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A STUDY ON PRESCRIBING PATTERN AND PHARMACOECONOMICS OF ANTIBIOTIC USE IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Introduction: There are various antibiotics available in the market with different brand names with respect to their generics. Due to the complexity of treatment in individual patients, this study has been used to assess the most commonly prescribed antibiotics in various age groups and their various dosage forms and also to evaluate the cost of anti-microbial regimen. **Objectives:** The Primary objective is to evaluate drug use pattern and pharmacoeconomics of antibiotics in a tertiary hospital. The Secondary objectives are to assess the rationality of prescribing pattern, to compare the percentage of the antibiotics prescribed in generic and brand and to carry out the cost identification analysis of antibiotics used in the in-patients. **Methodology:** This observational study was carried out in the various in-patient departments of the Sapthagiri tertiary care Hospital. The study was carried out for 110 patients satisfying the inclusion and the exclusion criteria in a 6 months period. The source of the data in this study are Patients'medicationchart and data is collected by using a self-designed data collection form. **Results:** The class of antibiotics which was used maximum was found to be Cephalosporins and class of antibiotics which was used minimum was found to be carbapenem. For 110 patients, the total number of antibiotics were prescribed to be 213, out of which fixed dose combinations used were 14.08% and individual antibiotics used were 85.90%, 23% antibiotics were prescribed as generic and 77% antibiotics were prescribed as brand. Average number of Antibiotics per Prescription was 1.9, average cost of Antibiotics per prescription was found to be 2149.35, average cost of Antibiotics per prescription if all the antibiotics were to be prescribed in Generic is 616.15. **Conclusion:** Hence it is very important to monitor the prescribing pattern of antibiotics and also the cost per prescription associated with the antibiotic therapy which can prove to be a valuable information to prescribers for rationality.

KEYWORDS: Pharmacoeconomics, Antibiotics, Generic, Brand.

INTRODUCTION

Antibiotics or anti-bacterials are a type of antimicrobial agents used specifically against bacteria and are often used in medical treatment of bacterial infections and certain parasitic infections. There are various antibiotics available in the market with different brand names. Anti-biotics are usually grouped together based on their action. Each type of antibiotic only works against certain types of bacteria or parasites. This is why different antibiotics are used to treat different types of infection. The main types of antibiotics include: Penicillins, Cephalosporins, Tetracyclines, Aminoglycosides, Macrolides and Quinolones.

Antibiotics works on two mechanisms, this is often done by interfering with the structure of the cell wall of the bacterium or parasite. Those arecalled Bactericidalantibiotics. Examples of Bactericidalantibiotics**:** Penicillins, Cephalosporins, Fluoroquinolones(Ciprofloxacin), Glycopeptides (Vancomycin), Monobactams, Carbapenems. Some antibiotics works by inhibiting the growth of organisms, those are called Bacteriostatics**.** Examples of Bacteriostatics**:** Tetracyclines, Spectinomycin, Sulphonamides, Macrolides, Chloramphenicol. Appropriate use of antibiotics is necessary to target drug-resistant bacterial infections and prevent further bacterial resistance fromemerging. Antibiotic overprescribing is

most prominent in outpatient settings such as clinics and emergency departments. In Europe, approximately 80% to 90% of antibiotic prescriptions are written by general practitioners. Rates of outpatient prescribing are similar in the United States, and CDC estimates that at least 30% of outpatient antibiotic prescriptions are unnecessary. Most inappropriate use of antibiotics in outpatient facilities occurs when antibiotics are prescribed for viral respiratory infections, such as viral bronchitis, otitis, and sinusitis.

According to the Mayo Clinic, antibiotic overuse and overprescribing in outpatient care can be attributed to clinicians prescribing antibiotics before test results confirm a bacterial infection, patient pressure to receive an antibiotic prescription from their provider, patients taking antibiotics they have purchased online or in another country after self-diagnosing a bacterial illness, and patients taking antibiotics left over from a previous prescription. Risks of antibiotic overuse or overprescribing include not only increases in antibiotic resistance, but increases in disease severity, disease length, health complications and adverse effects, risk of death, healthcare costs, re-hospitalization, and need for medical treatment of health problems that previously may have resolved on their own. Pharmacoeconomics centers on the economic evaluation of pharmaceuticals, and canuse cost-minimizationanalysis, cost-benefit analysis, cost-effectiveness analysis or cost-utility analysis. Quality-adjusted life years have become the dominant outcome of interest in pharmacoeconomic evaluations, and many studies employ a cost-per-QALY analysis. Economic evaluations are carried out alongside randomized controlled trials and using methods of decision-analytic modeling.As more expensive drugs are being developed and licensed it has become imperative especially in context of developing countries where resources are scarce to apply the principles of Pharmacoeconomics for various drugs and treatment options so that maximum improvement in quality of life can be achieved in minimum cost.The sole purpose of the study is to evaluate drug use pattern and pharmacoeconomics of antibiotics in a tertiary care hospital and to assess the rationality of prescribing pattern by using the appropriate guidelines.Besides this other parameters includes comparison of the percentage of antibiotics prescribed in Brand and Generic and to assess whether the prescribed drugs are in accordance with the WHO list of essential medicines. The lasts section of the study isto carry out the cost minimization analysis of antibiotics used in the in-patients.

MATERIALS AND METHODS

The study was performed at Sapthagiri Tertiary Care Hospital for a period of 6 months. The study design was based on an observational method that included 110 patients. The inclusion criteria consisted of prescriptions from all geriatric, pediatric and adult patients of either gender, however the prescriptions from emergency department and pregnant women with insufficient data were excluded.Data will collected by using a self-designed data collection form, which consists of details like patient demographics, laboratory data, drug therapy and other relevant information. Direct Costs calculations parameters were as follows

1. Cost of antibiotics (brand)=[cost of antibiotic unit x (frequency x no. of days)]
2. Cost of antibiotics (generic)=[cost of antibiotic unit x (frequency x no. of days)]
3. Cost antibiotics per prescription=[cost of antibiotic unit prescribed in brand or generic x (frequency x no. of days)]
4. All costs are in Indian rupees
5. Cost of Brand referred from CIMS 2019
6. Cost of Generic referred from Jan Aushadi.

The patients who were satisfying the inclusion criteria were enrolled into the study with the help of patient consent form. The clinical pharmacist reviewed the patient case notes, medication chart, laboratory data and other prevalentdata. A structured self designed data collection form was used to record all the necessary data including patient demographic details, patient medication chart, disease conditions and reason for admissionand lab investigation. The pattern of drug dosing was recorded along with the cost of each antibiotic prescribed and compare the difference between Brand and Generic. By using certain guidelines, the prescriptions will be assessed for appropriateness of dosing. The entire data will be analyze using appropriate statistical methods (MS Excel).

RESULTS

1. Patient Distribution based on demographic data

1.1. Gender distribution: Out of 110 patients included in the study, 71 (64.54%) were male and 39 (35.45%) were female.[Table 1, Figure 1]

Table 1: Patient Distribution Based on Gender.

Gender	No of patients	Percentage
Male	71	64.54%
Female	39	35.45%
Total	110	100%

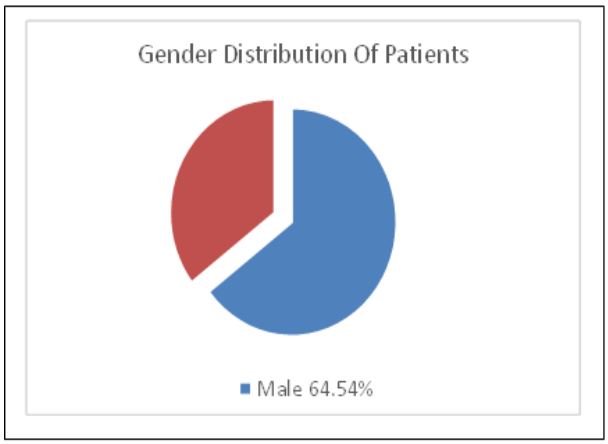

Fig 1: Patient Distribution Based on Gender.

1.2. Age distribution of Patients: [Table 2, Figure 2]

Table 2: Patient Distribution Based on Age.

Age Group	No of Patients	Percentage
Adult	71	64.54%
Geriatric	24	21.81%
Pediatric	15	13.63%
Total	110	100%

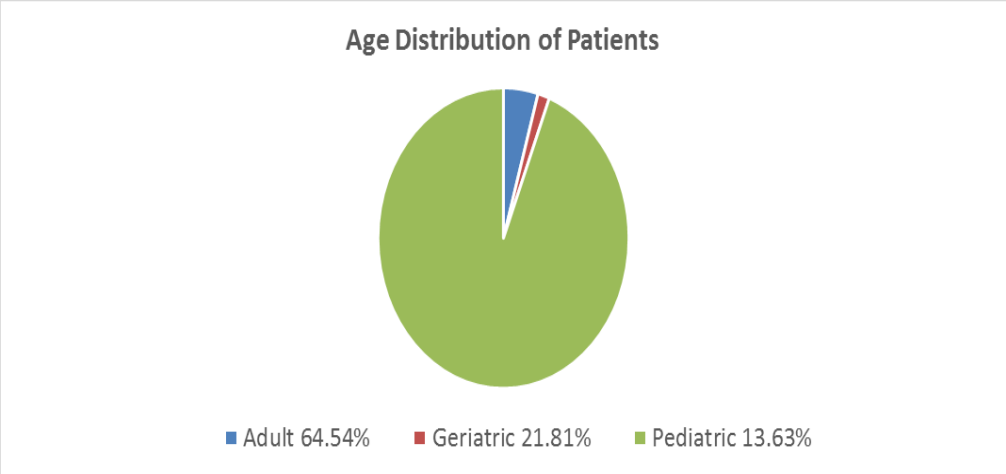

Fig 2: Patient Distribution Based on Age.

2. Patient distribution based on departments[Table 3, Figure 3]

Table 3: Patient Distribution Based on Departments.

Department	No of Patients	Percentage
Male General Ward	44	40%
Female General Ward	21	19.09%
Male Nephrology Ward	5	4.54%
Female Nephrology Ward	6	5.45%
Pediatric Ward	15	13.63%
Orthopedic Ward	2	1.81%
TB Ward	4	3.63%
ICU	13	11.81%
Total	110	100%

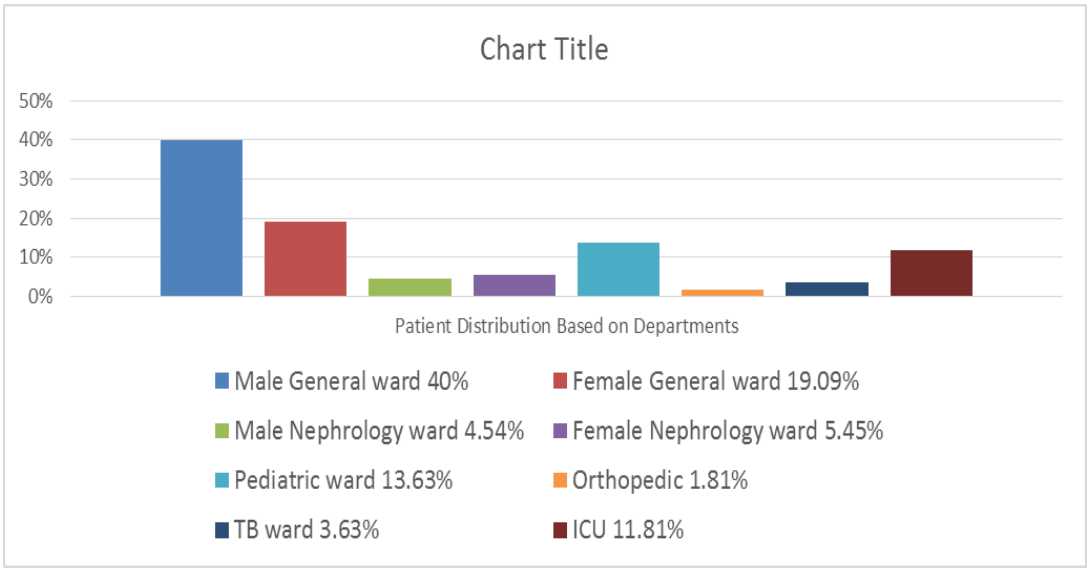

Fig 3: Patient Distribution Based on Departments.

3. Patient distribution based on length of hospital stay:[Table 4, Figure4]

Table 4: Patient Distribution Based on Length of Hospital Stay.

Length of Hospital Stay	No of Patients	Percentage
1-5 Days	81	73.63%
6-10 Days	28	25.45%
11 days or more	1	0.90%
Total	110	100%

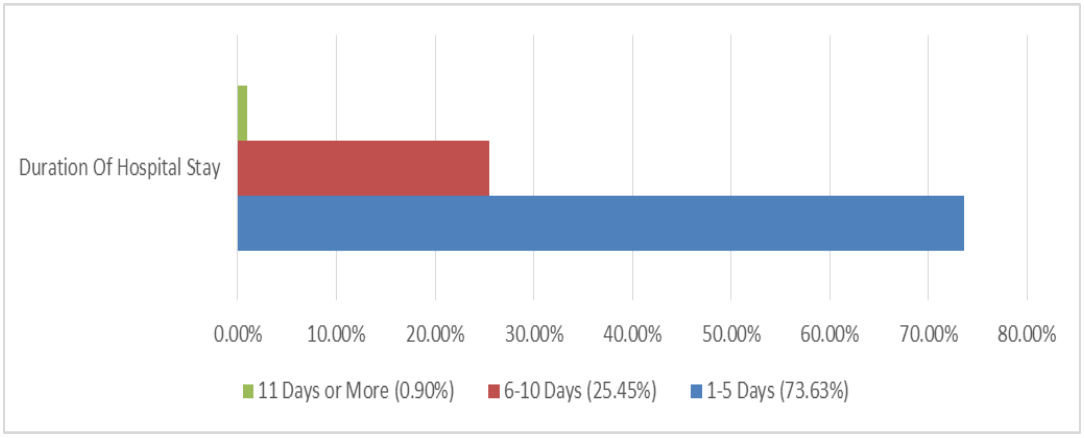

Fig 4: Patient Distribution Based on Length of Hospital Stay.

4. ANALYSIS OF PRESCRIBING PATTERN

4.1 Number of antibiotics used/case[Table 5, Figure 5]

Table 5: Number of Antibiotics Used/Case.

Number of Antibiotics	Number of Cases	Percentage
Single Antibiotic	34	30.90%
Two Antibiotics	52	47.27%
Three Antibiotics	21	19.09%
Four Antibiotics	3	2.72%
Total	110	100%

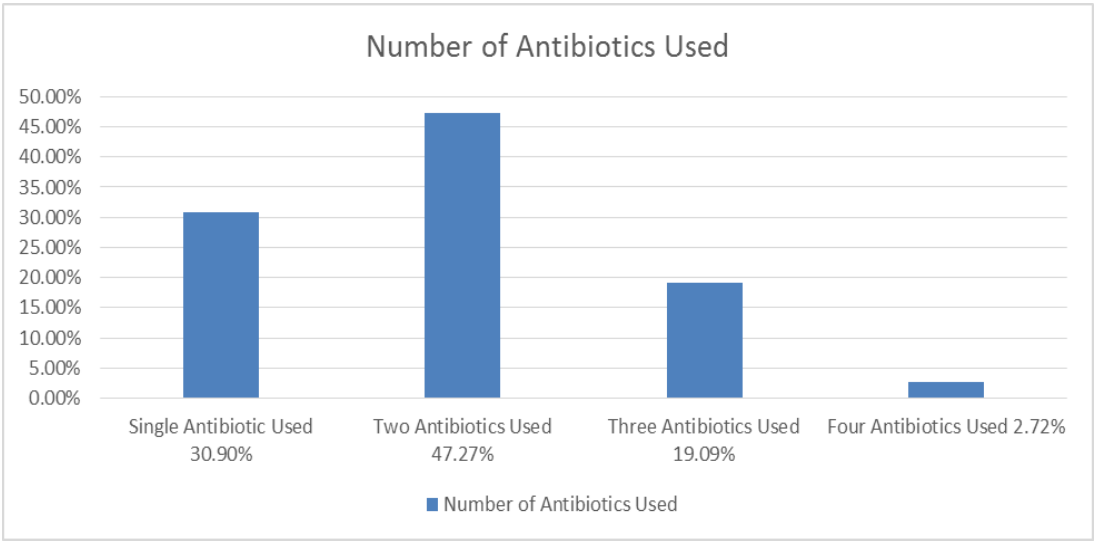

Fig 5: Number of Antibiotics Used/ Case.

4.2 Route of administration in prescribed antibiotics: [Table 6, Figure 6]

Table 6: Route of Administration in Prescribed Antibioti.

Route of Administration	Number of Antibiotics	Percentage
IV	170	79.81%
PO	43	20.18%
Total	110	100%

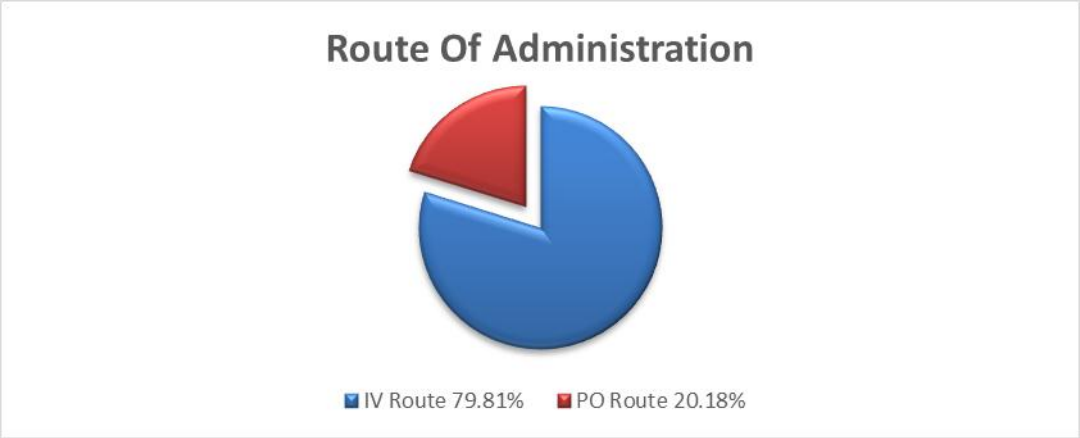

Fig 6: Route of Administration in Prescribed Antibiotics.

4.3Drug prescribed in brand/generic: [Table 7, Figure 7]

Table 7: Drug Prescribed in Brand/Generic Name.

Antibiotics Prescribed In	Number of Antibiotics	Percentage
Brand Name	164	77%
Generic Name	49	23%
Total	213	100%

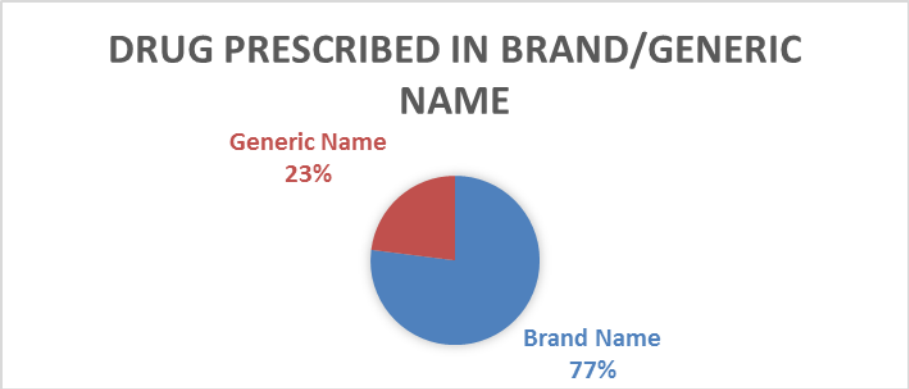

Fig 7: Drug Prescribed in Brand/Generic Name.

4.4 Use of combination drugs: [Fig 8]

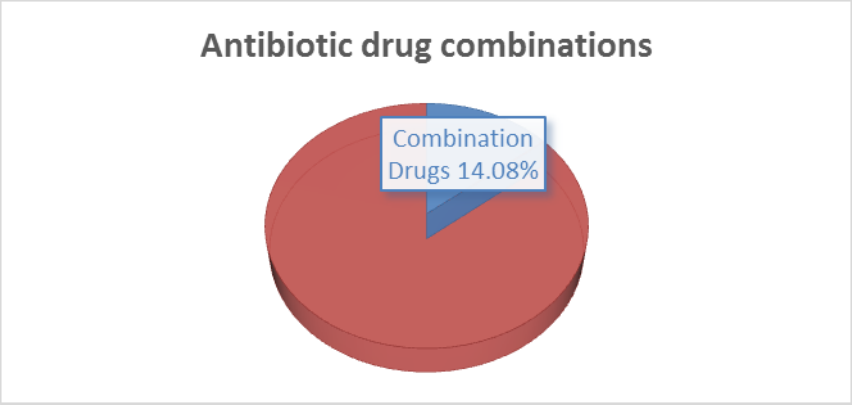

Fig 8: Use of Combination Drugs.

4.5 Most commonly prescribed antibiotics

1. Ceftriaxone 23%
2. Metronidazole 13.61%.
3. Amikacin 10.79%.
4. Meropenem 7.04%
5. Piperacillin+ Tazobactam

6. 57%6. Cefixime 5.63%
7. Amoxycillin+ Clavulanate 5.16%
8. Azithromycin 3.28%.
9. Ciprofloxacin 3.28%. [Fig 9]

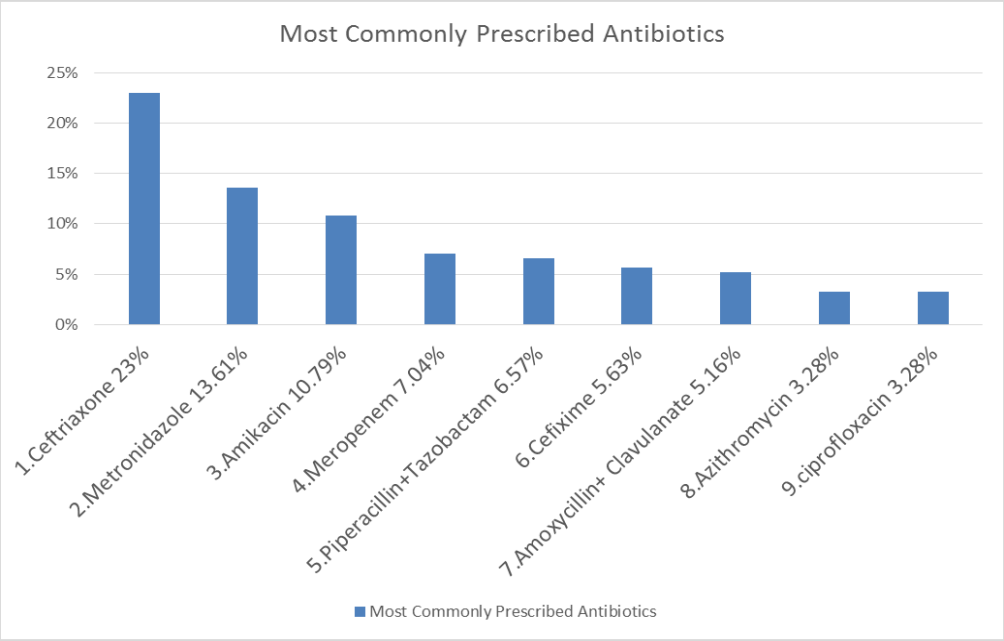

Fig 9: Most Commonly Prescribed Antibiotics.

4.6 Classification of prescribed antibiotics

1. Cephalosporin 31.45%
2. Nitroimidazole 13.61%
3. Penicillin+ Beta Lactamase Inhibitor 11.73%
4. Aminoglycoside 11.26%
5. Carbapenem 7.04%
6. Fluoroquinolone 7.04%
7. Anti TB Drug 5.16%
8. Macrolide 3.28%
9. Cephalosporin+ Beta Lactamase Inhibitor 2.34%
10. Tetracycline 1.40%
11. Azole 0.93%
12. GIT antibiotic 0.93%
13. Lincosamide Antibiotics 0.93%
14. Nitrofuran 0.93%
15. Penicillin 0.93%
16. Glycopeptide 0.46%
17. Oxazolidinone 0.46%. [Fig 10]

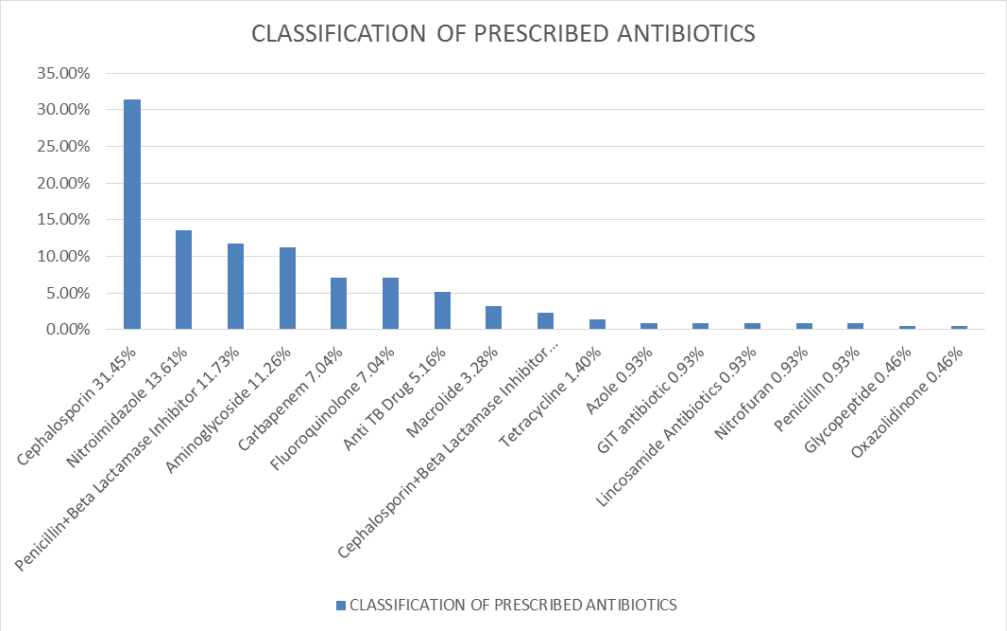

Fig 10: Classification of Prescribed Antibiotics.

5. Rationality assessment: [Table 8]

Table 8: Rationality Assessment of Prescribed Antibiotics.

Criteria	Appropriate %	Inappropriate %
indication	98.56%	1.44%
duration	97.45%	2.55%
dose	98.18%	1.82%
frequency	96.90%	3.1%
polypharmacy	85%	15%

6. COST ANALYSIS

6.1 Average cost analysis: [Table 9]

Average Number of Antibiotics/Prescription	1.9 Antibiotics
Avg Cost of Antibiotics/Prescription	2149.35 INR
Avg Cost of Antibiotics/Prescription if Prescribed in Generic	616.15 INR

6.2 Cost/unit analysis of prescribed antibiotics: [Fig 11 & 12]

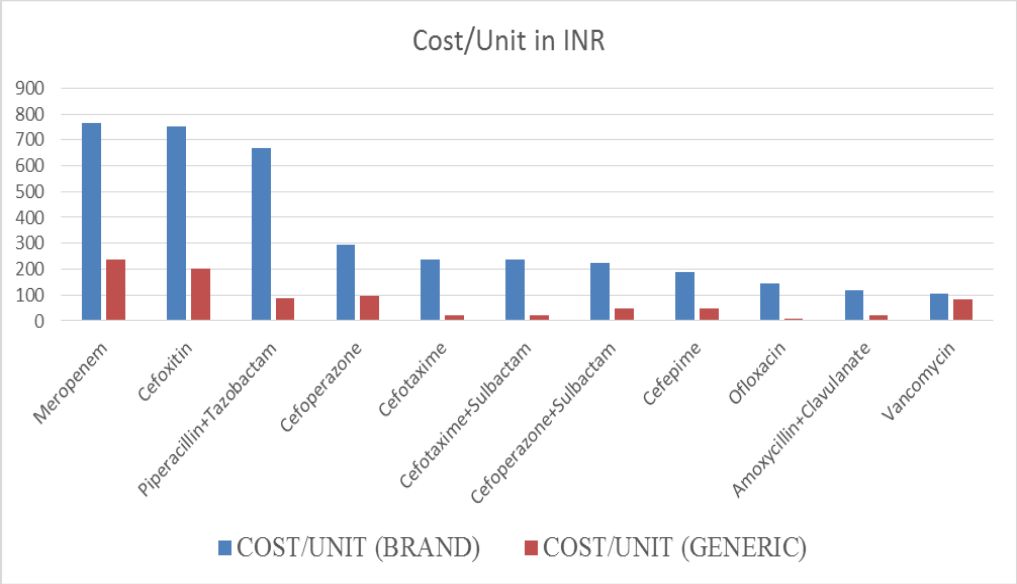

Fig 11: Cost/Unit Analysis.

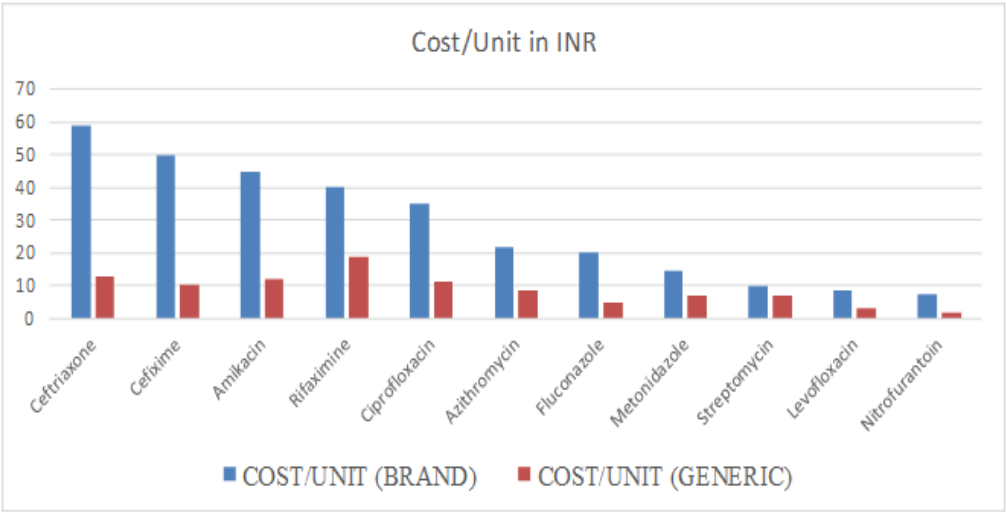

Fig 12: Cost/Unit Analysis.

7. Tabulation of commonly prescribed antibiotics

7.1. Antibiotic frequency distribution [Table 10]

Name of Antibiotic	Percentage of the drugs prescribed with 1-0-0	Percentage of the drugs prescribed with 1-0-1	Percentage of the drugs prescribed with 1-1-1
Ceftriaxone	4.5%	25.8%	0.64%
Metronidazole	1.29%	1.93%	12.25%
Amikacin	3.2%	10.3%	0.64%
Meropenem	1.29%	2.5%	5.8%
Piperacillin+ Tazobactum	3.2%	1.29%	5.1%
Cefexime	1.29%	5.1%	0%
Amoxicillin+Clavulanate	0.64%	2.5%	1.29%
Azithromycin	3.2%	0%	1.29%
Ciprofloxacin	0%	4.5%	0%

7.2 Duration of the antibiotic treatment [Table 11]

Name of Antibiotic	Percentage of the drug prescribed for 1 to 2 days.	Percentage of the drug prescribed for 3 to 5 days.	Percentage of the drug prescribed for 6 to 8 days.	Percentage of the drug prescribed for 9 to 11 days.
Ceftriaxone	3.7%	22.1%	5.06%	0%
Metronidazole	1.26%	13.29%	1.89%	0%
Amikacin	3.16%	7.59%	2.53%	0.63%
Meropenem	1.89%	5.69%	1.26%	0.63%
Piperacillin+ Tazobactum	1.26%	5.69%	1.89%	0%
Cefexime	0%	4.43%	1.26%	0%
Amoxicillin+Clavulanate	0.63%	5.06%	0%	0%
Azithromycin	0.63%	2.53%	1.26%	0%
Ciprofloxacin	1.89%	1.89%	0.63%	0%

7.3 Indication distribution [Table 12]

Name of Antibiotic	Primary Indication	Secondary Indication.	Percentage of the drugs prescribed for primary Indication	Percentage of the drugs prescribed for Secondary Indication
Ceftriaxone	LRTI*, Meningitis	Pre/Post-Operative prophylaxis, skin infections, UTI[#], wound infections	14.7%	13.5%
Metronidazole	Protozoal dysentery, amoebiasis	Gas Gangrene, An-aerobic bacterial wounds	2.9%	12.3%
Amikacin	URTI**, Meningitis	UTI, Sepsis, intra abdominal infections, Pre/Post Operative prophylaxis.	8.82%	10.5%
Meropenem	Wound Infections, Neurological Infections, Pre/Post Operative prophylaxis	LRTI, Intra abdominal infections	5.29%	3.52%
Piperacillin+ Tazobactum	LRTI, Pre/Post Operative prophylaxis	Intra abdominal infections, UTI, Skin Infections.	1.76%	7.05%
Cefexime	URTI	Gonorrhoea, Pre/Post Operative prophylaxis	2.35%	4.11%
Amoxicillin+Clavulanate	Respiratory Tract Infections	UTI.	4.11%	0.58%
Azithromycin	URTI	Intestinal Infections, Gonorrhoea, STD[##]	3.52%	0%
Ciprofloxacin	Diarrhoea, UTI, Typhoid fever, Wound Infections	Eye Infections, Joint Infections.	3.52%	1.17%

DISCUSSION

Our present study provides us with the overall pattern of antibiotic use profile in patients admitted to General wards, ICU, Pediatric wards, Nephrology wards, and TB wards in a Tertiary care in-patient. Male patients were predominant with 64.54% and female patients occupying 35.45% out of 110 cases as similarly showed in the findings of Ashok Kumar Malpani et *al* 2016[10], Department of Pharmacy Practice Karnataka, India. The age group of the patients as categorized into Pediatric, Adult and Geriatric showed 13.63%, 64.54% and 21.81% respectively. The average length of antibiotic treatment duration was 7-11 days and can be reduced by appropriate management of the diagnosed diseases so as to reduce the cost needed for the treatment. The results revealed that out of 110 prescriptions, 213 antibiotics were prescribed to the study population. The most commonly prescribed antibiotics were cephalosporins at 31.45% (ceftriaxone 23%, Cefixime 5.63%, Cefoperazone 1.40%, Cefotaxime 0.46%, Cefoxitin 0.46%, Cefuroxime 0.46%), followed by nitroimidazoles at 13.61% (metronidazole 13.61%), then Aminoglycosides at 11.26% (Amikacin 10.79%, Streptomycin 0.46%). In fixed dose combinations, the most commonly prescribed antibiotics were Piperacillin+ tazobactam (6.57%) followed by Amoxycillin+ Clavulanate (5.16%), then Ceftriaxone+ Sulbactam (0.93%). Overall antibiotics prescribed in combination were 14.08% and antibiotics prescribed individually were 85.91%.Then, 30.90% of prescriptions had 1 antibiotic, 47.27% of prescriptions having 2 antibiotics, 19.09% had 3 antibiotics and 2.72% had 4 antibiotics and the average was found to be 1.92± 0.01. A similar study was done by B. Rajalingam*et al*2016[11], Department of Pharmacy Practice, Sri Ramakrishna Institute, Coimbatore, India and reported that 1.6 ± 0.95 of antibiotics were prescribed out of 200 prescriptions and also found cephalosporins to be used in 1/3rd of the prescriptions especially ceftriaxone. The results revealed that in the study population of 110, 213 antibiotics prescribed with 170 (79.81%) were administered parenterally and 43 (20.18%) were given via oral route, similarly a study performed by Tsegaye Melaku Jimma university 2015[12], South-west Ethiopia accordingly showed out of the 590 total number of antibiotics prescribed, parenteral route was accounted for 532 (90.17 %) followed by oral (PO) 5.08%. The most commonly prescribed parenteral antibiotics were Ceftriaxone (23%) which was administered for a period of 6-7days and Piperacillin+ Tazobactam (6.57%) which was administered for a period of 4-7 days during their complete stay in the hospital. Usually parenteral preparations are found more costlier than the oral preparations which was given longer duration and hospitalization is necessary when drug is given as parenteral.The drug use pattern was assessed using WHO prescribing indicators as the same was referred to by the study conducted by Bhupalam Pradeep Kumar et al 2017[13], Raghavendra Institute, Anantapur, Andhra Pradesh. The range of drugs per encounter was found to be 8-10 and the average was found to be 8.18±0.01which is significantly higher than the WHO standard value of 2, this is suggestive of Polypharmacy, non-adherence and resistance. The average encounter of antibiotics per prescription was found to be 100% which is higher than the WHO standard value of 20-26.8%. Otherdrugs found to be mostly prescribed are Pantoprazole, Paracetamol and sodium Chloride. Prescriptions containing 1 antibiotic 26.36% were given as injections only, prescriptions containing 2 antibiotics 32.72% were given as injections only and prescriptions containing 3 antibiotics 10.90% were given as injections. The results also revealed that 18.18% of drugs were not prescribed from WHO Model of essential drug list and 81.81% of drugs were prescribed from this list. The rationality of antibiotics was analyzed with the help of guidelines prepared from Medicines Completes and NFI 2019. The dose, indication, route and duration of antibiotics were verified from Medicines Completes. When assessed from 213 antibiotics the results showed that 81.82% of the individual antibiotics were present (ceftriaxone, levofloxacin, azithromycin, Linezolid etc.,) in the Medicines completes and 18.18% was absent in Medicines completes (Cefoperazone+ Sulbactam, Rifaximin, Cefoxitin).When rationality was checked for appropriateness of antibiotics prescribed, 98.58% antibiotics were found appropriate specially with reference to indication and 97.45% with duration. Similarly, 98.18% with dose, 96.90% with frequency were found to be appropriate. Prescriptions were then subjected for Prospective Cost Minimization assessment, the results revealed that in the study population, 164 antibiotics (77%) were prescribed in Brand and the rest 49 antibiotics (23%) were prescribed in generic.. The data collections were aidedwith a developed data collection form consisted of number of antimicrobial agents, duration of the therapyand the number of days taken for the treatment. The cost of all prescribed antibiotics was calculated separately for brand and generic for comparison of lowest cost alternatives. A study conducted by Testsuya Fukuda et al [9] to study of the contribution of antimicrobial stewardship programs towards the reduction in cost of therapy in the community hospital in Japan for six-month period in the post-admission period. Their interventional study reduces the overall cost of antimicrobial therapy to 25.8% for one-year time span were by the 3-month current study reduced the overall antimicrobial cost to 19.5% of the population. When depicted in terms of monetary units, INR 1178.08 was saved in comparison to the pre-interventional phase which had placed a hefty economic burden on the patients. From the current study the overall average cost of antibiotics per prescription was found to be Rs 2149.35 which is more compared to when prescribed in generic alone (Rs 616.15). When prescribed in Brand alone the average cost of antibiotics comes down to Rs 2592.14. The limitations of this study was that the study was carried out for a smaller duration of time and data was limitedonly on the in-patients who were admitted to the hospital.No data was available on

the culture and the sensitivity test of an antibiotic, hence resistance of a pathogen to an antibiotic drug could not be analyzed.The study was performed in a superspeciality tertiary care hospital, hence the treatment pattern may not reflect the standard national trend of pattern of treatment. Hence this study recommends that longer duration of this study can be done for a larger sample size which can contribute for a more accurate result.Follow up for discharged antimicrobials can be done for compliance and adherence studies.Culture and sensitivity testing can be monitored for resistance studies and antimicrobial prescription history can be assessed to determine previous indications.Patient medication monitoring post hospital discharge can be done to determine total cost of treatment i.e., switch from brand to generic or other alternatives. Also more studies should be carried out for dosing and indications for sensitive groups i.e., Geriatrics and Pediatrics.

CONCLUSION

The use of antibiotics have seen to be very prevalent in any therapy when the patient is admitted to a hospital for direct relief or as prophylaxis. Hence it is very important to monitor the dose, frequency and route of administration of the antibiotics especially in case of pediatric and geriatric patients. Intravenous route of administration is preferred rather than any other route of administration as the therapeutic effect of the drug is achieved faster than any other route of administration. It is very important for the patients to take the antibiotics in proper dose and always complete the course. Certain adverse drug reactions may be associated with antibiotic therapy and must be informed to the health care providers, which can be managed through the dose adjustments or replacing the concerned antibiotics with an alternative. It was observed that most of the antibiotic drugs were prescribed in brand. On carrying out the Pharmacoeconomic studies using cost minimization analysis method it was found that there was tremendous reduction in treatment cost if the generic alternatives are being used instead of the branded drugs, where the efficacy of the generic drugs are almost same as that of the branded drugs. Taking into considerations of the economic status of the Indian population, where the majority belongs to economically backward section, where the cost of treatment is of great importance. Hence, generic alternative of antibiotics can be used which reduces the overall treatment cost thus reducing the economic burden of the patients.

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