU patients in that 32[80%] were male and 8[20%] were female. The majority of the patients belonged to 61-70 years of age. The mean duration of admission of patients in the ICU was 9 days. 34[85%] were medicine cases and 6[15%] were surgical cases. The most frequently prescribed AMA among the 40 cases was Metronidazole, followed by the FDC of

Piperacillin+Tazobactam, Ceftriaxone, FDC of Amoxicillin + Clavulanic acid, Ornidazole and Ofloxacin. 43.0% of patients received 2 AMAs. The most utilized common AMAs were Metronidazole, Piperacillin+Tazobactam, and Ceftriaxone whose utilization was 19.6, 17.3, and 12.4 DDD/100 bed days respectively.

**Conclusion:** Based on the local prevalence of organisms and their susceptibility pattern, every institution needs to have guidelines and policies for the use of antibiotics. These recommendations help the physician in making appropriate prescriptions.

**Keywords:** Antimicrobial agents, DDD/100 bed days, drug utilization, Intensive Care Unit

## INTRODUCTION

Infectious diseases constitute a major public health problem, particularly in developing nations like India. Out of the 5000 antimicrobial agents [AMAs] that have been identified so far, only about 100 are clinically employed to treat infections [1]. These antimicrobial agents are the most commonly prescribed for hospitalized patients, particularly in the surgical and intensive care unit [ICU] [2]. The intensive care unit is an integral part of a Teaching hospital, for appropriate care of critically ill patients. Most of the patients admitted to ICU will have pre-existing infections and are prone to develop new infections. To combat the existing infection as well as to prevent new infections anti-microbial agents are the most frequently prescribed drugs in ICU [3]. As a result, the number of antimicrobials prescribed for patients in the ICU is approximately 10 times more than those prescribed for patients in other wards of the hospital [4].

The major difficulty in the use of antimicrobial agents is an increase in the

emergence of bacterial resistance to antimicrobial agents. This necessitates the change and often the use of newer antimicrobials [5]. Even though newer antimicrobial is effective, the cost, availability and in some cases, safety are major concerns. Knowledge of the most common bacterial isolates from the ICUs and their antimicrobial susceptibility pattern can help to limit antimicrobial usage & thereby maintain their effectiveness [4, 5]. In order to frame guidelines and/or update them periodically, it is essential to study the pattern of antimicrobial utilization based on the local prevalence of organisms and their susceptibility pattern. Therefore, the present study evaluated the local prevalence of infections, the pattern of antimicrobial utilization and Susceptibility in an ICU of a teaching hospital in Vijayapura, Karnataka.

## MATERIALS AND METHODS

Our study was a prospective observational study conducted at the Department of Pharmacology in collaboration with the

Department of Medicine and Department of Surgery, Shri BM Patil Medical College, Hospital and Research Centre, BLDE [Deemed to be University] for the period of two months [01-06 2019 to 31-072019]. 40 patients admitted to ICU who were prescribed antimicrobial drugs were included in the study. Detailed written informed consent was obtained prior collection of data. Clinical and demographical information like sex, age, diagnosis, antimicrobial agents probed, route of administration of antimicrobial agents, mean duration of antimicrobials prescribed, duration of stay and the expenses incurred by

the patient, associated co-morbidities etc. were collected. The prescription frequency of the class of anti-microbial agents was performed as per WHO-ATC classification [6]. Institutional ethical clearance was obtained before starting the study. STROBE guidelines were considered the for preparation of the manuscript.

The most commonly used antimicrobials were classified using the ATC Classification system, and drug utilization was measured as DDD/100 bed-days [6]. The DDD per 100 bed-days was calculated by the formula:

$$\text{DDD/100 bed-days} = \frac{\text{Number of units administered in a given period} \times 10}{\text{DDD} \times \text{number of days} \times \text{number of beds} \times \text{occupancy index}}$$

$$\text{where Occupancy index} = \frac{\text{Total inpatient service days for a period} \times 100}{\text{Total inpatient bed count} \times \text{number of days in the period}}$$

**Statistical analysis:** The collected data was entered in Microsoft Excel and descriptive statistics was used for analysis. Quantitative data was expressed in the form of pie charts and qualitative data was expressed as percentages and proportions. Statistical software, SPSS version 23.0 was used for data analysis.

## RESULTS

The present study included a total of 40 ICU patients. Out of 40 patients, 32[80%] were male and 8[20%] were female. The majority of the patients were males in our study cohort. Age-wise distribution of cases showed, most of the cases [8;20%] belonged to 61-70 years of age, followed by 7[17.5%] patients belonged to 31-40 years. 6 [15%] patients belonged to 20-30 years, 41-50 years, and 81-90 years in each group. 5 [12.5%]

patients belonged to 71-80 years and only 2 [5%] patients belonged to 51-60 years (**Table 1**). The mean duration of admission of patients in ICU was 9 days.

Among the studied 40 cases, 34[85%] were medicine cases which include cardiovascular, central nervous, respiratory, renal, endocrine and gastrointestinal system illnesses. 6 [15%] were surgical cases (**Figure 1**). depicts the categorization of infectious diseases for which AMA therapy was given according to the systems involved.

In our study, 14 out of 40 patients had Diabetes Mellitus-2 and 9 patients had hypertension as a co-morbid condition. 7 and 4 patients had Ischaemic heart disease and chronic kidney disease respectively. 2 patients were suffering from Pulmonary Artery Hypertension whereas only 1 patient had cardiomyopathy. COPD was present in 4 patients. Benign Prostatic Hyperplasia, Cerebro Vascular Accident, and acute Coronary Syndrome were recorded in 3 patients each (**Figure 2**).

In our study, the most frequently prescribed AMA among the 40 cases was Metronidazole [15 patients], followed by the FDC of Piperacillin + Tazobactam [14 patients], Ceftriaxone [11 patients], Meropenem [8 patients], FDC of Amoxicillin + Clavulanic acid, Ornidazole and Ofloxacin were given to

4 patients each. Cefixime and Levofloxacin were prescribed to 3 patients each. Azithromycin, FDC of Clindamycin + Clotrimazole, Colistin, Vancomycin and Fluconazole were prescribed to 2 patients each. Some AMAs such as Amikacin, Doxycycline, Linezolid, Aztreonam, Streptomycin, Rifampicin, Moxifloxacin, Cefuroxime Axetil, Clindamycin and Gentamicin were prescribed to 1 patient each (**Figure 3**).

The present study also summarizes the number of anti-microbial agents for patients and the percentage of patients receiving AMAs. The majority of the patients i.e., 17[43.0%] received 2 AMAs followed by 6 [17.0%] patients who received 3 AMAs. 5 [12.0%] patients received 1 and 4 AMAs each. 3 [7.0%] patients were administered a total of 5 AMAs and only 1[3.0%] of the patient received 7 and 8 AMAs each. There was just 1[3.0%] patient who did not receive any AMAs (**Figure 4**).

During our study, we prescribed a total of 448 Drugs belonging to different classes which include alimentary tract and metabolism, cardiovascular system, blood and blood-forming agents etc. Among them 86 [19%] were WHO-ATC classified antimicrobial agents. The same details were shown in **Figure 5**.

In our study cohort the mean duration of AMA therapy of Ceftriaxone was 6 days, FDC of Piperacillin and Tazobactam was 7 days and Ofloxacin, Ornidazole and Meropenem for 6 days each on average. FDC of Amoxicillin and Clavulanic acid was given for 3 days whereas Metronidazole was administered for just 5 days on average per patient (**Figure 6**).

The most highly utilized common AMAs were Metronidazole, Piperacillin+ Tazobactam, Ceftriaxone, Meropenem, Ofloxacin, Amoxicillin+ Clavulanic acid, Ornidazole whose utilization were 19.6, 17.3, 12.4, 5.7, 5.2, 5.15 and 3.4 DDD/100 bed days, respectively (**Table 2**).

In our study, the route of administration of FDC of Piperacillin and Tazobactam, Amoxicillin and Clavulanic acid was oral while all the other AMAs used to treat patients

were administered parenterally. The mean cost of Meropenem was Rs 10479.37 for the mean duration for which it was administered and that of Piperacillin+ Tazobactam [2.5gm] was Rs 5904, Piperacillin + Tazobactam[4.5gm] was Rs 3296.4. The mean cost of Ceftriaxone [2gm] was Rs 2376, Ofloxacin [200mg] was Rs 1334.4, Amoxicillin+ Clavulanic acid [1.2gm] was Rs 822, Ceftriaxone [500mg] was Rs 663.32, Ornidazole was Rs 660. Ceftriaxone [1gm] cost Rs 621 on average and Ofloxacin [100mg] Rs 390, Amoxicillin+ Clavulanic acid[625mg] was Rs 380. The average cost of Ceftriaxone [1.5gm] was Rs 302, Amoxicillin+ Clavulanic acid[500mg] was Rs 230 and that of Metronidazole was Rs 169.86 (**Table 3**).

**Table 1: Age-wise distribution of recruited patients**

Age Group	No. of patients [N=40]	Percent of patients [%]
21-30	6	15
31-40	7	17.5
41-50	6	15
51-60	2	5
61-70	8	20
71-80	5	12.5
81-90	6	15

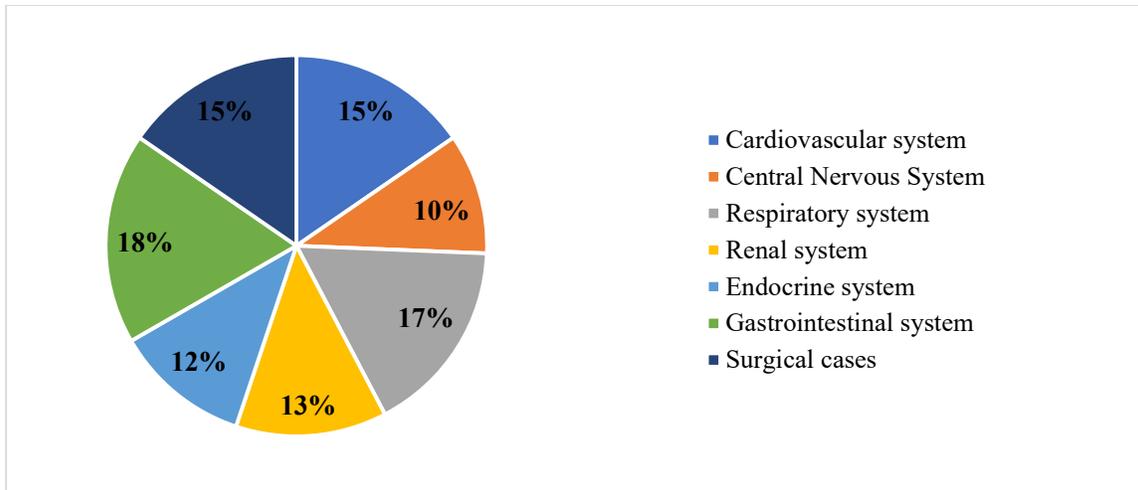


Figure 1: Distribution of pattern of illness based upon diagnosis

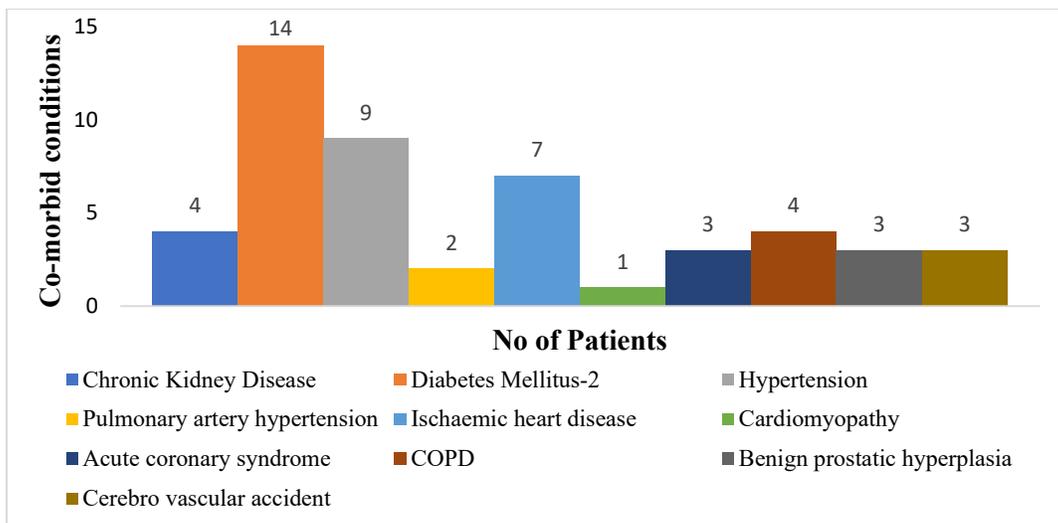


Figure 2: Associated co-morbidities in the present study cohort

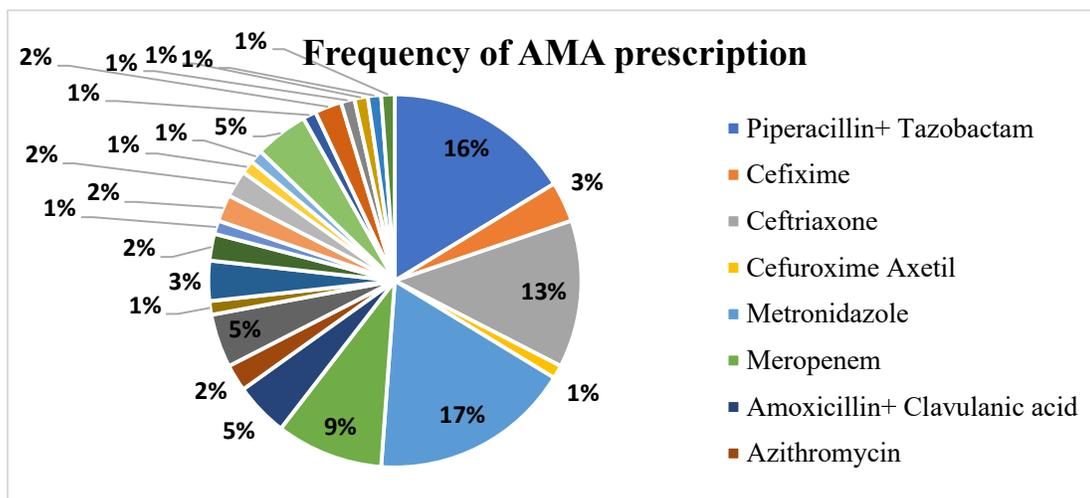


Figure 3: Frequency of individual anti-microbial prescription

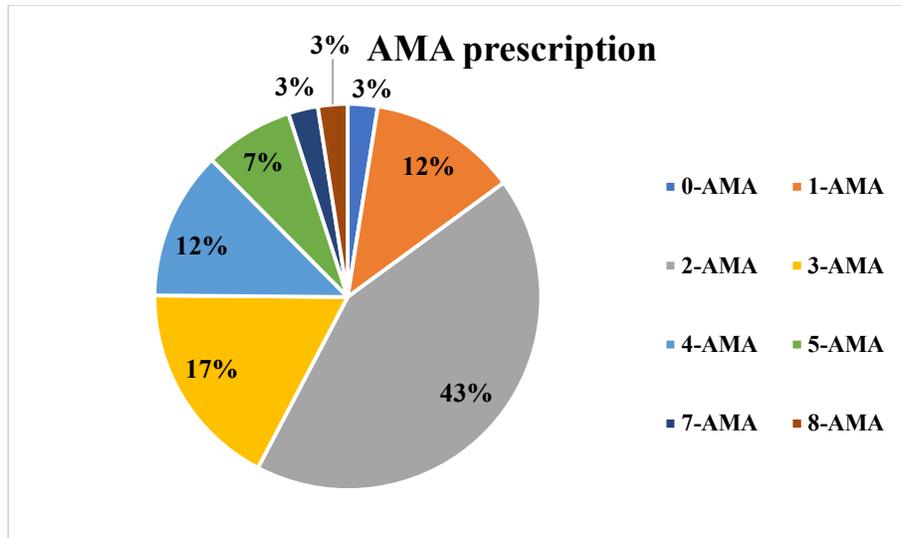


Figure 4: Frequency of anti-microbial agents prescribed for patients

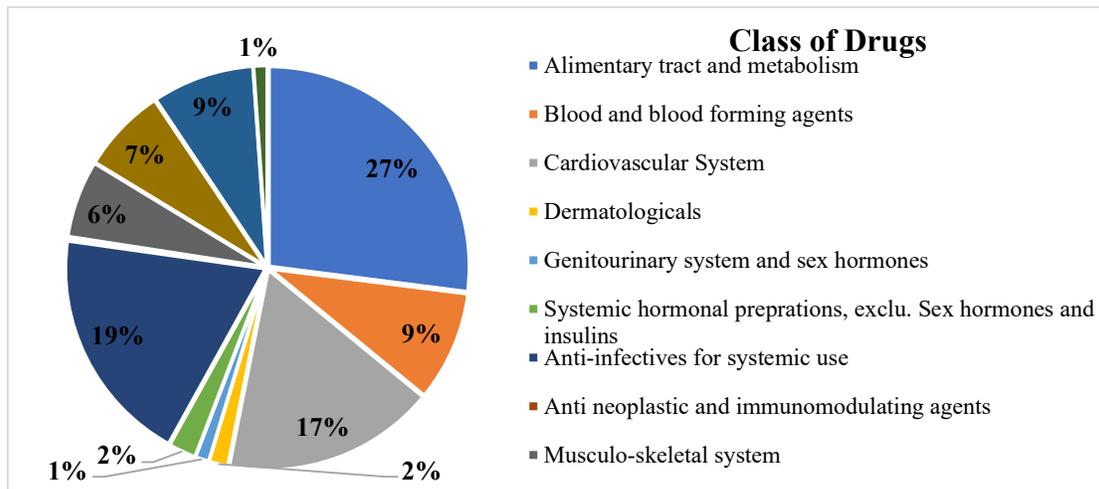


Figure 5: Frequency of prescribed class of anti-microbial agents

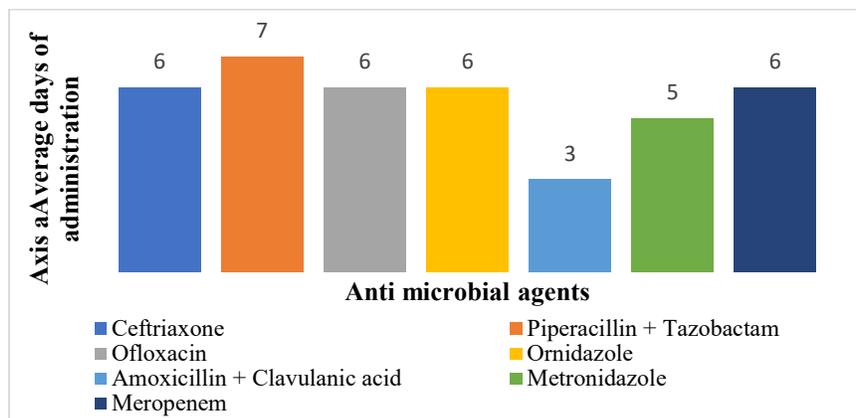


Figure 6: Average duration of therapy of most frequently prescribed AMAs

Table 2: Utilization of most prescribed antimicrobial agents used in the intensive care ICU as presented as DDD/100 patient days

Antibiotics	ATC	DDD/100 bed-days
Metronidazole	J01XD01	19.6
Piperacillin+ Tazobactam	J01CR05	17.3
Ceftriaxone	J01DD04	12.4
Meropenem	J01DH02	5.7
Ofloxacin	S01AE01	5.2
Amoxicillin+ Clavulanic acid	J01CR02	5.15
Ornidazole	P01AB03	3.4

Table 3: The mean cost of AMA therapy of prescribed AMA

Name of AMA	Average cost
Meropenem	Rs 10479.37
Piperacillin+Tazobactam[2.5gm]	Rs 5904
Piperacillin+Tazobactam [4.5gm]	Rs 3296.4
Ceftriaxone[2gm]	Rs 2376
Ofloxacin [200mg]	Rs 1334.4
Amoxicillin+Clavulanic acid [1.2gm]	Rs 822
Ceftriaxone[500mg]	Rs 663.32
Ornidazole	Rs 660
Ceftriaxone[1gm]	Rs 621
Ofloxacin [100mg]	Rs 390
Amoxicillin+Clavulanic acid[625mg]	Rs 380
Ceftriaxone[1.5gm]	Rs 302
Amoxicillin+Clavulanic acid [500mg]	Rs 230
Metronidazole	Rs 169.86

## DISCUSSION

Drug utilization research is the study in which drugs are marketed, distributed, prescribed, and used in society with a focus on the consequent medical, social, and economic effects according to the WHO [7]. Drug utilization studies help in identifying clinical drug use in communities and its effects on the healthcare system. The ICUs are one of the most significant sources of nosocomial infections. Due to the high prevalence of infections and the likelihood of getting infections antimicrobial drugs are used extensively in ICUs, around 10 times more than they are used in general wards, [8].

Antibiotic resistance has dramatically increased during the past few years, resulting in challenging-to-treat infections. A present prospective observational study was undertaken to study and analyze the antimicrobial usage pattern in the ICU of Shri B.M Patil Medical College, Hospital and Research Centre Vijayapura, Karnataka. The present study recorded more male patients as compared to females [80% vs 20%]. This is in accordance with several studies carried out across India [9-13].

In our study the average duration of hospital stays of patients who receive antimicrobials was approximately 9 days, this

is in accordance with the study conducted by Anusha Natrajan in a South Indian hospital revealed that the average duration of hospital stays of patients who receive antimicrobials was approximately 11 days [14]. The majority of the studies carried out in North India, South India, Central India and Nepal showed the average duration of hospital stays of patients ranges from 5-7 days [11].

The commonest AMA prescribed in our study was Metronidazole followed by the FDC of Piperacillin + Tazobactam, Ceftriaxone, and Meropenem. This is not in accordance with the study carried out by Vandana A B *et al.*, 2012, Suhena *et al.*, 2016 and N Anand *et al.*, 2016 in which the commonest AMA prescribed was Cefotaxime [8, 9, 12]. Metronidazole was the 3<sup>rd</sup> most common AMA in the study by Anand *et al.*, 2016. The top 3 commonly prescribed AMAs of our study have been found to be common in different studies across the country.

The increasing cost of antibiotics causes a heavy economic burden on patients for treatment in India. Considering this, we estimated the average cost of AMAs per patient. The AMA which was administered for a maximum of days on average was Piperacillin+ Tazobactam for 7 days which would probably account for its new high mean cost of AMA therapy [Rs 5904 for

Piperacillin+Tazobactam ‘2.5g and Rs3296.4 for Piperacillin+Tazobactam ‘2.5g]. The highest mean cost of AMA therapy was Meropenem accounting for Rs 10479.37 which can also be attributed to more average days of administration [6 days]. Our study results are similar to a south Indian study by Anand N *et al.*, 2016 they showed Piperacillin/tazobactam constitutes the major part of the total cost of all Anti-Microbial Agents used and the drug Meropenem was the most expensive AMA utilized in the study [12]. Comparisons of Anti-Microbial Agents utilization cost across the world could be misleading/inaccurate because of the vast difference in the pricing of the drugs.

The patients suffering from Type 2 Diabetes Mellitus and Hypertension were the most common comorbid conditions in our study. which is in close correlation with the study undertaken in Himachal Pradesh teaching hospital [15]. Since the patients admitted to ICU are mostly immunocompromised and require immediate attention to the ailment, most of the AMAs were administered parenterally. Only Piperacillin +Tazobactam[4.5g] and Amoxicillin +Clavulnic Acid[625mg] were used as oral preparations. The majority of the studies administered the drugs parenterally compare orally [12, 16]. Because of improved

drug monitoring, a quicker onset of action, and greater absorption with the former, the parenteral mode of administration is favored over oral administration.

The most highly utilized common AMAs in the present study were Metronidazole, Piperacillin+ Tazobactam, and Ceftriaxone. Our findings are similar to several studies performed across the country they showed that utilization of metronidazole and piperacillin + tazobactam was slightly more compared to other AMAs [10]. Reviewing several different studies from India showed, the five most utilized antibiotics were 3rd generation cephalosporin followed by meropenem, metronidazole, levofloxacin, and ceftriaxone [12, 17].

Our study had certain limitations, however. Since this was a retrospective study, the availability of records impacted the data accuracy. Since the sample size is also too small, it is impossible to extrapolate the exact results to other environments or the entire population. Hence the study can serve as a pilot study for future purposes which can be done on a larger scale and can include NICU as well. further research is required, to establish guidelines that reduce the current use of multiple medications to prevent the development of drug resistance and accomplish improved outcomes.

## CONCLUSION

Studies on drug usage assist in identifying community-based clinical drug use and its impact on the healthcare system. Therefore, based on the local prevalence of organisms and their susceptibility pattern, every institution needs to have guidelines and policies for the use of antibiotics. Periodic updates should be made to these guidelines as well. These recommendations help the physician in making appropriate prescriptions.

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