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# Study of prescribing pattern of antibiotics and its resistance in tertiary care hospital

**Nikhila Adla, Sushmitha Ganta, Swathi Kontham, Shravan Kumar Sonaboina and Mounika Tejaswi Gorle**

**Abstract**
**Back ground:** Antibiotics are most commonly prescribed drugs to treat various infectious diseases. Irrational prescribing of antibiotics leads to emergence of resistance of antibiotics, drug interactions, increased stay of hospitalization and poly pharmacy.
**Objectives:** The main objective of the study is to assess the prescription pattern of antibiotics and resistance pattern of antibiotics towards organisms and drug interactions.
**Methods:** Patients who met the study criteria were included in the study. 255 prescriptions were examined in the inpatient department of tertiary care hospital from the departments of General Medicine, Cardiology, Nephrology, Gastroenterology, Neurology, Oncology, orthopaedics and Pulmonology. The required data like patient demographics, medication charts, culture sensitivity reports etc were recorded in the designed data collection forms and the data was analyzed to determine prescribing and resistance pattern of antibiotics.
**Results:** In our study male patients were more infected with bacteria than females. Polypharmacy was more commonly seen. Most of the antibiotics were administered through intravenous route. Beta-lactam and Beta-lactamase inhibitor combinations (25.6%) were frequently prescribed and among them mostly Cefoperazone + Sulbactam (62.9%) was the drug of choice. Among single antibiotics Carbapenems (13.9%) were prescribed widely. Cefipime and Trimethoprim/Sulfamethoxazole (91) showed more resistance towards the isolated organisms. Meropenem (101) was more susceptible towards the isolated organisms. Serious interactions; moderate interactions; minor interactions with antibiotics were observed.
**Conclusion:** Rational prescribing of antibiotics is required in order to prevent the resistance of antibiotics and Polypharmacy. Physicians should consider the culture sensitivity reports before prescribing the antibiotics and should have an idea about interactions of antibiotics with other drugs while prescribing. Create awareness of antibiotics usage in the population to avoid emerging resistance of antibiotics.

**Keywords:** snail, bovine, porcine, physicochemical properties, mucin, mucoadhesives

## Introduction
Antibiotics can be defined as pharmacological agents that selectively kill or inhibit the growth of bacterial cells, while having little or no effect on the mammalian host [1]. An antibiotic should be selectively toxic to pathogenic microorganisms, should not stimulate an allergic response in the body, should not disturb the normal microbial population of various body sites, and should not promote the development of drug resistance and must be cost effective [2, 3].

## Aim
The aim of present research is to study the prescription pattern of antibiotics and its association with the antibiotic resistance.

## Objectives
### General objective
Collect relevant demographic information and information on duration of hospitalization of patients and prescribed antibiotics during the study.

### Specific objectives
- Obtain information on the antibiotic prescribing pattern and the disease conditions for which antibiotics were prescribed.
- Obtain information on the common organisms isolated during culture and sensitivity testing and their antibiotic sensitivity patterns.
- Obtain information on the interactions with antibiotics.

## Materials and Methods

### Study design
It is a prospective observational study.

### Study site
The study was conducted at Yashoda Hospitals, Secunderabad, and Telangana, India.

### Study period
Study period of 6 months.

### Study population
The study was carried out in 255 patients in Yashoda Hospital, Secunderabad, and Telangana.

### Study criteria
#### Inclusion criteria
- In-patients of either sex.
- In-patients of various departments like cardio ward, general ward, gastro ward, acute care unit, intensive care units, respiratory wards.
- Patients prescribed with antibiotics.
- Age group up to 90 years.

#### Exclusion criteria
- Patients of international wing, post transplantation ward are excluded from our study.
- Pregnant and lactating women.
- Patients having mental incapability.

### Source of data
1. Patient case notes
2. Treatment charts

### Outcome measurements
- The efficacy of the different types of antibiotics based on their drug-drug interactions will be studied.
- The effectiveness of the monotherapy in regard to polytherapy will be studied.
- The resistance of the antibiotics will be studied and concluded.

### Study method
#### Development of patient data collection form
Relevant information from the study population was collected by using specially designed data collection form. The data collection forms had provision for collecting key information like demographics (name, age, sex and weight), date of admission or visit to the hospital and date of discharge, diagnosis, current and relevant past medical conditions, past and current medication (medication details, dose, route, frequency, duration and indication).

#### Computerization of data collection form
The data collection and assessment form designed for use in this study was computerized using Microsoft® Access 2007 and Microsoft® Excel 2007 for easy storage, accessibility, retrieval and analysis of data.

#### Data collection and documentation
All the relevant and necessary data such as demographic details like age, sex, etc. and medication details like name of the antibiotics prescribed, dose, route, frequency and duration of the therapy and other relevant information was collected from the inpatients case notes.

#### Data analysis
All the collected data was subjected to analysis with respect to various parameters such as incidence, pattern of use including the details of the diagnosis, medications received, dosage forms, indications and their percentage values were calculated.

#### Patient demographics
The results of the study indicate about the antibiotics which were prescribed commonly in the departments of a tertiary care hospital, the sensitivity pattern of antibiotics to organisms by using culture sensitivity tests, interactions of drugs with the antibiotics which were administered simultaneously. Out of 255 study sample, 212 samples showed the growth of various organisms. Remaining samples contains bacteria cocci and bacilli. In this study majority of study samples were male patients. The study was conducted according to inclusion and exclusion criteria.

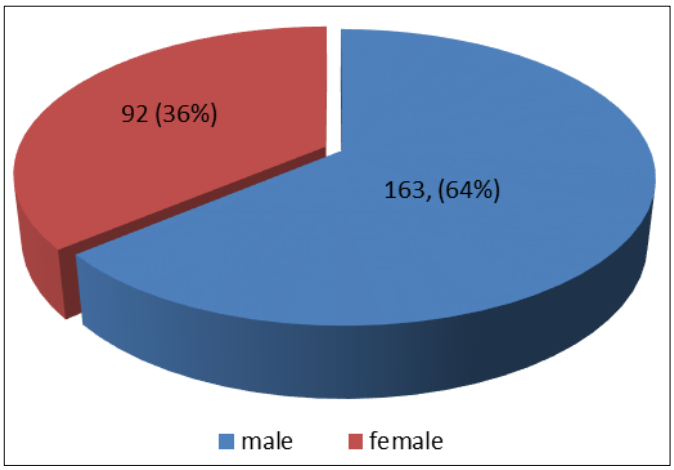


**Fig 1:** Distribution of study subjects based on gender

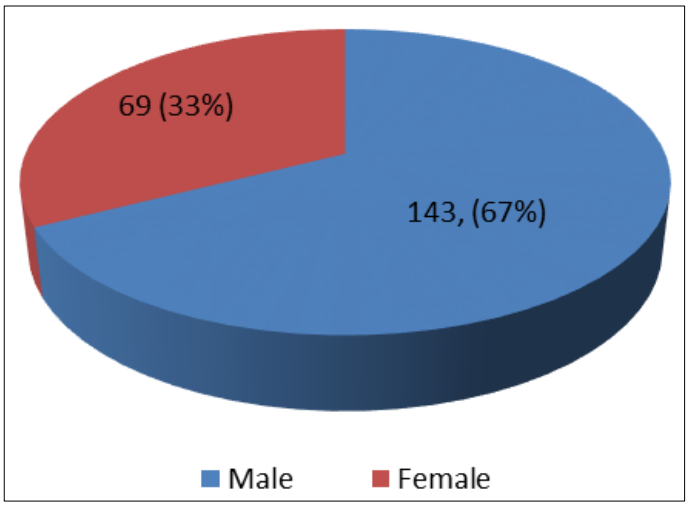


**Fig 2:** Distribution of bacterial infections based on gender

The study population comprises of 255 patients, out of which 63% are male and 36 % are female patients (Figure 1). On comparison 143 (67%) male patients are infected with bacteria whereas 69(33%) female patients are infected with bacteria (33%).

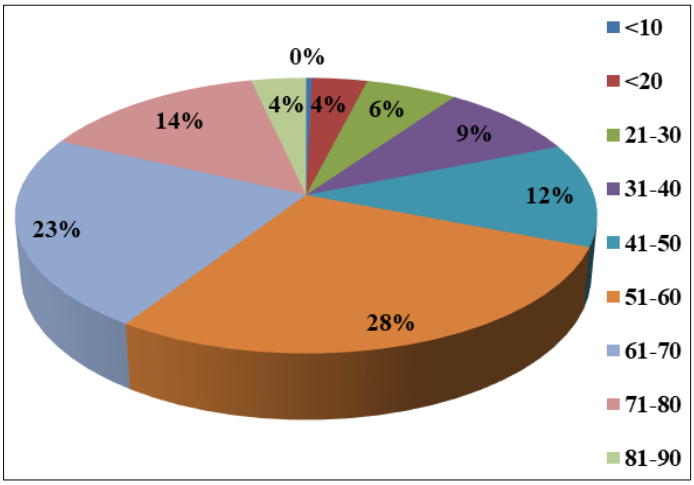


**Fig 3:** Age wise distribution of study population

The study population consists of 255 patients, out of which majority of the patients were observed at age group of 51-60 years is 28%. Followed by 23% patients of age group 61-70years, 14% patients of age group 71-80 years, 12% patients of age group 41-50 years, 9% patients of age group 31-40 years, 6% patients of age group 21-30 years, 4% of patients of age groups of less than 20 years, 81-90 years and 1 patient of age group below 10 years.

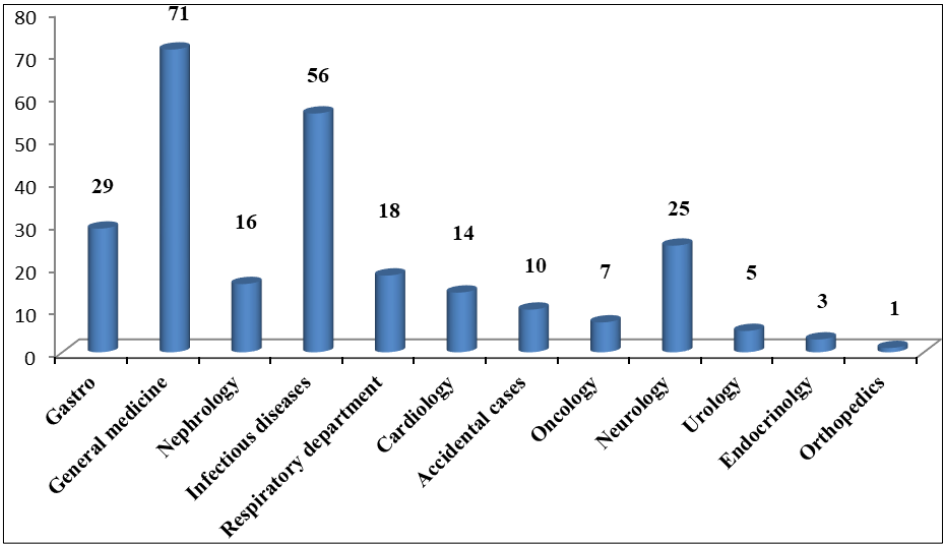


**Fig 4:** Distribution of sample among various departments

The study sample was collected among various departments in tertiary care hospital. About 71 cases are found in general medicine. Followed by 56 cases in infectious diseases, 29 cases in gastroenterology, 25 cases in neurology, 18 cases in respiratory ward, 16 cases in nephrology, 14 cases in cardiology, 10 cases are accidental cases, seven cases in oncology, five cases in urology, three cases in endocrinology, one case in orthopaedics.

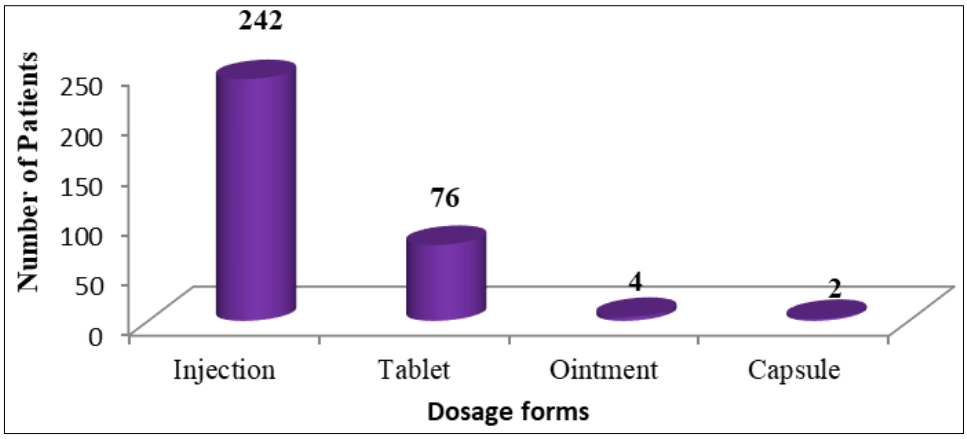


**Fig 5:** Utilization of different dosage forms

Different dosage forms are utilized in the hospital, out of which majority of antibiotics are prescribed in injection form 242(74%), followed by tablets 76 (23.4%), ointments 4 (1.2%), capsules 2 (0.6%).

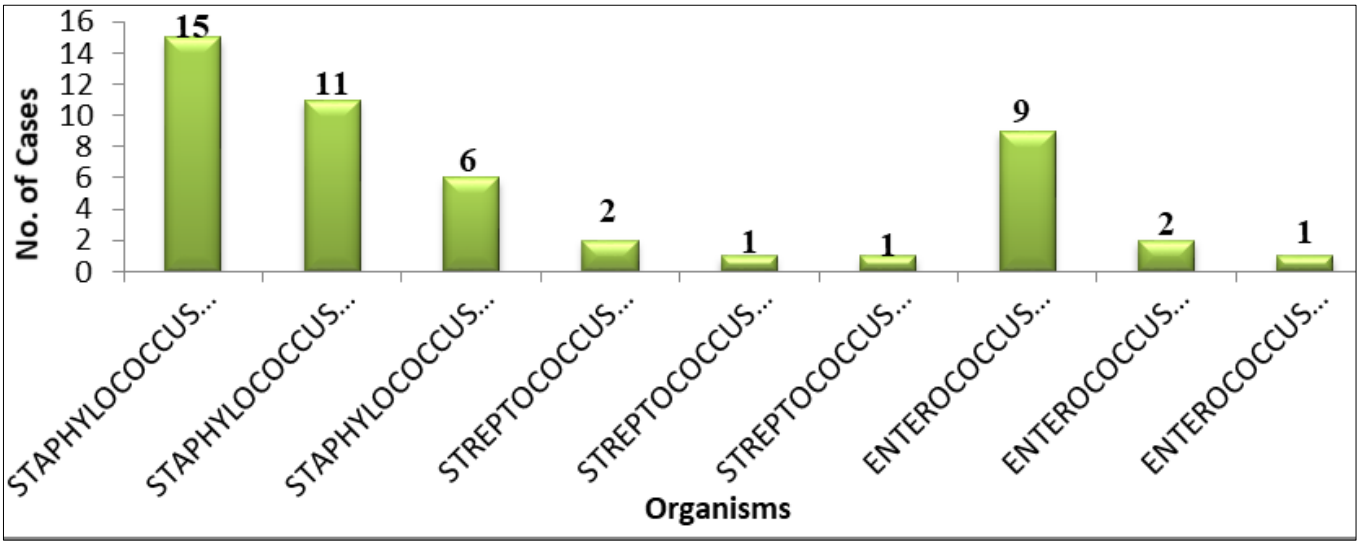


**Fig 6:** Gram +ve organisms isolated in the culture sensitivity tests

Out of 255 patients, culture test was done in 212 patients. In 212 samples, only 50 samples consist of gram positive organisms of 3 different species. Majority of gram positive samples were observed to contain *Staphylococcus* species {*Staphylococcus aureus* (31.2%), *Staphylococcus epidermidis* (22.9%) and *Staphylococcus haemolyticus* (12.5%)}. Followed by *Enterococcus* species {*Enterococcus faecium* (18.9%), *Enterococcus faecalis* (4.1%), *Enterococcus casseliflavus* (2%)}, *Streptococcus* species {*Streptococcus pyogenes* (4.1%), *Streptococcus viridians* (2%), *Streptococcus agalactiae* (2%)}.

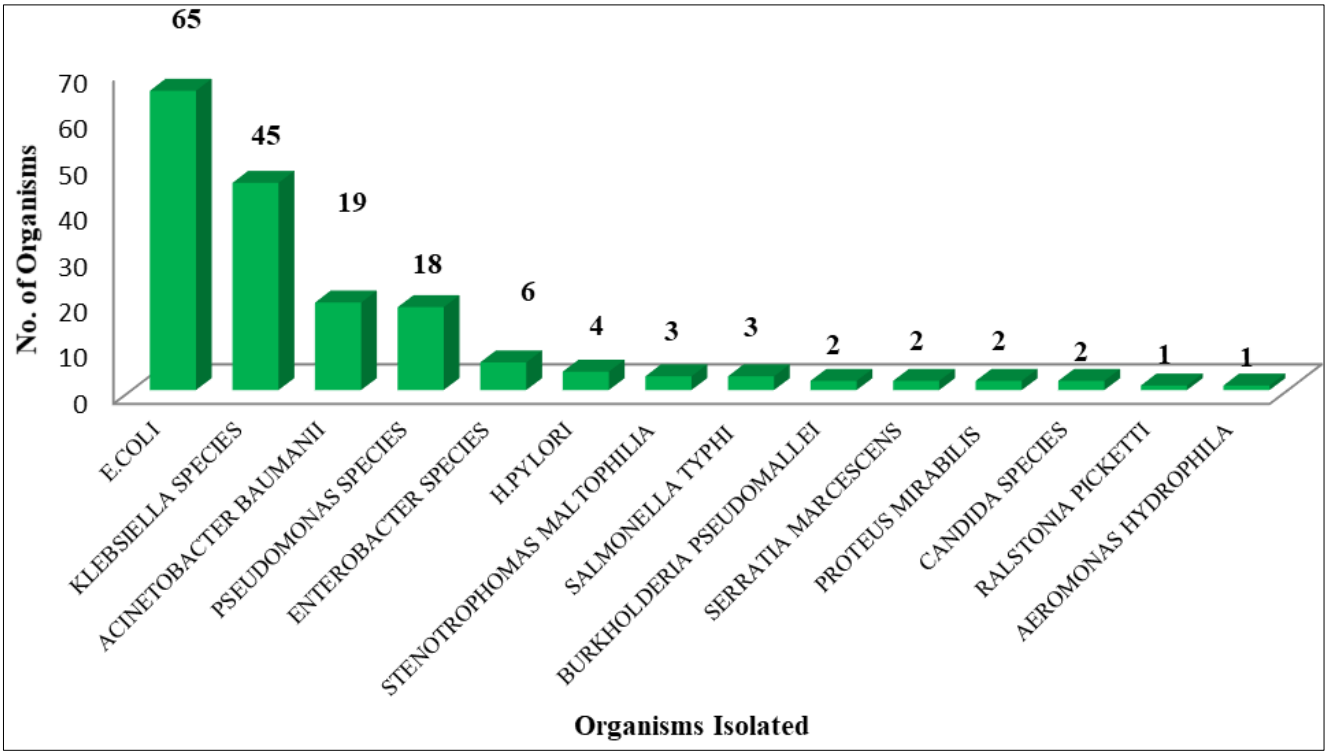


**Fig 7:** Gram –ve organisms isolated in the culture sensitivity tests

The study consists of 162 cultured samples of gram negative organisms. Among the gram negative organisms' *E. coli* (40%) was seen in more number of samples. Followed by 27% of patients *Klebsiella* species, 11% of patients with *Acinetobacter* species, 11% of patients with *Pseudomonas* species, 3% of patients with *H. pylori* species, 3 of patients with *Stenotrophomas* species, 3 of patients with *Salmonella typhi*, two patients with *Burkholderia pseudomallei*, two patients with Proteus Mirabilis, one patient with *Ralstonia picketti*, one patient with *Aeromonas hydrophila* and two patients consists of fungal species i.e. *Candida* species.

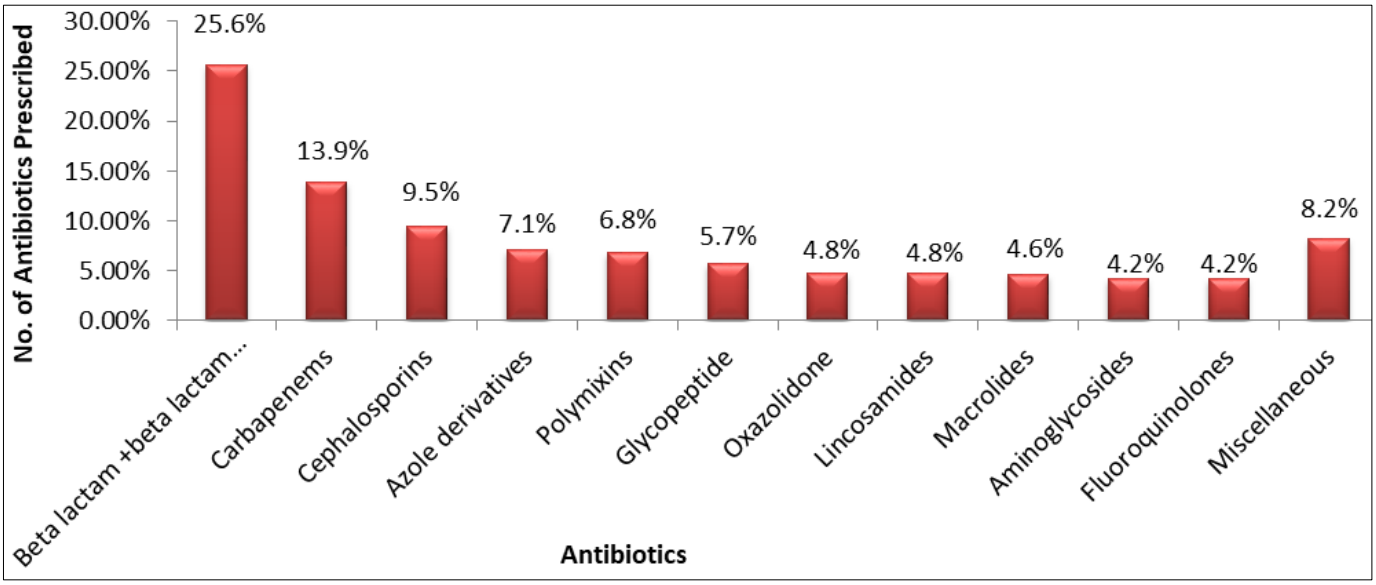


**Fig 8:** Miscellaneous antibiotics

The study sample is prescribed with various classes of antibiotics. The most commonly prescribed antibiotics are beta lactam + beta lactamase inhibitor complex with 25.6%. Followed by 13.9% of carbapenems, 9.5% of cephalosporins, 7.1% of azole derivatives, 6.8% of polymixins, 5.7% of glycopeptides, 4.8% of oxazolidones and lincosamides, 4.6% of macrolides, 4.2% of aminoglycosides, fluoroquinolones and 8.2% of various other classes of antibiotics.

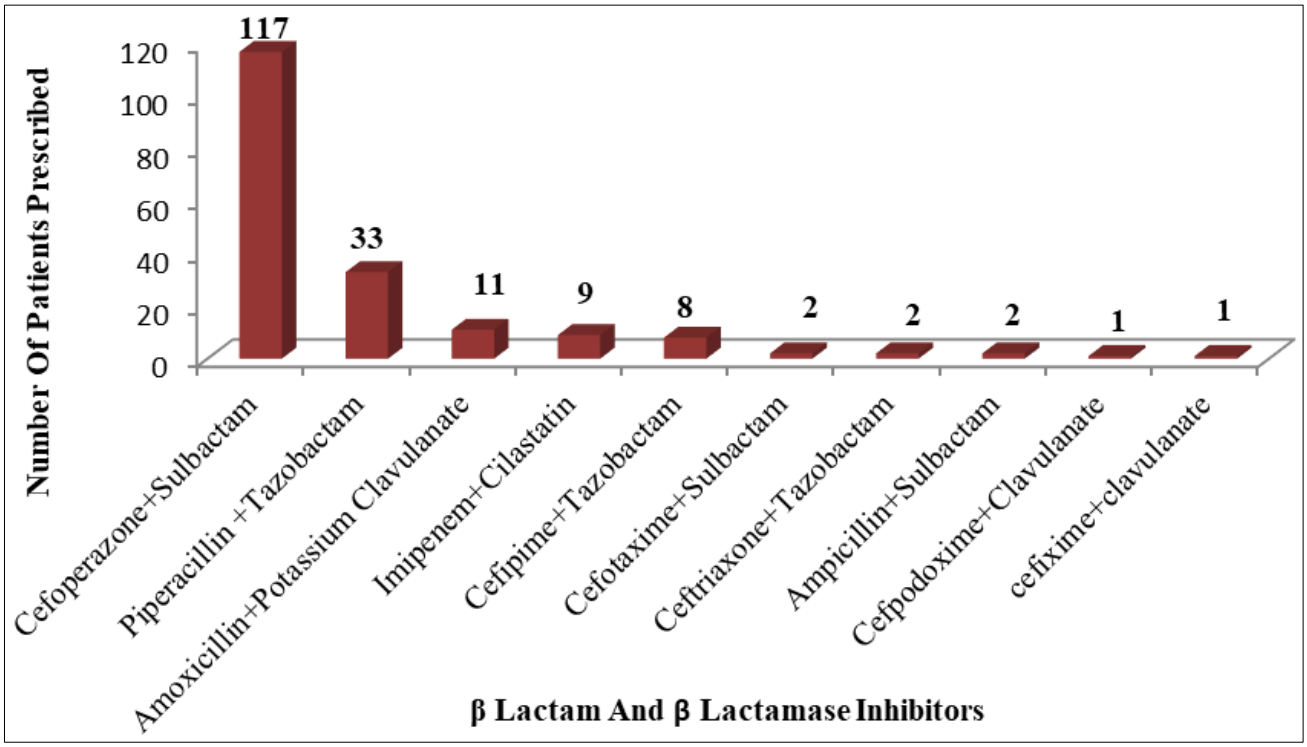


**Fig 9:** Prescription pattern of β-lactam and β-lactamase inhibitors

The study samples are prescribed with different combinations belonging to beta lactam and beta lactamase inhibitors. Patients prescribed with cefoperazone + sulbactam are more in number i.e. 117 (62.9%). Followed by piperacillin + tazobactam 33 (17.7%), amoxicillin + potassium clavulanate 11 (5.9%), imipenem + cilastation 9 (4.8%), cefepime + tazobactam 8 (4.3%), cefotaxime + sulbactam 2 (1%), ceftriaxone +tazobactam 2 (1%), ampicillin + sulbactam 2 (1%), cefpodoxime + clavulanate 1 (0.5%), cefexime + clavulanate 1 (0.5%).

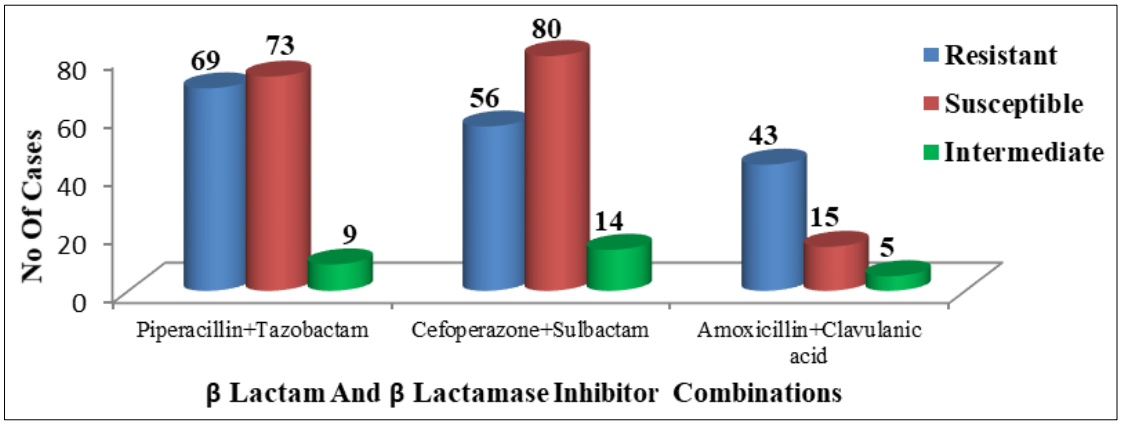


**Fig 10:** Sensitivity pattern of β-lactam and β-lactamase inhibitor combinations

The study consists of 212 cultured samples. The three types of beta lactam and beta lactamase inhibitor combinations are tested for sensitivity pattern. Among the three piperacillin + tazobactam showed resistance in more number of samples i.e. 69. Followed by cefoperazone + sulbactam (56), amoxicillin + clavulanate (43). Cefoperazone + sulbactam were found to be susceptible in more of samples i.e. 80. Followed by piperacillin + tazobactam (73), amoxicillin + clavulanate (15). cefoperazone + sulbactam found to show intermediate action in more number of samples i.e. 14. Followed by piperacillin + tazobactam (9), amoxicillin + clavulanate (5).

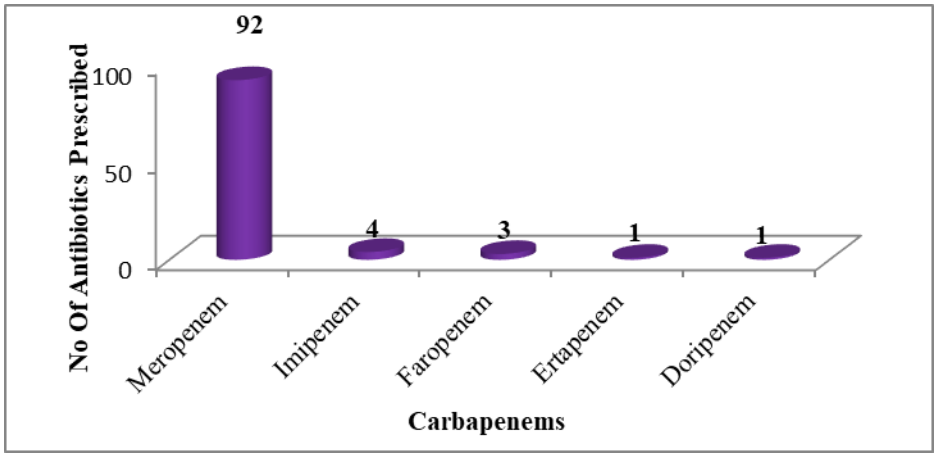


**Fig 11:** Prescription pattern of carbapenems

The study samples were prescribed with different drugs belonging to carbapenems group of antibiotics. Among those meropenem were prescribed in more number of samples i.e. 92. Followed by imipenem (4), faropenem (3), ertapenem (1) and doripenem (1).

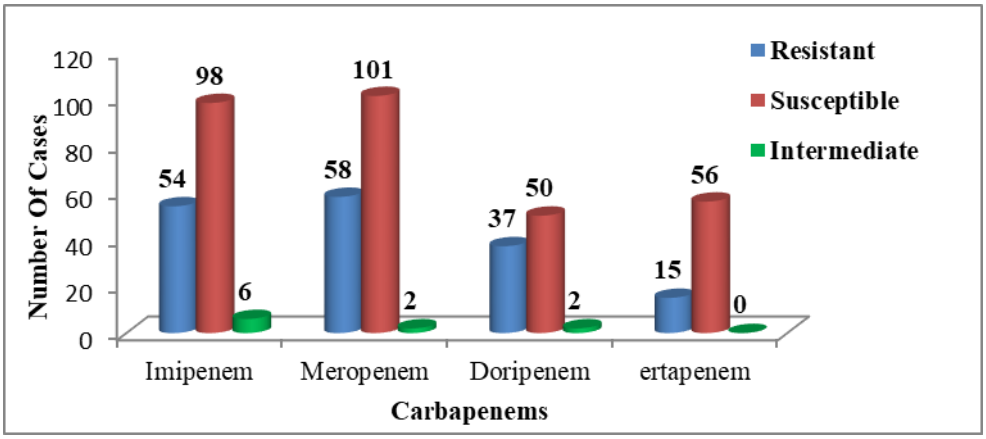


**Fig 12:** Sensitivity pattern of carbapenems

The study sample was prescribed with different drugs of carbapenems. Among those drugs meropenem showed resistance in more number of cases i.e. 58. Followed by imipenem (54), doripenem (37) and ertapenem (15), meropenem showed susceptible pattern in many cases i.e. 101. Followed by imipenem (98), ertapenem (56), doripenem (50). Imipenem showed intermediate action against organisms in many cases i.e. 6. Followed by meropenem (2), doripenem (2).

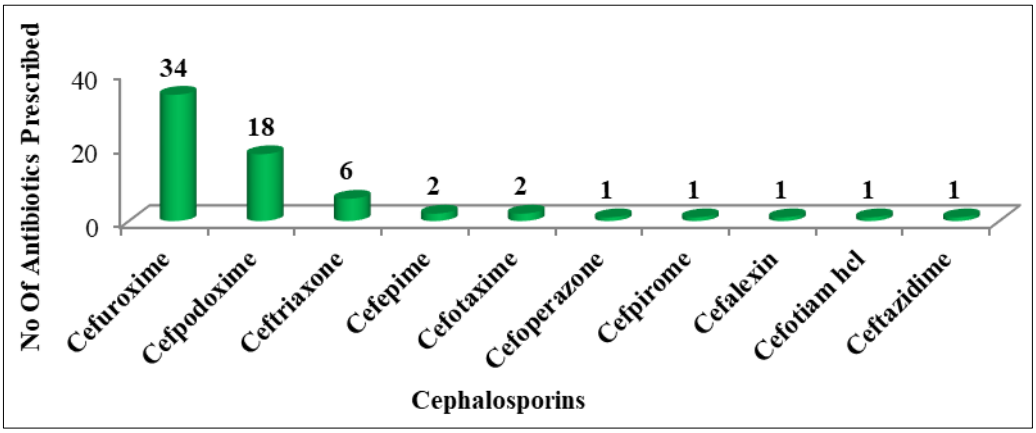


**Fig 13:** Prescription pattern of cephalosporins

The study sample was prescribed with different antibiotics belonging to class of cephalosporins. Among the cephalosporins, cefuroxime was prescribed in more number of samples i.e. 34. Followed by cefpodoxime (18), ceftriaxone (6), cefepime (2), cefotaxim (2), cefoperazone (1), cefpirome (1), cefalexin (1), cefotiam hcl (1) and ceftazidime (1).

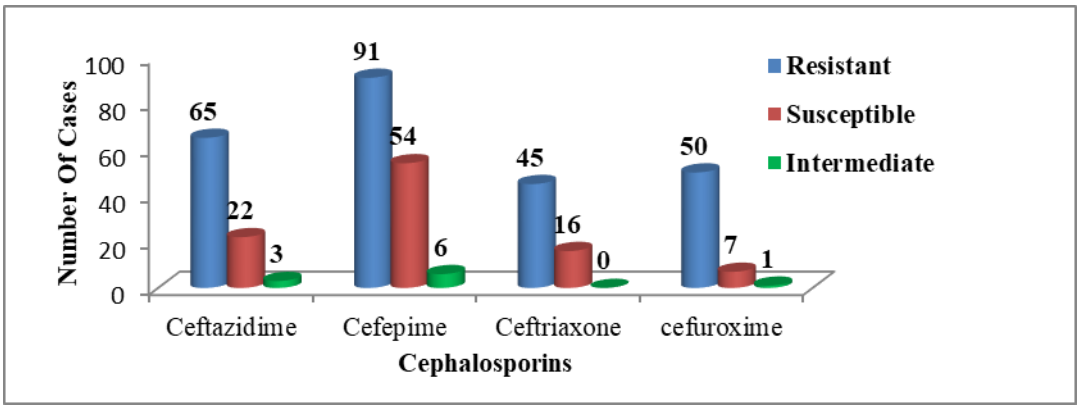


**Fig 14:** Sensitivity pattern of cephalosporins

The study sample was prescribed with different antibiotics belonging to class of Cephalosporins. Among the Cephalosporins, Cefipime showed resistance in more number of cases i.e. 91. Followed by Ceftazidime (65), Cefuroxime (50) and Ceftriaxone (45). Cefepime was susceptible to organisms in many cases i.e. 54. Followed by Ceftazidime (22), Ceftriaxone (16), and Cefuroxime (7). Cefipime showed intermediate action in six cases. Followed by Ceftazidime (3), Cefuroxime (1).

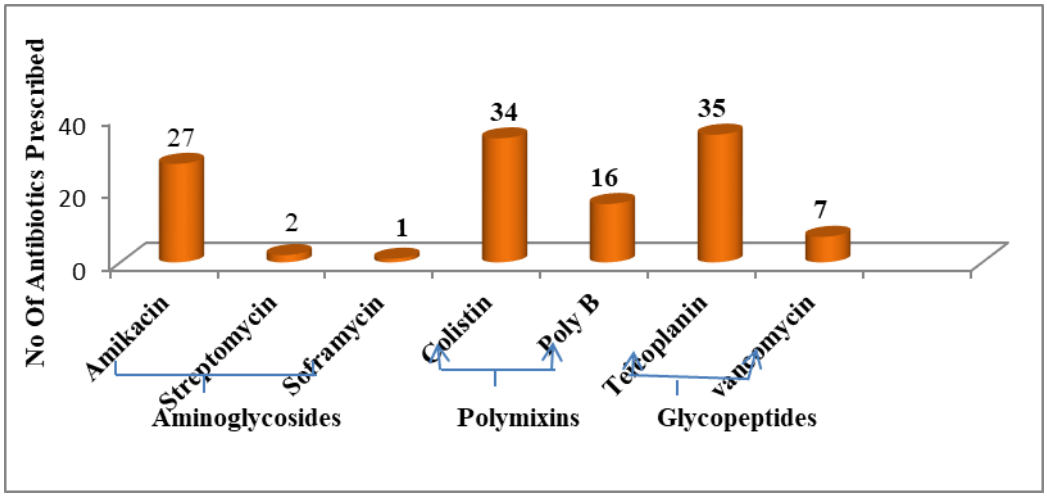


**Fig 15:** Prescription pattern of amino glycosides, polymixins and glycopeptides

The study population was prescribed with antibiotics belonging to aminoglycosides, polymixins and glycopeptides. Among aminoglycosides, amikacin was prescribed in more number of cases i.e. 27. Followed by streptomycin (2), soframycin (1). Among polymixins, colistin was prescribed in 34 patients followed by Poly B in 16 patients. Among glycopeptides, teicoplanin was prescribed in 35 patients followed by vancomycin in 7 patients.

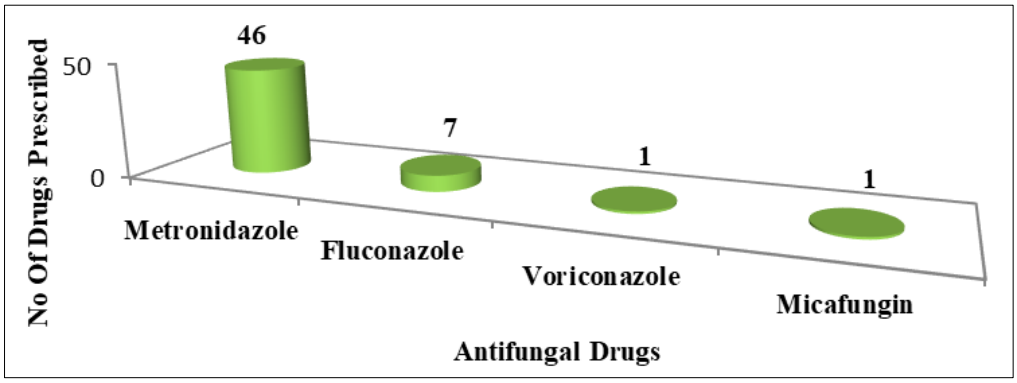


**Fig 16:** Prescription pattern of antifungal drugs

The study population was prescribed with antifungal drugs. Metronidazole was prescribed in 46 patients followed by Fluconazole in 7 patients, voriconazole in one patient, micofungin in one patient.

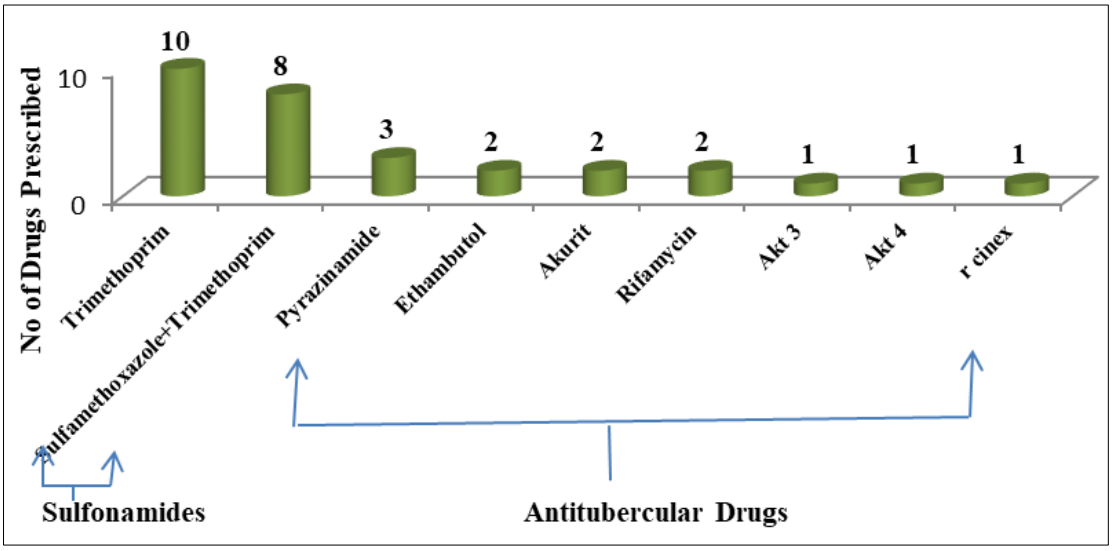


**Fig 17:** Prescription pattern of sulfonamides, antitubercular drugs

The study population was prescribed with sulfonamides, antitubercular drugs. Among sulfonamides, trimethoprim was prescribed in 10 patients followed by sulfamethoxazole + trimethoprim in 8 patients. Among antitubercular drugs, pyrazinamide was prescribed in 3 patients, followed by ethambutol in 2 patients, akurit in 2 patients, rifamycin in 2 patients, AKT 3 in one patient, AKT 4 in one patient, R-Cinex in one patient.

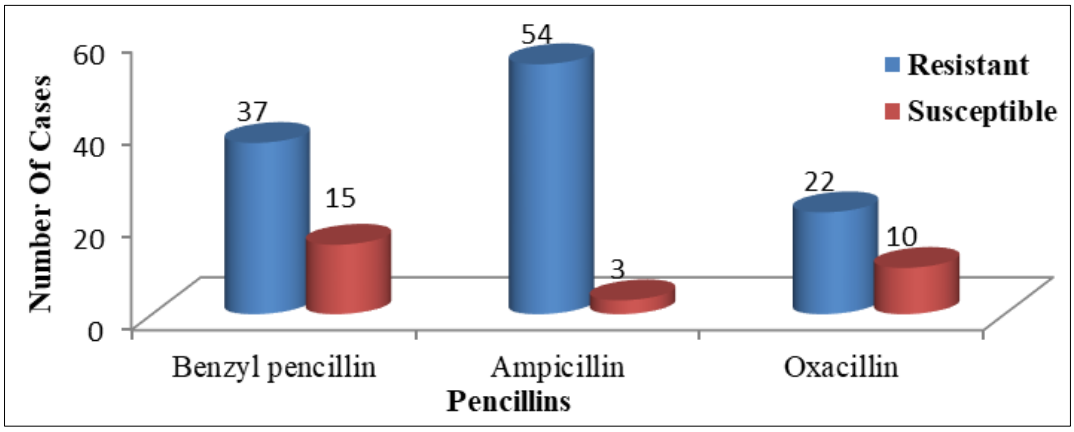


**Fig 18:** Sensitivity pattern of penicillins

The study population was prescribed with penicillins. Among the pencillins, ampicillin showed resistance in 54 patients. Followed by benzyl pencillin in 37 patients, oxacillin in 22 patients. Benzyl penicillin showed susceptible pattern in 15 patients. Followed by oxacillin in 10 patients and ampicillin in 3 patients.

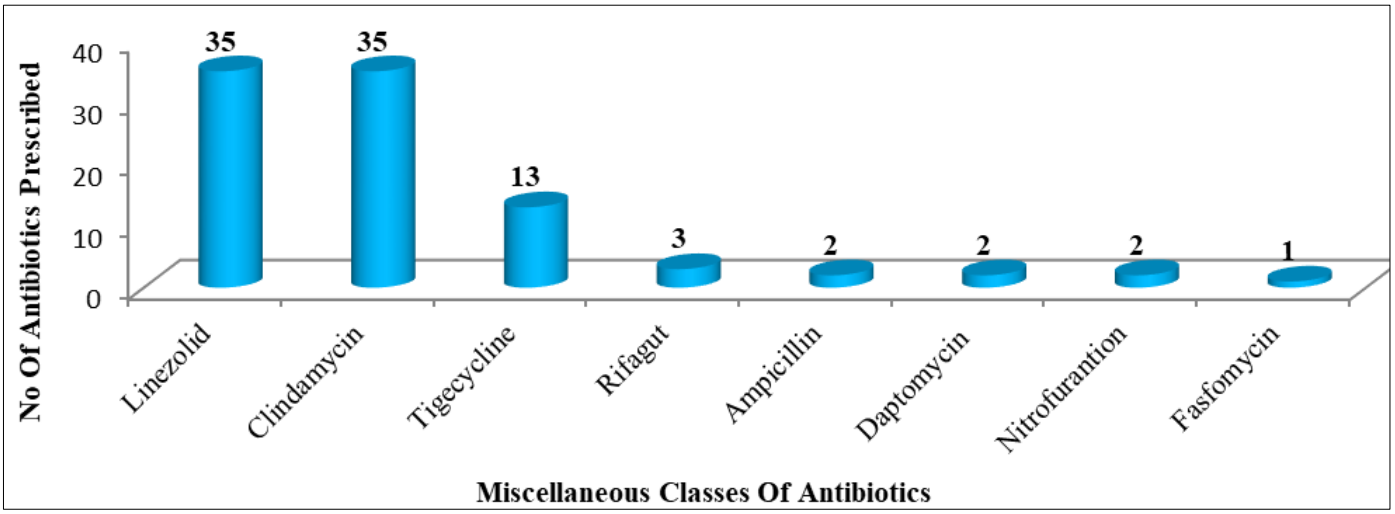


**Fig 19:** Miscellaneous classes of antibiotics

The study samples were prescribed with different classes of antibiotics. Among them linezolid and clindamycin was prescribed in more number of patients. Followed by tigecycline prescribed in 13 patients, rifagut in 3 patients, ampicillin in 2 patients and daptomycin in 2 patients, nitrofurantoin in two patients and fasfomycin in one patient.

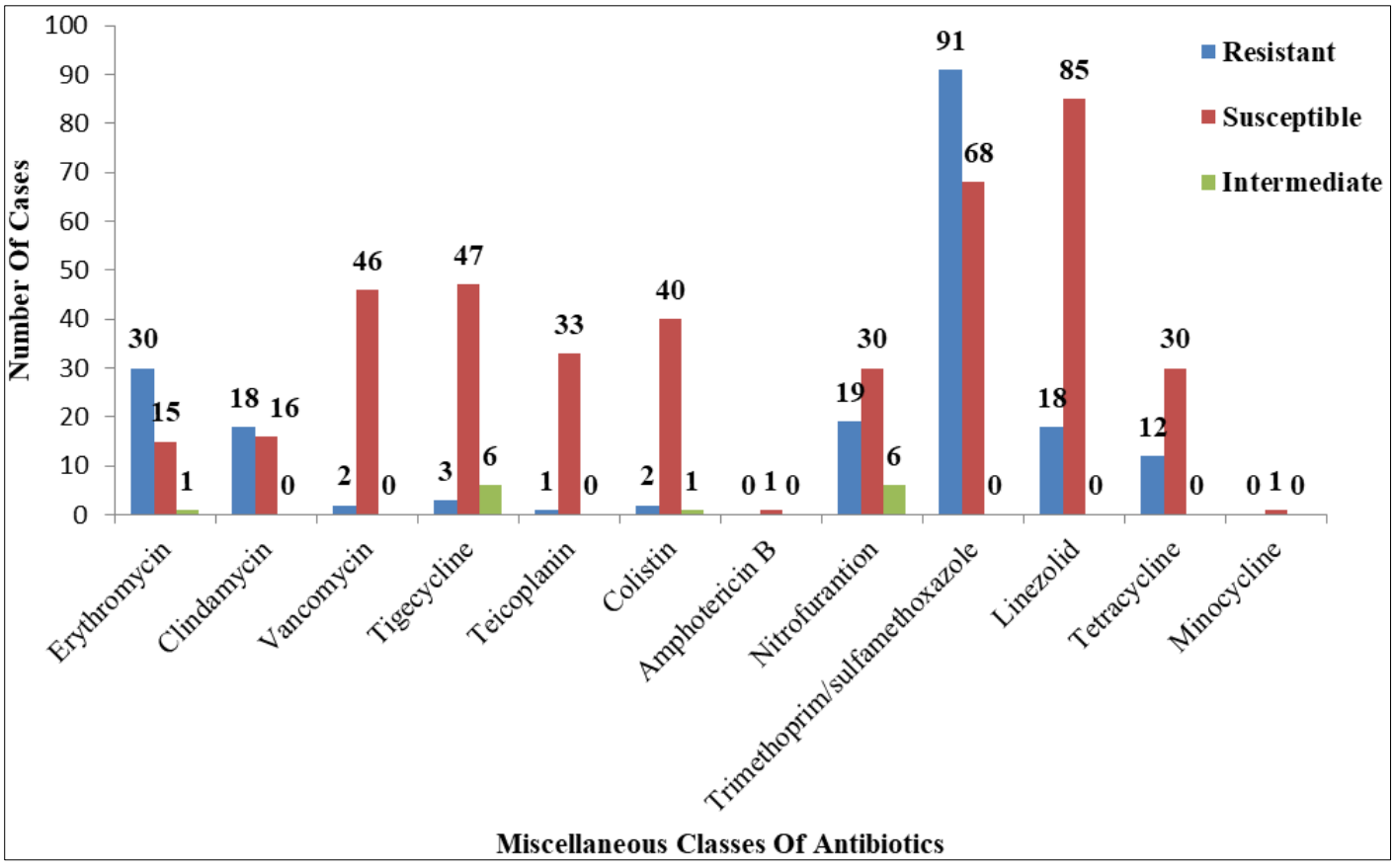


**Fig 20:** Sensitivity pattern of various classes of antibiotics

The study population was prescribed with different antibiotics. Among them Trimethoprim/Sulfamethoxazole was resistant in many cases i.e. 91. Followed by Erythromycin (30), Nitrofurantoin (19), Clindamycin (18), Linezolid (18), Tetracycline (12), Tigecycline (3), Vancomycin (2), Colistin (2) and Teicoplanin (1). Linezolid was susceptible in more number of cases i.e. 85. Followed by Trimethoprim/Sulfamethoxazole in 68 patients, Tigecycline in 47 patients, Vancomycin in 46 patients, Colistin in 40 patients, Teicoplanin in 33 patients, Nitrofurantoin in 30 patients, Tetracycline in 30 patients, Clindamycin in 16 patients, Erythromycin in 15 patients, Amphotericin B in one patient and Minocycline in one patient. Tigecycline and Nitrofurantoin showed intermediate action in each six patients.

**Table 1:** Sensitivity pattern of antibiotics towards gram positive organisms

| S. No. | Drugs | *Staphylococcus* species | | *Enterococcus* species | |
|---|---|---|---|---|---|
| | | Resistant | susceptible | Resistant | susceptible |
| 1 | Ceftazidime | 1 | 1 | 5 | 0 |
| 2 | Cefepime | 3 | 2 | 4 | 1 |
| 3 | Piperacillin + Tazobactam | 3 | 1 | 4 | 2 |
| 4 | Cefoperazone + sulbactam | 7 | 3 | 4 | 2 |
| 5 | Imipenem | 2 | 2 | 3 | 6 |
| 6 | Meropenem | 3 | 2 | 4 | 4 |
| 7 | Doripenem | 3 | 0 | 3 | 3 |
| 8 | Ertapenem | 0 | 0 | 1 | 4 |
| 9 | Amikacin | 0 | 13 | 2 | 7 |
| 10 | Gentamycin | 8 | 17 | 7 | 6 |
| 11 | Tobramycin | 0 | 0 | 0 | 1 |
| 12 | Ciprofloxacin | 24 | 6 | 11 | 6 |
| 13 | Levofloxacin | 24 | 6 | 11 | 4 |
| 14 | Tigecycline | 0 | 6 | 0 | 6 |
| 15 | Trimethoprim/sulfamethoxazole | 12 | 13 | 3 | 4 |
| 16 | Ampicillin | 1 | 0 | 0 | 0 |
| 17 | Benzyl penicillin | 25 | 4 | 8 | 5 |
| 18 | Oxacillin | 21 | 11 | 12 | 6 |
| 19 | Amoxicillin + Clavulanic acid | 1 | 0 | 3 | 0 |
| 20 | Colistin | 0 | 2 | 0 | 2 |
| 21 | Nitrofurantoin | 1 | 0 | 1 | 5 |
| 22 | Teicoplanin | 0 | 22 | 1 | 9 |
| 23 | Tetracycline | 0 | 25 | 7 | 4 |
| 24 | Erythromycin | 19 | 10 | 7 | 0 |
| 25 | Clindamycin | 15 | 12 | 0 | 0 |
| 26 | Vancomycin | 0 | 28 | 2 | 10 |
| 27 | Linezolid | 1 | 20 | 0 | 13 |
| 28 | Ceftriaxone | 1 | 0 | 2 | 1 |

Among 212 cultured samples, 50 samples consist of gram positive organisms. Benzyl penicillin (25) was found to be more resistant towards staphylococcus species whereas Vancomycin (28) was found to be more susceptible towards the staphylococcus species. Oxacillin (12) was found to be more resistant towards the *Enterococcus* species whereas Linezolid (13) was found to be more susceptible towards the *Enterococcus* species. Sensitivity pattern of various antibiotics toward gram positive organisms was mentioned in Table 1.

**Table 2:** Sensitivity pattern of antibiotics towards gram negative organisms

| S. No. | Drugs | *E. coli* | | *Klebsiella* species | | *Acinetobacter* species | | *Pseudomonas* species | |
|---|---|---|---|---|---|---|---|---|---|
| | | Resistant | Susceptible | Resistant | Susceptible | Resistant | Susceptible | Resistant | susceptible |
| 1 | Ceftazidime | 21 | 4 | 19 | 2 | 12 | 2 | 8 | 11 |
| 2 | Cefepime | 41 | 14 | 22 | 20 | 16 | 2 | 10 | 8 |
| 3 | Piperacillin + Tazobactam | 20 | 32 | 23 | 21 | 17 | 1 | 10 | 8 |
| 4 | Cefoperazone + sulbactam | 19 | 40 | 18 | 22 | 9 | 2 | 9 | 9 |
| 5 | Imipenem | 13 | 47 | 15 | 27 | 17 | 1 | 9 | 10 |
| 6 | Meropenem | 13 | 51 | 17 | 27 | 17 | 1 | 8 | 12 |
| 7 | Doripenem | 7 | 20 | 9 | 17 | 16 | 0 | 5 | 9 |
| 8 | Ertapenem | 4 | 35 | 10 | 18 | 0 | 0 | 1 | 0 |
| 9 | Amikacin | 10 | 48 | 8 | 29 | 0 | 1 | 7 | 11 |
| 10 | Gentamycin | 26 | 32 | 18 | 25 | 12 | 5 | 8 | 8 |
| 11 | Tobramycin | 3 | 7 | 0 | 12 | 3 | 0 | 2 | 3 |
| 12 | Ciprofloxacin | 56 | 5 | 20 | 19 | 17 | 1 | 9 | 7 |
| 13 | Levofloxacin | 26 | 5 | 11 | 12 | 14 | 0 | 8 | 7 |
| 14 | Tigecycline | 0 | 16 | 1 | 11 | 0 | 9 | 2 | 1 |
| 15 | Trimethoprim/Sulfamethoxazole | 38 | 18 | 21 | 18 | 13 | 3 | 2 | 2 |
| 16 | Ampicillin | 35 | 1 | 18 | 0 | 0 | 0 | 1 | 0 |
| 17 | Benzyl penicillin | 2 | 1 | 0 | 1 | 3 | 0 | 0 | 0 |
| 18 | Oxacillin | 0 | 1 | 22 | 21 | 16 | 2 | 11 | 10 |
| 19 | Amoxicillin + Clavulanic acid | 26 | 8 | 10 | 7 | 0 | 0 | 1 | 0 |
| 20 | Colistin | 0 | 9 | 1 | 12 | 0 | 14 | 0 | 8 |
| 21 | Nitrofurantoin | 4 | 23 | 11 | 2 | 0 | 0 | 0 | 1 |
| 22 | Teicoplanin | 0 | 33 | 0 | 0 | 0 | 1 | 0 | 0 |
| 23 | Tetracycline | 0 | 32 | 10 | 0 | 1 | 2 | 0 | 0 |
| 24 | Erythromycin | 2 | 15 | 0 | 1 | 2 | 1 | 0 | 0 |
| 25 | Clindamycin | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 0 |
| 26 | Vancomycin | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 |
| 27 | Linezolid | 0 | 2 | 0 | 0 | 0 | 10 | 2 | 0 |
| 28 | Ceftriaxone | 29 | 1 | 13 | 5 | 0 | 1 | 1 | 0 |

Among 212 cultured samples, 162 samples consist of gram negative organisms. Ciprofloxacin (56) was found to be more resistant towards *E. coli* where as Meropenem (51) was found to be more susceptible towards the *E. coli*. Piperacillin + Tazobactam (23) was found to be more resistant towards the *Klebsiella* species where as Amikacin (29) was found to be more susceptible towards the *Klebsiella* species. Levofloxacin, Ciprofloxacin, Piperacillin + Tazobactam, Meropenem (17) was found to be more resistant towards the *Acinetobacter* species where as Colistin (14) was found to be susceptible towards the *Acinetobacter* species. Oxacillin (11) was found to be more resistant towards the *Pseudomonas* species where as Cefepime (11) was found to be more susceptible towards the *Acinetobacter* species. Sensitivity pattern of various antibiotics toward gram positive organisms was reported in Table 2.

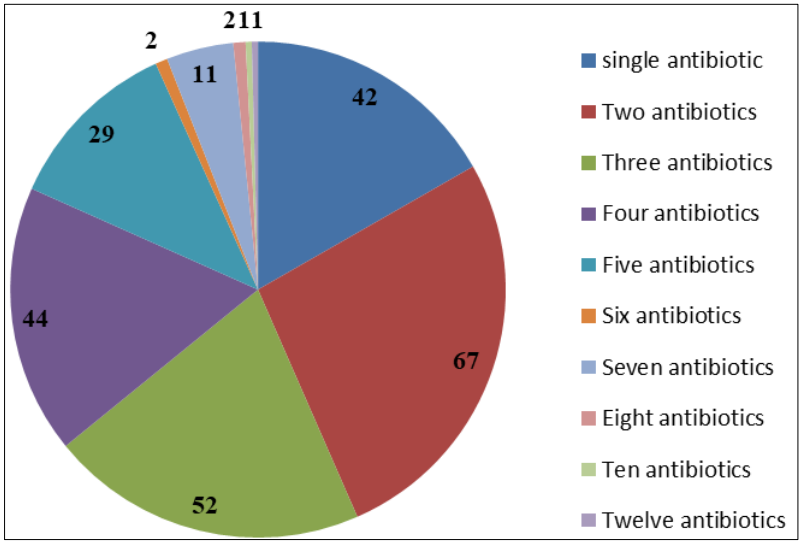


**Fig 21:** Statistical representation of subjects based on number of antibiotics prescribed

Among the 255 study sample, single antibiotic (monotherapy) was prescribed in 42 cases. In polytherapy prescriptions two antibiotics (26.6%) were prescribed predominantly. Followed by three antibiotics (52), four antibiotics (44), five antibiotics (29), seven antibiotics in 11 cases, six antibiotics and eight antibiotics in 2 patients, ten and twelve antibiotics in single patient.

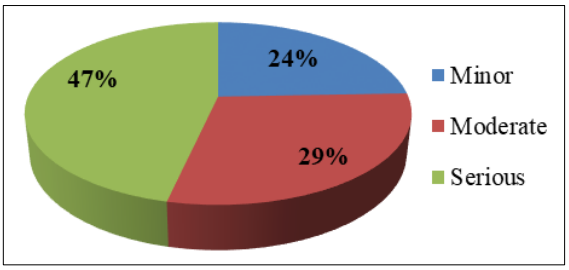


**Fig 22:** Interactions of antibiotics with other drugs

Various categories of interactions were found with the antibiotics. Out of 255 prescriptions serious interactions were found in 59 (47%) cases, moderate interactions were found in 37 (29%) cases, minor interactions were found in 31 (24%).

**Discussion**

A total of 255 patients with prescription pattern of antibiotics and its resistance were enrolled among them 163 (63%) were male patients and 92 (36%) were female patients in which male patients were more compared to females. In our study more number of patients was observed at age group of 51-60 years (28%) followed by 61-70 years (22.7%), 71-80 years (14%) and less number of patients at age group 81-90 years (4%) and one patient at age group below ten years.

During 6 months of this study period, the study samples were collected among various departments in a tertiary care hospital, in which 71 (27.8%) cases were found in General Medicine followed by 56 (21.9%) cases of Infectious Diseases, 29 (9.8%) cases of neurology, 18 (7%) cases from respiratory ward, 16 (6.2%) cases from nephrology, 14 (5.4%) cases from cardiology,10 (3.9%) cases are accidental cases, 7 (2.7%) cases from oncology, 5(1.9%) cases from urology, 3 (1.1%) cases from endocrinology and 1 (0.3%) case from orthopaedics department.

In the present study different dosage forms of antibiotics were prescribed in the hospital. Out of which majority of the antibiotics were prescribed in injection form 242 (74%), followed by tablets 76 (23.4%), ointments 4(1.2%) and capsules 2 (0.6%). Our study describes the distribution of antibiotics and its susceptibility pattern of microbial species isolated from in-patient population in a tertiary care hospital.

In the present study out of 255 study samples, culture test was done in 212 patients, of which 48 cultured samples consist of gram positive organisms with three different species and 162 cultured samples consist of gram negative organisms. Among the gram positive organisms, *Staphylococcus aureus* 15 (31.2%) was seen in more number of study subjects followed by *Staphylococcus epidermidis* 11 (22.9%), *Enterococcus faecium* 9 (18.7%), *Staphylococcus haemolyticus* 6 (12.5%), *Streptococcus pyogenes*, *Enterococcus faecalis* 2 (4.1%), *Streptococcus viridians*, *Streptococcus agalactiae* and *Enterococcus casseliflavus* 1 (2%) and they were resistant to most of the antibiotics. Among the gram negative organisms *E. coli* 65 (37.5%) was more resistant to antibiotics when compared with other organisms like *Klebsiella* species 45 (26%), *Acinetobacter baumannii* 19(10.9%), *Pseudomonas* species 18 (10.4%), *Enterobacter* species 6 (3.4%), *H. pylori* 4 (2.3%), *Stenotrophomonas maltophilia* 3 (1.7%), *Salmonella typhi* 3 (1.7%), *Burkholderia pseudomallei*, *Serratia marcescens*, *Proteus mirabilis*, *Candida* species 2 (1.1%), *Ralstonia pickettii* and *Aeromonas hydrophila* 1 (0.5%).

Around 30% of the hospitalized patients are treated with antibiotics. The study subjects were prescribed with various classes of antibiotics. In this, the most commonly prescribed antibiotics are Beta Lactam + Beta Lactamase inhibitor combinations 186 (25.6%) followed by 101(13.9%) of Carbapenems, 69 (9.5%) of Cephalosporins, 52 (7.1%) Of Azole derivatives, 50 (6.8%) of Polymixins, 42 (5.7%) of Glycopeptides, 35 (4.8%) of Oxazolidones, Lincosamides, 34 (4.6%) of Macrolides, 31 (4.2%) of Aminoglycosides and Flouroquinolones, 60 (8.2%). The study samples were prescribed with different drugs belonging to Carbapenem group of antibiotics. Among the Carbapenems, Meropenem was prescribed in more number of samples i.e. 92 (91%) and Doripenem 1 (0.9%) was least prescribed. Resistant, susceptible, intermediate patterns of Carbapenems can be seen. Among those Meropenem showed high resistance in more number of cases i.e. 58 and Ertapenem (5) showed lower resistance. Meropenem showed susceptible pattern in many cases i.e. 101. Followed by Imipenem (98), Ertapenem (56) and Doripenem (50). Imipenem showed intermediate action against organisms in many cases i.e. 6. Followed by Meropenem (2), Doripenem (2).

The present study sample was prescribed with different antibiotics belonging to class of cephalosporins. Among those Cefuroxime ($2^{nd}$ generation) was found to be most commonly prescribed drug i.e. 34 (50.7%) and least commonly prescribed drugs were Cefaperazone, Cefipime, Cefalexin, Cefotiam HCl and Ceftazidime 1 (1.4%). Followed by Ceftazidime (22), Ceftriaxone (16), and Cefuroxime (7). Cefipime showed intermediate action in six cases. Followed by Ceftazidime (3), Cefuroxime (1). The study population was prescribed with antibiotics belonging to aminoglycosides, Polymixins and Glycopeptides. Among aminoglycosides, Amikacin was prescribed in more number of cases i.e. 27. Followed by Streptomycin (2), Soframycin (1). Among Polymixins, Colistin was prescribed in 34 patients followed by Poly B in 16 patients. Among Glycopeptides, Teicoplanin was prescribed in 35 patients followed by Vancomycin in 7 patients.

In the present study, Out of 255 study samples, few patients were prescribed with antifungal drugs along with antibiotics to treat infections caused by microorganisms. The most commonly prescribed antifungal drugs are Metronidazole in 46 patients and Micofungin was least prescribed. The study population was prescribed with Sulfonamides and antitubercular drugs. Among Sulfonamides, Trimethoprim was prescribed in more number of patients followed by Sulfamethoxazole + Trimethoprim. Among Anti tubercular drugs, Pyrazinamide was more prescribed drug followed by Ethambutol, Akurit, Rifamycin, AKT 3, AKT 4, R-Cinex.

The study population was prescribed with different classes of antibiotics. Among them Linezolid and Clindamycin was prescribed in more number of patients i.e. 35 (37.6%). Followed by Tigecycline prescribed in 13 patients, Rifagut in 3 patients, Ampicillin in 2 patients, Daptomycin in 2 patients, Nitrofurantoin in two patients and fasfomycin in one patient. Similar comparison were found in other studies too.

From the overall study population, the sensitivity pattern of various classes of antibiotics towards microbial agents can be seen. Among them Trimethoprim/Sulfamethoxazole was resistant in many cases i.e. 91 and the least resistance was shown by Teicoplanin i.e. 1. Linezolid was susceptible in more number of cases i.e. 85. Amphotericin B and Minocycline (1) were least susceptible to organisms. Tetracycline and Nitrofurantoin showed intermediate action in each six patients. The sensitivity pattern of Penicillins was studied specifically from the overall population. Among the Penicillins, Ampicillin showed resistance in more cases and Oxacillin showed resistance in least cases. Benzyl penicillin showed susceptible pattern in more cases and ampicillin in 3 patients.

In our study when antibiotic resistance and susceptibility pattern was studied from the Gram negative and Gram positive organisms isolated from the study samples, it was observed that most common bacterial isolate among gram negative organisms are *E. coli* followed by *Klebsiella* species, *Acinetobacter* species and Pseudomonas Species. Out of 162 gram negative organisms, Ciprofloxacin was found to be highly resistant when tested on *E. coli* and *Acinetobacter* species. Piperacillin + Tazobactam were found to be highly resistant when tested on *Klebsiella* species and Oxacillin was found to be highly resistant against Pseudomonas Species. Meropenem was found to be highly susceptible against Klebsiella and Pseudomonas Species. Only *Klebsiella* species were found highly susceptible to amikacin and *Acinetobacter* species were found highly susceptible to colistin among all other antibiotics.

Out of 50 gram positive organisms, Benzyl penicillin was found to be highly resistant when tested on Staphylococcus Species. Tetracycline, Erythromycin and Clindamycin was found to be highly resistant when tested on Streptococcus Species and Oxacillin showed higher resistance on *Enterococcus* species. It was observed that most common bacterial isolate among Gram positive organisms are Staphylococcus Aureus followed by *Enterococcus* species and *Streptococcus* species. Tobramycin, Tigecycline and Colistin have shown no resistance when tested on *Staphylococcus Aureus, Streptococcus* species and *Enterococcus* species whereas Staphylococcus Species and *Streptococcus* species were found highly susceptible to Vancomycin, only *Streptococcus* species were found highly susceptible to Benzyl Penicillin, Linezolid and Ceftriaxone. *Enterococcus* species were found highly susceptible to Linezolid. *Streptococcus* isolates were found susceptible to Vancomycin and Linezolid.

In the present study monotherapy of antibiotics was prescribed in 18% of prescriptions whereas polytherapy of antibiotics was prescribed in 82% of prescriptions. Antibiotics may have interactions with other prescription and non-prescription medications. Poly pharmacy is one of the major causes for drug drug interactions. It is difficult to treat patients in the hospital with multiple co morbidities with less number of drugs for treatment of specific conditions as well as for prophylaxis, but it is also essential to keep a balance between number of drugs and effective pharmacotherapy.

In the present study fluconazole + Pantoprazole was found to be a minor interaction with more no of cases (9) followed by Amikacin + Diclofenac (4). Total 31 minor interactions were found in the study. Similarly 37 major interactions were found in the study and they have to be monitor closely. Claribid + Piperacillin was found to be a major interaction with more number of cases (6) followed by Colistin + Tacrolimus. About 59 serious interactions were found in the study where Linezolid + Tramadol in 16 cases followed by Claribid + Ondansetron (14). This study was in consistent with clinically significant drug interactions.

## Conclusion

Male patients are more infected with bacteria than females and most of the patients belonged to age group of 51-60 years. In our study poly therapy prescriptions are more when compared to monotherapy prescriptions of antibiotics. Most of them were administered through intravenous route. The class of drugs observed were β-lactam and β-lactamase inhibitor combinations were frequently prescribed and mostly Cefoperazone + Sulbactam are the drug of choice. Of the single antibiotics Carbapenems were prescribed widely. Out of the isolated gram positive organisms Staphylococcus Species was frequently seen and in isolated gram negative organisms *E. coli* was commonly seen. It was observed that Cefipime and Trimethoprim/Sulfamethoxazole showed more resistance towards the isolated organisms. Meropenem was more susceptible towards the isolated organisms.

Out of the gram positive organisms, Benzyl Penicillin showed high resistance towards *Staphylococcus* species; Tetracycline, Erythromycin and Clindamycin were more resistant toward *Streptococcus* species; Ciprofloxacin and Levofloxacin were more resistant against *Enterococcus* species and among gram negative organisms Ciprofloxacin was more resistant against *E. coli*, Piperacillin+ Tazobactam was more resistant against *Klebsiella* species, Piperacillin + Tazobactam, Imipenem, Meropenem and Ciprofloxacin were more resistant against *Acinetobacter* species and Oxacillin showed high resistance towards *Pseudomonas* species. It was observed that interactions of antibiotics with various drugs were common.

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