



INDO AMERICAN JOURNAL OF PHARMACEUTICAL RESEARCH



ANTIBIOTICS – THEIR EVALUATION AND USAGE IN AN ADULT POPULATION IN TERTIARY CARE HOSPITAL

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ARTICLE INFO

Article history

Received 20/03/2023

Available online

31/03/2023

Keywords

Antibiotics,
Cephalosporins,
 β -lactam antibiotics,
Macrolides.

ABSTRACT

AIMS AND OBJECTIVE: We aimed to evaluate the prescribing pattern of antibiotics and their utilization in the adult population in a tertiary care hospital. **RESULTS:** A total of 200 patient cases were collected. Out of which 104 were male, where as 96 were female patients. A total of 472 antibiotics were prescribed to the patients. Out of which there are 204 cephalosporins; 98 β -lactam antibiotics (Sulbactam, tazobactam, clavulanic acid); 20 carbapenems; 32 fluoroquinolones; 32 macrolides; 26 penicillins; 20 carbapenems; 16 aminoglycosides; 14 tetracyclines; 12 antitubercular antibiotics; 8 metronidazole; 6 lincosamide antibiotics; 2 glycopeptides and 2 urinary antiseptics. Various formulations of antibiotics were given to the patients which included injections – 286; tablets – 174; capsules – 10 and drops – 2. Antibiotics that are given without combination were about 264, where as 100 antibiotics were given in double combination and 2 in more than triple combination. **CONCLUSION:** The study concluded that a total of 472 antibiotics were prescribed to the patients in which, class of cephalosporins was most commonly prescribed (i.e., 204) because of its high - efficacy, broad - spectrum antibacterial activity, and fewer adverse effects when compared to other antibiotics.

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Please cite this article in press as **Anapuram Priyanka et al. Antibiotics – Their Evaluation and Usage in an Adult Population in Tertiary Care Hospital. Indo American Journal of Pharmaceutical Research. 2023; 13(03).**

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INTRODUCTION

In the 20th century, Antimicrobial drugs (AMD) had the greatest contribution to therapeutics. The drugs that belong to the class of antibiotics differ from all other drugs in that they are designed either to kill the micro organism or to limit its growth. This type of treatment is known as “Chemotherapy” which means “treatment of systemic infections with the particular drugs that suppress the growth of microorganism or kill the microorganism selectively which is responsible for causing the infection without causing any harmful effect to the host”.

ANTIBIOTICS

These are the substances that are derived from the micro organisms or produced synthetically either to limit growth or to kill the other microorganisms.[1]

ANTIBIOTIC RESISTANCE

Antimicrobial resistance occurs when there is continuous use of antimicrobial drugs. So long-term use of antimicrobial drugs leads to the development of resistant organisms. Microorganisms can resist at some point because in nature the resistance mechanisms are already present. To avoid resistance or to slow the resistance, much care has to be taken to avoid the misuse of antibiotics occurs indifferent ways; i.e., the use of antibiotics in patients who are not having bacterial infections, or prolonged use of antibiotics for a long period of time and use of broad-spectrum antibiotics when not needed.[2]

SULFONAMIDES

The first effective chemotherapeutic agents that are used systematically for the prevention and cure of pyrogenic bacterial infections in humans were sulfonamides[3].

Sulfonamides will limit the growth of bacteria (i.e., bacteriostatic) which include both gram-positive and gram-negative bacteria [4]. Due to the introduction of other new anti-microbial agents which are safe and more effective than sulfonamides and also because of the rapid emergence of bacterial resistance, these sulfonamides are given in combination with trimethoprim as cotrimoxazole or it is given along with pyrimethamine for malaria.[5]

QUINOLONES

These are the synthetic anti-microbial agents possessing a quinolone structure and these quinolones primarily inhibit the gram-negative bacteria and the newly introduced fluoroquinolones are active against gram-positive bacteria also [6]. This is used for the treatment of UTIs and is effective against a wide variety of infectious diseases after oral administration [7].

PENICILLINS

In 1941, the first antibiotic that is used clinically was penicillin. Penicillin was derived from “*Penicillium notatum*” and “*Penicillium chrysogenum*”[8].The common structure i.e., present in all penicillin the β -lactam ring attached to a thiazolidine nucleus therefore, the β -lactam ring is responsible for the antimicrobial activity of the penicillin[9].

CEPHALOSPORINS

These are the semi-synthetic substances that are obtained from the products of different micro-organisms which include cephalosporins and streptomycetes [10]. All cephalosporins have the same mechanism of action as that of penicillin's i.e., inhibition of synthesis of the bacterial cell wall. In general, cephalosporins are categorized into 4 generations and now the newly introduced drugs have been designated as 5th generation [11].

MONOBACTAMS

Monocyclic β -lactams are compounds produced by various bacteria [12]. The spectrum of activity for the aerobic gram-negative organisms was found to be low. Compared to other β -lactam antibiotics monobactams have no activity against anaerobes or gram-positive bacteria [13].

AMINOGLYCOSIDES

Most of the aminoglycosides occur either naturally or are derived from soil actinomycetes [14].The aminoglycoside group consists of neomycin, kanamycin, gentamycin, streptomycin, amikacin, netilmicin, etc. Aminoglycosides are mostly given in combination with other drugs to treat drug-resistant micro-organisms [15].

TETRACYCLINES

Actinomycetes which are present in soil are the sources of all tetracyclines. In 1940, the first tetracycline named chlortetracycline was introduced under the name aureomycin. These tetracyclines are less water soluble, but their hydrochloride forms are more soluble and these are slightly bitter solids. Aqueous solutions of tetracyclines are unstable in nature [16].

MACROLIDES

Macrolides are antibiotics possessing a macrocyclic lactone ring attached to sugars. In the 1950's erythromycin was the first drug to be discovered were as other macrolide antibiotics i.e., clarithromycin, azithromycin, roxithromycin, and telithromycin are introduced later. In 1952 erythromycin was isolated from *Streptomyces erythreus* and used as an alternative to penicillin [17].

LINCOSAMIDE ANTIBIOTICS

Clindamycin is a lincosamide that is derived from amino-acid i.e., Trans-L-4-n-propylhygrimic acid, attached to a sulfur group containing a derivative of an octose. [18] It is a chlorine-substituted derivative of lincomycin which is obtained from streptomyces, lincollinolsensis. [19]

GLYCOPEPTIDE ANTIBIOTICS

Vancomycin is a glycopeptide antibiotic that is derived from the bacterium amycolatopsis orientalis. As it possesses a large molecular weight, it is active against gram-positive bacteria but cannot penetrate into the cell membranes of gram-negative bacteria. Its product is water soluble and can be stored in the refrigerator for 14 days due to its solubility following reconstitution. [20]

URINARY ANTISEPTICS

Urinary antiseptics are anti-microbial agents which are administered orally. They only show antibacterial concentration in urine and do not interfere with systemic circulation.[21]

AMINOCYCLITOL ANTIBIOTICS

It is active against gram-positive and gram-negative bacteria. [22] Spectinomycin is an aminocyclitol antibiotic that is derived from streptomyces spectabilis. [23]

OXAZOLIDINONES

This is the first new class of synthetic anti-microbial agents "Oxazolidinones" that can be used to treat resistant gram-positive coccal (aerobic and anaerobic) and bacillary infections. Linezolid is effective against MRSA as well as some VRSA, VRE, penicillin-resistant streptococcus pyogenes, streptococcus viridans, and streptococcus pneumoniae. It is primarily bacteriostatic, but it can also be bactericidal against certain streptococci, pneumococci, etc. [24]

STREPTOGRAMINS

Quinupristin- dalfopristin is a combination of quinupristin and dalfopristin. Quinupristin is a streptogramin B whereas dalfopristin is a streptogramin A. These both are taken in the ratio of 30:70 respectively. [25]

LIPOPEPTIDES

Daptomycin i.e., derived from streptomyces roseosporus is a cyclic lipopeptide antibiotic that was discovered more than 25 years ago. [26]

POLYPEPTIDES

Polymyxins were discovered in 1947. These are a class of antibiotics produced by various strains of Bacillus polymyxa. Bacillus (Aerobacillus) colistins produces colistin detergent drugs that are relatively simple basic peptides with molecular masses of 1000Da. Polymyxin B is a polymyxin B1 and B2. Mixture. [23]

ANTI-TUBERCULAR DRUGS

Tuberculosis (TB) is a communicable disease that spreads more widely in the world. [27] World Health Organization (WHO) estimates that one-third of the population of this world is affected by Mycobacterium tuberculosis. [28]

OBJECTIVES OF THE STUDY:

- To study and evaluate the use of a different class of antibiotics.
- To find out the class of drug which is mostly prescribed.
- To study antibiotic usage in patients with different age groups, gender, and severity of illness.
- To compare the antibiotics prescribed to the patients under generic and brand names.

METHODOLOGY

STUDY SITE:

The study was conducted in all inpatient departments of General Medicine of Aware Gleneagles Global Hospitals, Hyderabad.

STUDY DESIGN:

Type of study: A prospective study
Place of study: Aware Gleneagles Global Hospital
Sample Size: 200 patients

STUDY PERIOD:

The research was carried out over a six months period, from September 2022 to February 2023.

INCLUSION CRITERIA

- Patients of age between 20 years and 80 years.
- Patients who have been prescribed antibiotics.
- Patients with co-morbid conditions other than coma.
- Patients of either sex having a prescribed mentioned drug.
- Patients who are admitted within factious diseases.
- Patients who had undergone surgeries.
- The patients who are willing to participate in the study.

EXCLUSION CRITERIA

- Patients in which antibiotics are not prescribed.
- Patients admitted for more than 15 days.
- Children (<20 years) and infants.
- Pregnant women.
- Patients with insufficient data in their records.
- Patients who are not willing to participate in the study.

RESULTS:

TABLE 1: GENDER DISTRIBUTION OF PATIENTS USING ANTIBIOTICS.

S.No	GENDER	NO.OF PATIENTS	PERCENTAGE(%)
1	MALE	104	52
2	FEMALE	96	48

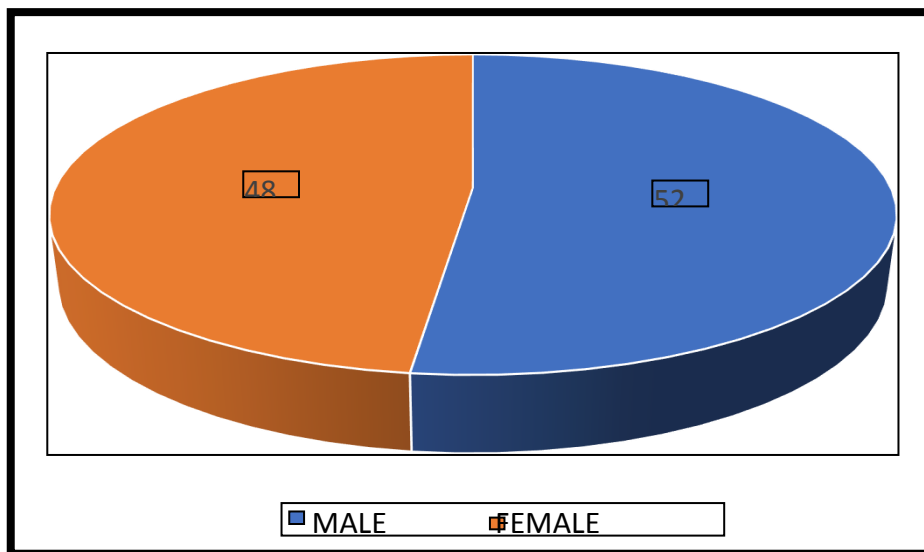


FIGURE 1: PIE CHART PRESENTATION OF GENDER-WISE DISTRIBUTION.

Among the study population of 200 subjects, 104 were found to be male whereas 96 were found to be female.

TABLE 2: GENDER-WISE DISTRIBUTION OF PATIENTS ON ANTIBIOTICS.

S.NO	GENDER	NO. OF ANTIBIOTICS GIVEN TO PATIENTS	PERCENTAGE OF ANTIBIOTICS(%)
1	MALE	260	55.084
2	FEMALE	212	44.915

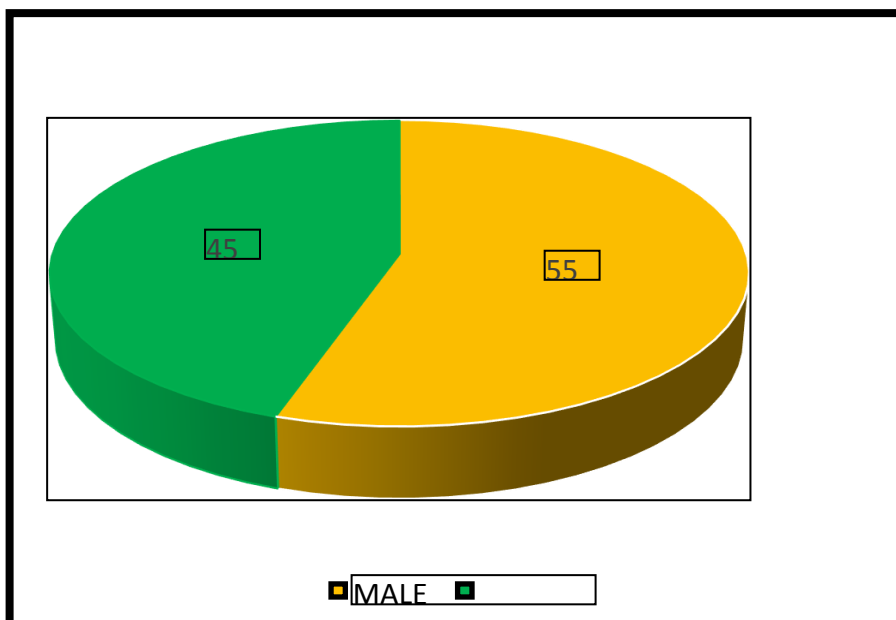


FIGURE2: PIE CHART PRESENTATION OF GENDER-WISEDISTRIBUTIONOFPATIENTSON ANTIBIOTICS.

A total of 472 antibiotics were given to the subjects among which 260 antibiotics were given to the male and 212antibiotics were given to the female.

TABLE3:AGE-WISEDISTRIBUTIONOF SUBJECTSUSING ANTIBIOTICS.

S.No	AGEINYEARS	NO.OF PATIENTS	PERCENTAGE(%)
1	20 – 40	58	29
2	41 – 60	94	47
3	61 – 80	40	20
4	>80	8	4

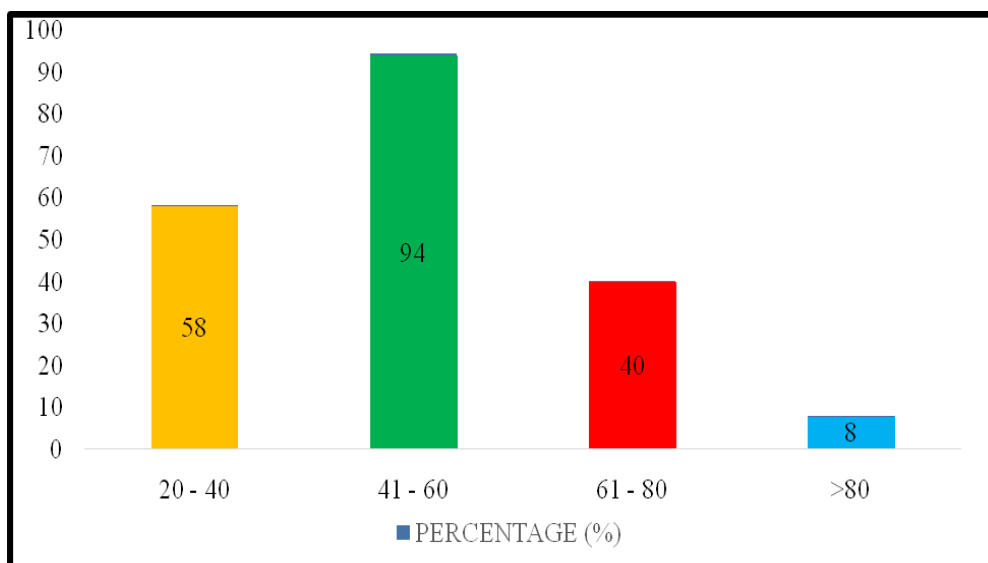
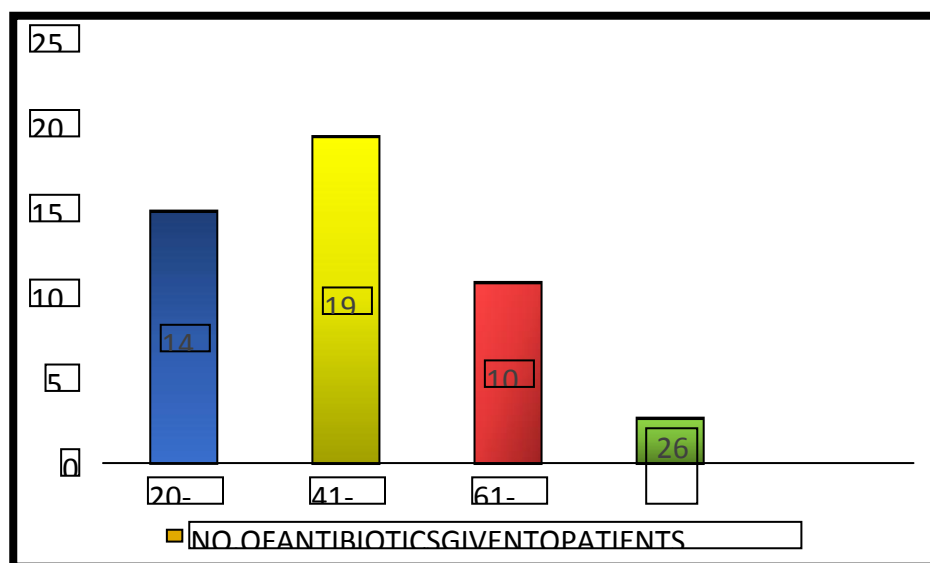


FIGURE 3: BAR GRAPH PRESENTATION O FAGE-WISE DISTRIBUTION OF PATIENTS.

From table & figure - 3 it is found that mostly the patients that were participated in this study were between the age group of 41-60 (94 members).

TABLE4: AGE-WISE DISTRIBUTION OF ANTIBIOTICS IN PATIENTS.

S.NO	AGEINYEARS	NO. OF ANTIBIOTICS GIVENTOPATIENTS	PERCENTAGE(%)
1	20 – 40	148	31.355
2	41 – 60	192	40.677
3	61 – 80	106	22.457
4	>80	26	5.508

**FIGURE 4: BAR GRAPH PRESENTATION OF AGE-WISE DISTRIBUTION OF ANTIBIOTICS.**

Among the subjects mostly antibiotics were prescribed between the age group of 41-60(192 no.of antibiotics were prescribed).

TABLE 5: DIFFERENT CLASSES OF ANTIBIOTICS GIVEN TO PATIENTS.

S.No	CLASS OF ANTIBIOTICS	MALE	FEMALE	TOTAL	PERCENTAGE (%)
1	PENICILLINS	18	8	26	5.50
2	CEPHALOSPORINS	98	106	204	43.22
3	CARBAPENEMS	16	4	20	4.23
4	AMINOGLYCOSIDES	8	8	16	3.38
5	FLUOROQUINOLONES	18	14	32	6.67
6	TETRACYCLINES	10	4	14	2.96
7	MACROLIDES	12	20	32	6.77
8	β-LACTUM ANTIBIOTICS	62	36	98	20.76
9	LINCOSAMIDE ANTIBIOTICS	6	-	6	1.27
10	GLYCOPEPTIDE ANTIBIOTICS	2	-	2	0.42
11	URINARY ANTISEPTICS	2	-	2	0.42
12	ANTI-TUBERCULAR ANTIBIOTICS	4	8	12	12.54
13	METRONIDAZOLE	4	4	8	1.69

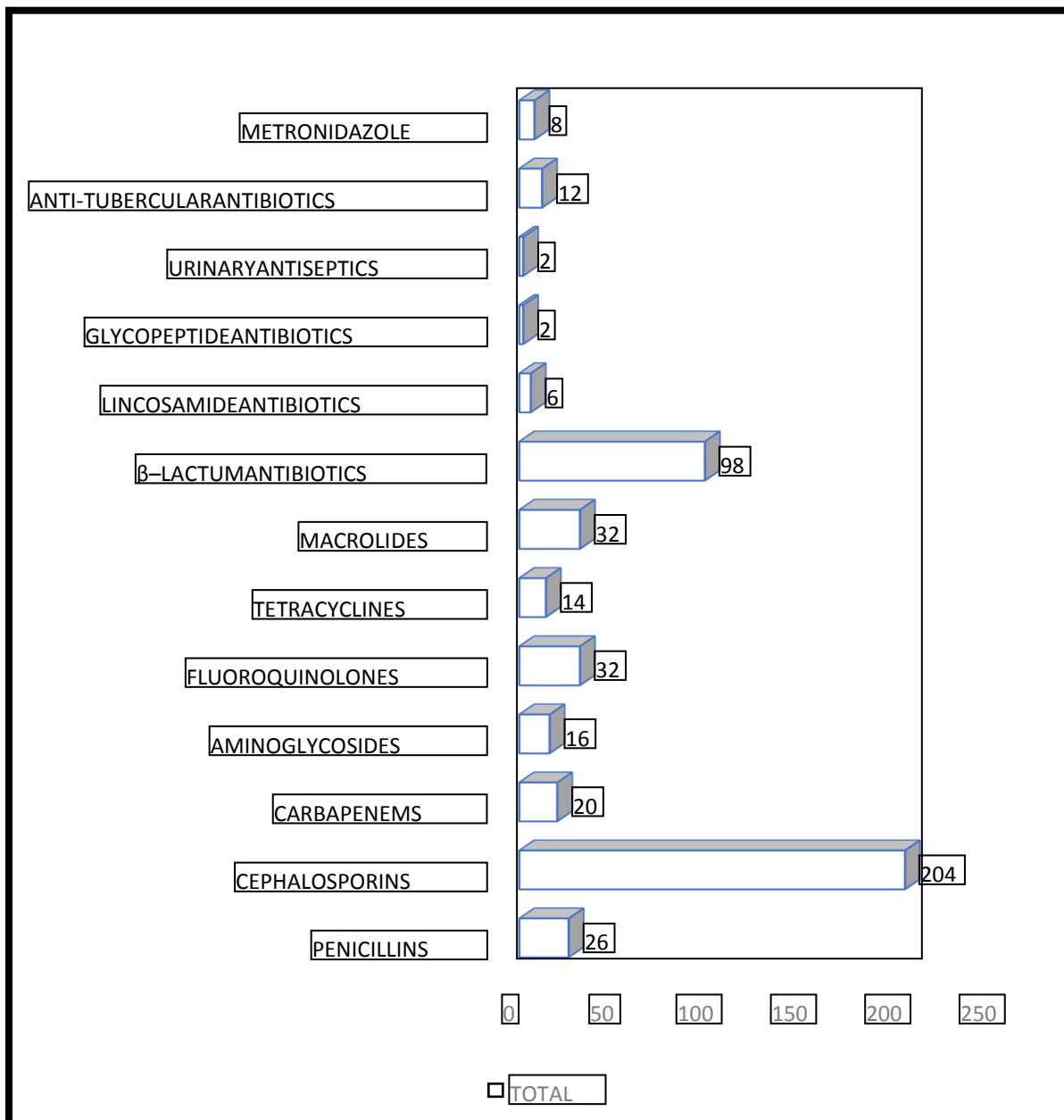


FIGURE5:BAR GRAPH PRESENTATION OF CLASS OF ANTIBIOTICS GIVEN TO PATIENTS.

In our study, the most prescribed class of antibiotics is Cephalosporins (among 472 antibiotics 204 were cephalosporins).

TABLE 6: CLASS OF CEPHALOSPORINS GIVEN TO THE PATIENTS.

S.No	CLASS OF CEPHALOSPORINS	MALE	FEMALE	TOTAL	PERCENTAGE(%)
1	GENERATION1	-	-	-	0
2	GENERATION2	-	2	2	0.98
3	GENERATION3	96	104	200	98.03
4	GENERATION4	2	-	2	0.98
5	GENERATION5	-	-	-	0

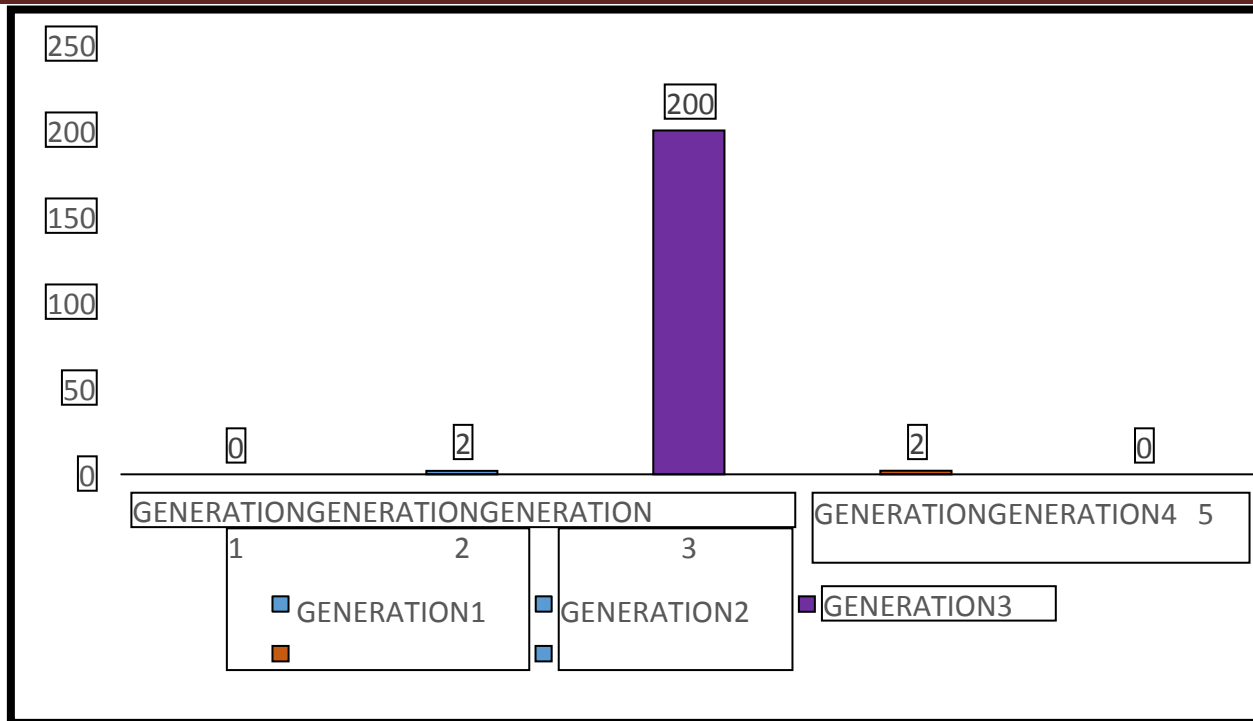


FIGURE 6: BAR GRAPH PRESENTATION OF CLASS OF CEPHALOSPORINS GIVEN TO THE PATIENTS.

From our study, it is also found that mostly 3rd generation cephalosporins are prescribed (200), followed by the 2nd and 4th generation cephalosporins.

TABLE 7: CLASS OF PENICILLINS GIVEN TO THE PATIENTS.

S.No	CLASS OF PENICILLINS	MALE	FEMALE	TOTAL	PERCENTAGE (%)
1	NATURAL PENICILLINS	-	-	-	-
2	SEMI-SYNTHETIC PENICILLINS	-	-	-	-
a.	ACID-RESISTANT ALTERNATIVE PENICILLIN-G	-	-	-	-
b.	PENICILLINASE RESISTANT PENICILLINS	-	-	-	-
c.	EXTENDED-SPECTRUM PENICILLINS	-	-	-	-
	Aminopenicillins	14	4	18	69.23
	carboxypenicillins	-	-	-	-
	Ureidopenicillins	4	4	8	30.76

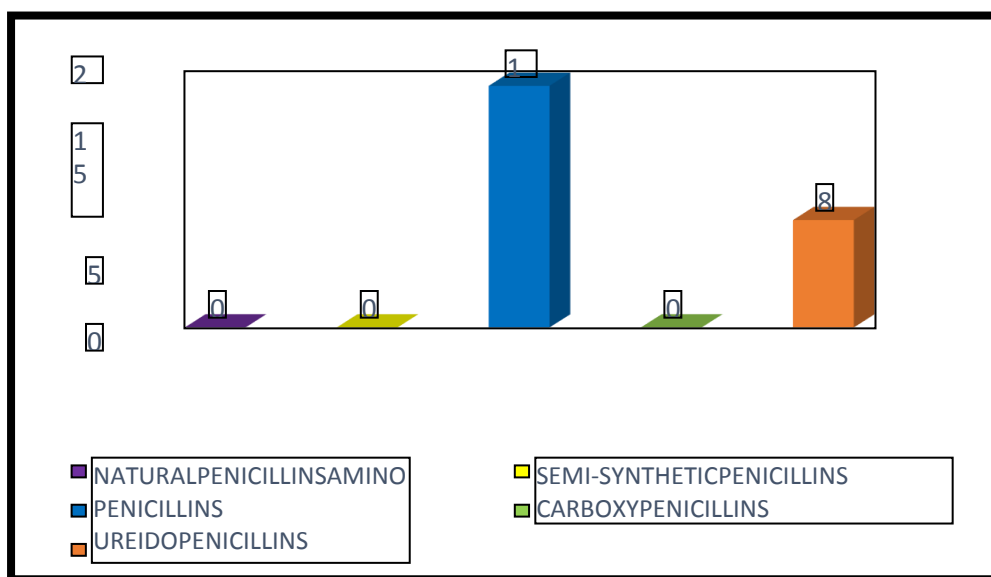


FIGURE 7: BAR GRAPH PRESENTATION OF CLASS OF PENICILLINS GIVEN TO THE PATIENTS.

In our study it is also found that aminopenicillins (18) are the mostly prescribed from the class of penicillins followed by ureidopenicillins(8).

TABLE8:CLASS OF BETA-ACTAMASE INHIBITORS GIVEN TO THE PATIENTS.

S.NO	CLASS OF BETA-LACTAMASE INHIBITORS	MALE	FEMALE	TOTAL	PERCENTAGE(%)
1	SULBACTAM	34	20	54	55.10
2	TAZOBACTUM	4	4	8	8.16
3	CLAVULANICACID	24	12	36	36.73

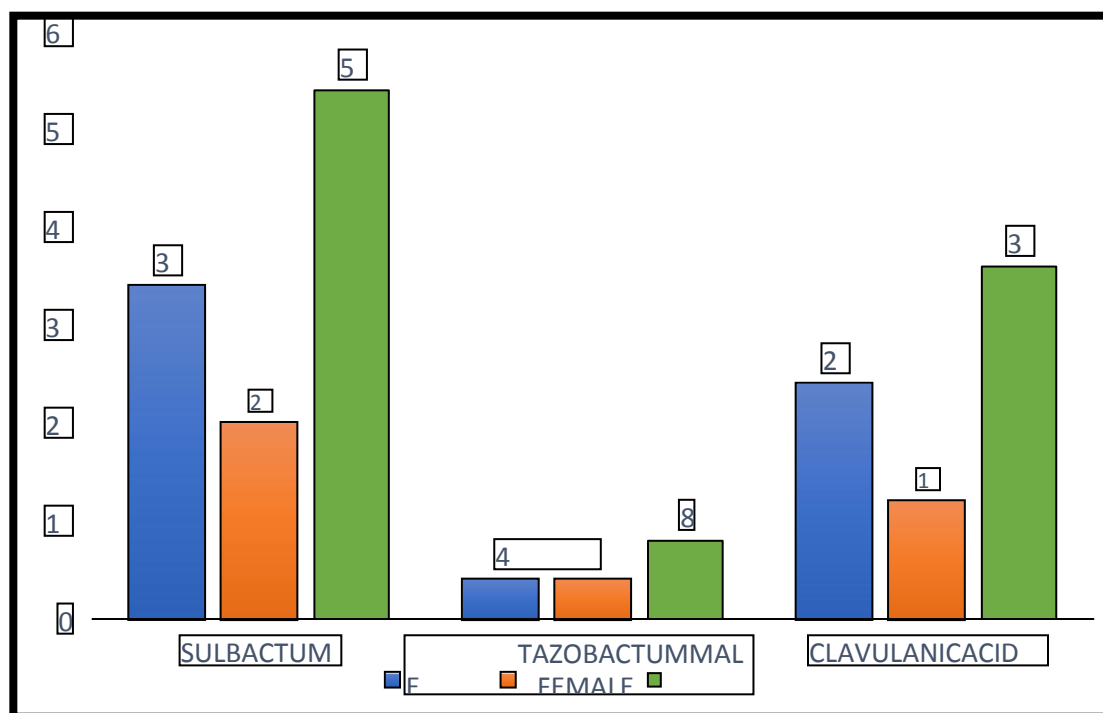


FIGURE 8: BAR GRAPH PRESENTATION OF CLASS OF BETA-LACTAMASE INHIBITORS GIVEN TO THE PATIENTS.

From our study it is found that mostly sulbactam (54) is prescribed from the β -lactamase inhibitors class of antibiotics, followed by clavulanic acid (36).

TABLE9:CLASS OF QUINOLONES GIVEN TO THE PATIENTS

S.NO.	CLASS OF QUINOLONES	MALE	FEMALE	TOTAL	ENTAGE(%)
1	NON-FLUORINATED QUINOLONES	-	-	-	0
2	FLUROQUINOLONES				
a.	1 st generation fluoroquinolones	16	12	28	87.5
b.	2 nd generation fluoroquinolones	2	2	4	12.5
3	ATYPICAL QUINOLONES	-	-	-	0

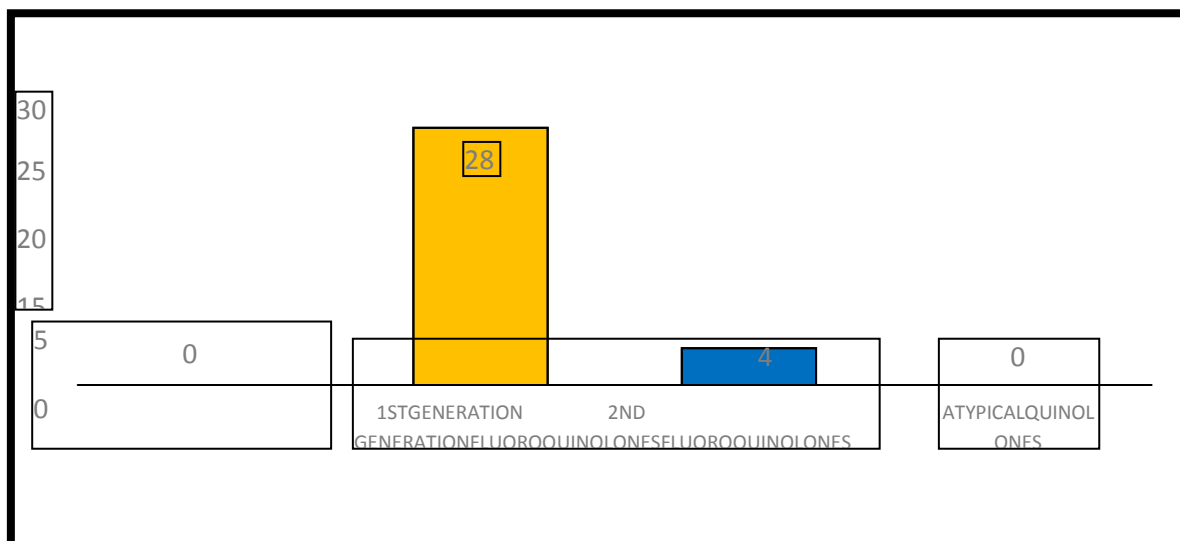


FIGURE 9: BAR GRAPH PRESENTATION OF CLASS OF QUINOLONES GIVEN TO THE PATIENTS.

In our study, we also found that 1st generation fluoroquinolones (28) are commonly prescribed from the class of Quinolones.

TABLE 10: COMMONLY PRESCRIBED ANTIBIOTICS FROM EACH CLASS.

S.No	CLASS OF ANTIBIOTICS	COMMONLY PRESCRIBED ANTIBIOTICS
1	PENICILLINS	AMOXICILLIN
2	CEPHALOSPORINS	CEFTRIAZONE
3	CARBAPENEMS	MEROPENEM
4	AMINOGLYCOSIDES	AMIKACIN
5	FLUOROQUINOLONES	OFLOXACIN
6	TETRACYCLINES	DOXYCYCLINE
7	MACROLIDES	AZITHROMYCIN
8	BETA-LACTAM INHIBITORS	SULBACTAM
9	LINCOSAMIDE ANTIBIOTICS	CLINDAMYCIN
10	GLYCOPEPTIDE ANTIBIOTICS	VANCOMYCIN
11	URINARY ANTISEPTICS	NITROFURANTOIN
12	ANTI-TUBERCULAR ANTIBIOTICS	RIFAMPICIN, ISONIAZID
13	NITROIMIDAZOLE	METRONIDAZOLE

TABLE 11: VARIOUS FORMULATIONS OF ANTIBIOTICS GIVEN TO THE PATIENT.

S.NO	TYPE OF FORMULATION	NO. OF ANTIBIOTICS	PERCENTAGE (%)
1	TABLETS	174	36.86
2	INJECTIONS	286	60.59
3	DROPS	2	0.42
4	CAPSULES	10	2.11

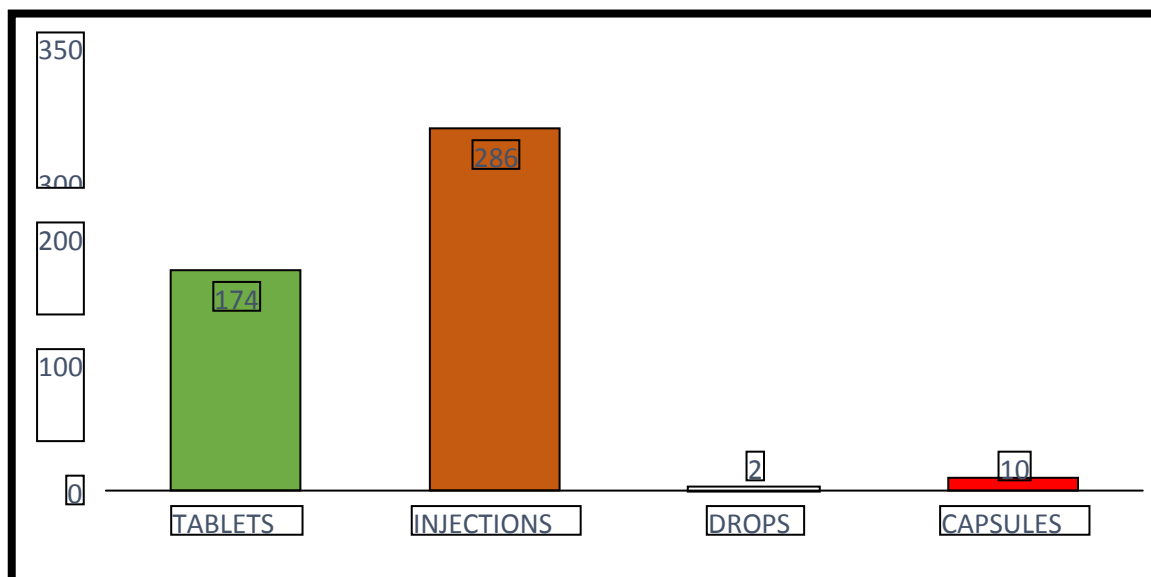


FIGURE 10: BAR GRAPH PRESENTATION OF VARIOUS FORMULATIONS OF ANTIBIOTICS GIVEN TO THE PATIENTS.

In our study, the commonly used formulation is via injections (286).

DISCUSSION

Antibiotics are substances that are derived from microorganisms and are produced synthetically either to kill the organism or to suppress its growth. Antibiotics are generally prescribed to treat infectious diseases or used as prophylactic treatment during surgeries. But over use of antibiotics may lead to the development of antimicrobial resistance. Microorganisms can be resistant at some point because already the resistance mechanisms are present in nature. Therefore, care must be taken to avoid the misuse of antibiotics. Antibiotics are categorized into many classes based on various characteristics such as chemical structure, type of action, mechanism of action, spectrum of activity, natural source, etc, some of these include sulphonamides, penicillin, cephalosporins, carbapenems, monobactam, quinolones, aminoglycosides, macrolides, tetracyclines, lincosamide antibiotics, glycopeptides antibiotics, urinary antiseptics, oxazolidinones, streptogramins, lipopeptide antibiotics, polypeptide antibiotics, aminocyclitol antibiotics, anti-tubercular drugs, etc.

In our study it is observed that a greater number of antibiotics are mostly given to male patients i.e., 104 (52%) when compared to female patients i.e., 96 (48%). Whereas in the previous study, it is found to be there are more female patients (70 members) compared to male patients (66 members)⁽²⁹⁾.

In the previous study mostly, the prescribed class is β -lactams (42.7%) whereas in our study it is the 2nd most prescribed class of antibiotics (20.76%).⁽³⁰⁾

Our study also found that more number of antibiotics are given between the age group of 41-60 years, but in the older study antibiotics are mostly given between the 17-42 years of age group⁽³¹⁾.

In our study the most prescribed class of antibiotics is cephalosporins i.e., 204 [43.22%] as well cephalosporins are also the most commonly prescribed class of drugs in the previous study.⁽³²⁾

In the previous study, mostly 3rd generation cephalosporins were prescribed among which ceftriaxone was the most commonly used drug⁽³³⁾, whereas in our study the most prescribed 3rd generation cephalosporine was ceftriaxone.

In the earlier study, the study was carried out on 822 patients, among them, 1653 antibiotics were prescribed⁽³⁴⁾. In our study, 200 patients were observed, in which 472 antibiotics were prescribed to the patients.

In previous studies mostly preferred route of administration was oral (52.3%)⁽³⁴⁾, whereas in the present study conducted mostly parenteral route was mostly preferred (60.59%) followed by oral (36.8%)

CONCLUSION

Our study is a prospective observational study conducted at Aware Gleneagles Global Hospital, Hyderabad, Telangana, India. For 200 patients a total of 472 antibiotics were given.

- A total of 200 patient cases were collected.
- A total of 472 antibiotics were prescribed to the patients.
- Gender-wise distribution of patients during the study periods showed that the maximum number of male patients receiving antibiotics was [104(52%)] and female patients was [96(48%)].
- The gender-wise distribution of antibiotics during the study period at a study site showed that the maximum number of antibiotics [260 (55.0845%)] were encountered in male patients and [212 (44.915%)] of the antibiotics were encountered in female patients.
- Age-wise distribution of the patients who had encountered Antibiotics at the study site, the data revealed that the maximum number of patients, who had encountered Antibiotics during the study period were in the age group of 20-40 Years [148(31.355%)], in the age group of 41-60 years [192 (40.677%)], in the age group of 61-80 years [106(22.457%)], in the age group of above 80 years [26(5.508%)].
- Total no. of cephalosporins given to the patients - [204(43.22%)].
- Total no. of penicillin given to the patients - [26 (5.50%)].
- Total no. of carbapenems given to the patients - [20(4.230%)].
- Total no. of aminoglycosides given to the patients - [16(3.39%)].
- Total no. of fluoroquinolones given to the patients - [32(6.67%)].
- Total no. of tetracycline's given to the patients - [1(2.96%)].
- Total no. of macrolides given to the patients - [32 (6.77%)].
- Total no. of β lactam antibiotics - [98(20.76%)].
- Total no. of lincosamide antibiotics - [6(1.27%)].

Future research recommends considering that frequent use of most commonly prescribed antibiotics may develop resistance, by giving rational therapy developing resistance might be reduced.

ACKNOWLEDGMENT

We are immensely thankful to Aware Gleneagles Global Hospital and Sree Dattha Institution of Pharmacy (SDIP), their management, and Principal and Assistant professor Dr. Amatul Ali Sameera of SDIP for their constant encouragement and support provided during the study.

CONFLICT OF INTEREST

The author declares no conflict of interest.


ABBREVIATIONS

- AMD - Antimicrobial drugs
- UTI - Urinary Tract Infections
- MRSA - Methicillin-resistant Staphylococcus aureus
- VRSA - Vancomycin-resistant Staphylococcus aureus
- VRE - Vancomycin-resistant Enterococci
- TB - Tuberculosis
- WHO - World Health Organisation

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