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A Study on Trends and Usage Pattern of Antibiotics among In-Patients in a Tertiary Care Hospital

Abhishek Pradhan[1], Fatima Ridha Safar[2], Akhil Raj[2], Abhilash C[2], Architha Aithal[2], A.R Shabarayya[3]

[1]Asst. Professor, Department of Pharmacy Practice, Srinivas College of Pharmacy, Mangalore, Karnataka, India – 574143.
[2]Student, Department of Pharmacy Practice, Srinivas College of Pharmacy, Mangalore, Karnataka, India – 574143.
[3]Professor & Head, Department of Pharmacy Practice, Srinivas College of Pharmacy, Mangalore, Karnataka, India – 574143

Corresponding Author: Fatima Ridha Safar

ABSTRACT

Antibiotics have effectively prolonged life expectancy and 'antibiotics' revolution has turned the entire landscape of infectious disease by making them curable. Currently, Antibiotics are assumed to be the most commonly prescribed drugs in hospitals, worldwide. But, excessive and inappropriate use of antibiotics renders increased drug resistance, and hence, need for a study regarding sensitivity and resistance pattern of antibiotics for proposal or implementation of rational therapy guidelines. This study will also provide microbiological information to clinicians to pick the most effective treatment options, positively influencing patient outcomes. A prospective observational study was conducted in a total of 220 patients at Srinivas Institute of Medical Science and Research Centre, Mangalore, for a period of six months. In-Patients of either gender who are 18 years old or above, in Respiratory and Nephrology department prescribed with antibiotics were included in the study. Patients under other departments and the ones who are not prescribed with antibiotics and pediatric patients were excluded from the study. Data were collected using a validated data collection form. Data were analyzed using MS Excel 2016. From a total of 220 patients involved in the study, majority were females and young adults in both the departments. The most prescribed antibiotic was found to be Piperacillin - Tazobactam of doses 4.5g and 2.25g. Gram negative organisms isolated were 82.30%, and out of these Klebsiella species being the most frequent. These organisms showed high rates of sensitivity towards Meropenem and Gentamicin. Sensitivity of antibiotics towards species was found to be dwindling and it is an unpleasant warning of emergence of resistance. It can be anticipated in the developing society and routine culturing and sensitivity testing can be performed to detect the emergence of resistance.

Key words: Infection, Antibiotic, Organisms, Resistance, Sensitivity.

INTRODUCTION

Infections caused by microorganisms have been a threat to human life since time immemorial [1]. An infection is an invasion of an organism's body tissues by disease-causing agents like microorganisms such as bacteria and viruses and their multiplication in the host. An infection may be subclinical and show no symptoms or clinically apparent with certain symptoms [2]. How an infection spreads and its effects on the human body depend on the type/s of pathogen/s. The immune system is an effective barrier against infectious agents. However, pathogens may sometimes overwhelm the immune system's ability to ward them off. At this stage, an infection becomes deleterious. Some pathogens have little effect at all. Others produce toxins or inflammatory substances that trigger negative responses by the body. These variations indicate that some infections may be mild and barely noticeable, while others are severe and life-threatening [3]. These have been a major concern for the high morbidity and mortality in humans during the pre-antibiotic era. Some of the virulent organisms with the potential to spread infection from person to person at a very rapid rate may cause worldwide pandemics, epidemics, or outbreaks [1]. With the remarkable discovery of the first antibiotic, "Penicillin" by Sir Alexander Fleming in the year 1928, patients could be effectively cured of many life threatening infections. This gave a huge relief and breakthrough to the medical practitioners and thus marked the advent of the antibiotic revolution which ultimately changed the course of modern medicines [4]. The next three decades saw the development and discovery of a wide variety of antimicrobial agents. Antibiotics being one of the most important discoveries in the field of medical science are widely used against infectious agents. Most of the antibiotics used currently have been discovered more or less accidentally and their mechanisms of action have only been elucidated after their discovery. An antibiotic is a type of antimicrobial substance active against bacteria. It is the far-reaching type of antibacterial agent to combat bacterial infections. Antibiotics have played a vital role in concluding major advances in medicine and surgery. It has successfully prevented or treated infections that occur in patients with chronic diseases such as diabetes, end-stage renal disease or rheumatoid arthritis, complex surgeries, and in patients with chemotherapy treatments. Today, antibiotics are still powerful, life-saving medications for people with certain serious infections. They can also prevent less-serious infections from worsening. There are many classes of antibiotics like Penicillins, Cephalosporins, Fluoroquino-lones, Aminoglycosides, Monobactams, Carbapenems, Macrolides, and a few others with most of them having different mechanisms of action. Certain types of antibiotics work best for specific types of bacterial infections [5]. How do antibiotics work against bacteria? Antibiotics alleviate bacterial infections either by killing bacteria or slowing and suspending its growth. They do this by:

- Attacking the wall or coating surrounding bacteria
- Interfering with bacteria reproduction
- Blocking protein production in bacteria

Antibiotics have effectively prolonged life expectancy and the ‘antibiotics’ revolution has reversed the entire landscape of infectious disease thus making the disease healable. Antibiotics are currently the most commonly prescribed drugs in hospitals, worldwide. But, excessive and inappropriate use of antibiotics has rendered increased drug resistance [2]. Grievously, the enormous prerequisite of these valuable drugs had a momentous downturn. The fruitful use of any therapeutic agent is always superseded by the potential evolution of resistance to that agent from the time it is initial employed. The pace of discovery of newer molecules declined from 1970 to 1987. It has reached a “disclosure vacuum” level from 1987 forth up till now. This is the post-antibiotic era in which medical practitioners have to treat and manage all types of infections with equal or greater efficiency [1]. Though antibiotics were always considered one of the wonder discoveries of the 20th century, the real wonder that came along was the development of antibiotic resistance in hospitals, communities, and the environment concomitant with their use. The spontaneous natural development of antibiotic resistance in the microorganisms in nature is a slow process. However, the frequent and inappropriate use of a newly discovered antibiotic drug leads to the development of altered mechanisms in the pathophysiology of the perturbed microbes as a endurance strategy. Aforesaid antibiotic election pressure kills the susceptible microbes and aids in eclectic replication of drug-resistant bacteria. These resistant bacteria already existed in the populace along with the susceptible susceptible bacteria that acquired resistance during antibiotic treatment. Conclusively, such resistant bacteria multiply profusely and wholly oust the susceptible bacterial population. This results in treatment failure or ineffective management of such infected patients. Antibiotic resistance has been observed and reported with practically all the newly discovered antibiotic molecules to date. Antibiotic resistance makes the treatment of patients difficult, costly, and sometimes impossible. The emergence of antibiotic resistance in pathogens has lead to a great public health perturb. Antibiotic resistance is well recognized as a global threat to human health [4]. Factors that contribute to the development of antibiotic resistance include:

- Over-prescription of antibiotics
- Patients not finishing the entire antibiotic course
- Poor infection control in health care settings
- Poor hygiene and sanitation
- Absence of new antibiotics being discovered
- Self-medication

Following an unprecedented number of antibiotic discoveries in the last years, the number of new antibiotics being identified has slumped to an all-time low. Without new drugs to combat the ever-increasing number of antibiotic resistances, society is running out of options in the treatment of infections [5]. As a consequence of antibiotic resistance, once treatable infections have become difficult to cure, raising costs to both patients and society.

The U.S. Centers for Disease Control and Prevention estimates that antibiotic resistance is responsible for more than 2 million infections and 23,000 deaths each year in the United States. In India, the burden of Infectious disease is amongst the highest in the world leading to high consumption of antibiotics. In the years 2005-2009, India showed about a 40% increase in the sale of antibiotic units. Antibiotics can be marvel drugs but they also have risks. As found by Centers for disease control and prevention (CDC), between a third and a half of all antibiotics used in the U.S. are either unnecessary or the antibiotic does not match the germ. Antibiotic resistance is said to be a direct consequence of antibiotic use, the greater the volume of antibiotics used, the greater is the chance of existence of antibiotic resistance populations of bacteria. From various literatures available, it is evident that viral illnesses are given a significant portion of antibiotics prescribed in the outpatient setting thereby making the use of antibiotic therapy irrational. Antibiotics used in such situations where these cannot be expected to cure or alleviate patient's infection, may increase the chances of antibiotic resistance. Nevertheless, inappropriate use of antibiotics has been described worldwide in both community and hospital settings particularly in developing countries [6]. Presently, more than 50% of strains of Klebsiella pneumonia are said to be carbapenem-resistant and are reported worldwide thereby causing healthcare associated infections like pneumonia, and bloodstream infections. More than 50% of Escherichia coli strains to cause urinary tract infections are reported worldwide to be resistant to fluoroquinolones. Similarly, patients suffering from gonorrhea were supposedly reported to be resistant to the last antibiotics like third generation cephalosporins. Among the patients infected, high mortality (64%) was noticed in among patients with Methicillin-resistant Staphylococcus aureus (MRSA). Overall, the antibiotic resistance is associated with a higher mortality rate, longer hospital stays, delayed recuperation, and long term disability. Similar observations on the emergence of gram-negative and gram-positive antimicrobial resistance in gram-negative and gram-positive bacteria were also reported from India. The range of resistance range varies widely depending on the health care type setting and the geographical location, availability of antibiotics in hospitals, and over the counter, prescribing habits of treating clinicians from different streams of medicine. Around 80 million antibiotic prescriptions are prescribed unnecessarily each year, which makes improving antibiotic prescribing and use a national priority, according to the centers for disease control, explaining the importance of the initiative in an era where antibiotic-resistant bacteria haunt the public health [7]. The problem of the overuse of antibiotics is a global phenomenon. The prevalence of the use of antibiotics in India varies from 24% to 67%. It is important to assess the quality of patient care through proper surveillance. The study of prescribing pattern reasons to monitor, evaluate, and suggest modifications in the practitioner's prescription habits, so as to make patient care reasonable and effective. The insight about antibiotic utilization patterns is crucial for a constructive advent to obstacle that arises from numerous antibiotic usages. It is extremely important that institutions and hospitals should have an antibiotic policy and ensure that the best judgement is made by individual prescribers. A highly representative data aids the healthcare professionals in rational antibiotic use and can revamp the quality of patient care. This further contemplates the need for the current study. However, a serious reduction in the use of antibiotics can help to decrease the spread of antibiotic resistant micro-organisms and disease. To tackle this problem, global initiatives are trying to promote the rational use of antibiotics but it requires continuous education of physicians and patients, which ought to be supported by high-quality evidence linking antibiotics used to the emergence of resistance.

MATERIALS AND METHODS

Study Site:

A prospective observational study was carried out at Srinivas Institute of Medical Science and Research Centre, Mukka-574146, a multi-speciality tertiary care teaching hospital in Mangaluru from October 2019 to March 2020.

Study Design:

Hospital based Prospective Observational study

Study Duration:

The study was conducted for a duration of 6 months from October 2019 to March 2020.

Ethical Clearance

The study protocol was approved by Institutional Ethics Committee (IEC) of Srinivas Institute of Medical Science and Research Centre, Mukka-574146. (Ref No:2019/10/28/3)

Study Criteria

Inclusion criteria

- Patients above 18 years of age.
- In-Patients diagnosed with and undergoing antibiotic treatment for any illness under respiratory and nephrology departments.
- Patients who are not pregnant or lactating.

Exclusion criteria

- Out-patients.
- In-patients below 18 years prescribed with antibiotics.
- In-patients of pregnant, lactating and paediatric category.

Source of data

The data collected for study was taken from the case files of MRD and pulmonology and nephrology in-patients of Srinivas Institute of Medical Science and Research Centre, and it included demographic details, medical and medication history, length of stay and discharge status, biochemical investigations, diagnosis, treatment including dose, frequency, route, time of administration.

Sample size

Based on the inclusion and exclusion criteria medical records of patients admitted to the hospital were obtained. A total of 220 case files of in-patients met the selection criteria.

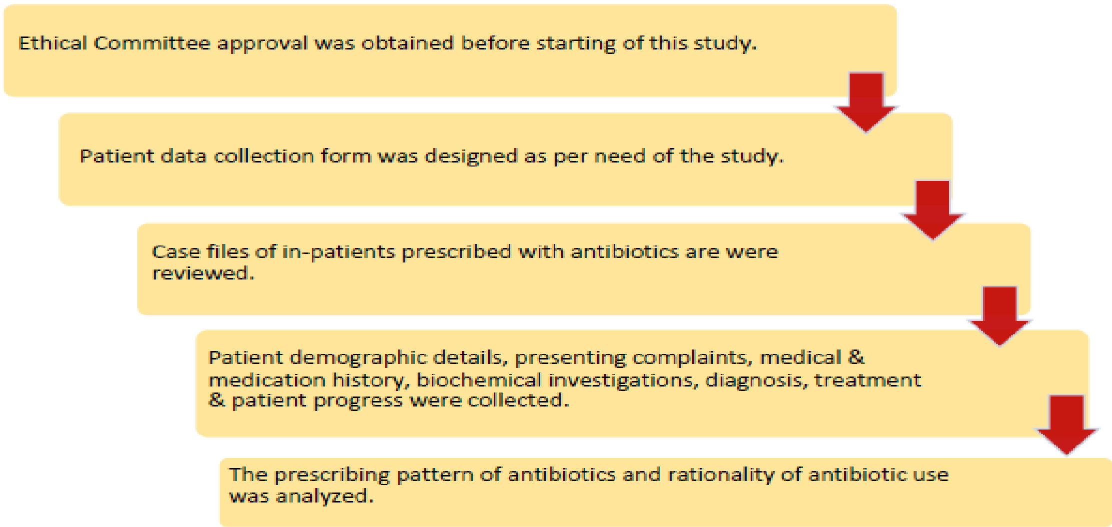
Study method

A structured data collection form was used to collect the data from MRD and pulmonology and nephrology in-patients. Data collection form was designed with the help of resources and are validated by the Department of Microbiology, SIMS&RC, Mukka. The data was collected from the medical record of patients which are filled by doctors, nurses, pharmacist and other health-care professionals. Data collected includes demographic details, medical and medication history, length of stay and discharge status, biochemical investigations, diagnosis, treatment including dose, frequency, route, time of administration. Microbiological culture isolates and prescribed antibiotics were also collected and all the details will be kept confidential.

Data analysis

The collected data were analysed by using Microsoft Excel 2016. The resistance and sensitivity pattern of antibiotics and prescription pattern were noted and the same were observed and concluded on the basis of prescription of the hospitalized patients in tertiary care hospital.

Operational modality



RESULTS

5.1. Demographic characteristics of patients

Table 1. Demographic characteristics of in-patients in each department.

Department	Age	Male	Female	Total no. of patients
Pulmonology	18-35	8	16	24
	36-60	30	22	52
	>60	18	26	44
Nephrology	18-35	8	31	39
	36-60	11	21	32
	>60	22	7	29
Total		97	123	220
Percentage (%)		48.5	61.5	

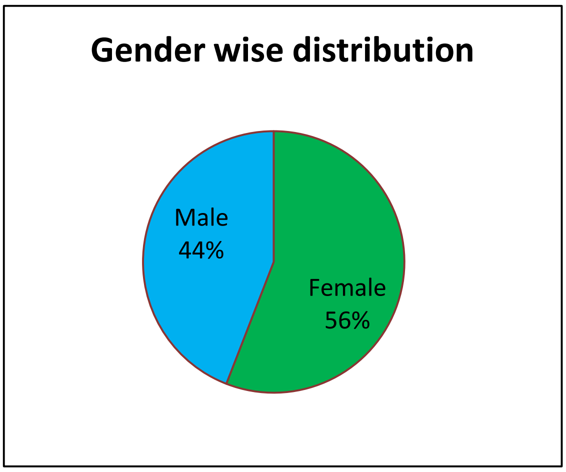


Figure1. Gender wise distribution among the study population.

In the present study, 220 in-patient's data were collected from the MRD and case files of Srinivas Institute of Medical Science and Research Centre, Mukka, Mangaluru, who met the inclusion and exclusion criteria for the study. Out of 220 patients, 97 (44%) were males and 123 (56%) were females. In Pulmonary cases, 24 (20%) patients belonged to the age group of 18-35, 52 (43.33%) patients belonged to the age group of 36-60, 44 (36.66%) patients in the age group of above 60. In renal cases, 39 (39%) patients belonged to the age group of 18-35, 32(32%) patients belonged to the age group of 36-60, 29 (29%) patients in the age group above 60. The demographic characteristics of patients diagnosed with pulmonary and renal infections can be observed in Table 1.

5.2. Length of stay in hospitalized during treatment

Out of the 220 in-patients, 74 patients were hospitalized for 1-2 days, 100 patients for 3-4 days, 26 subjects for 5-6 days, 16 patients for > 1 week. Most of the patients stayed in the hospital for less than one week.

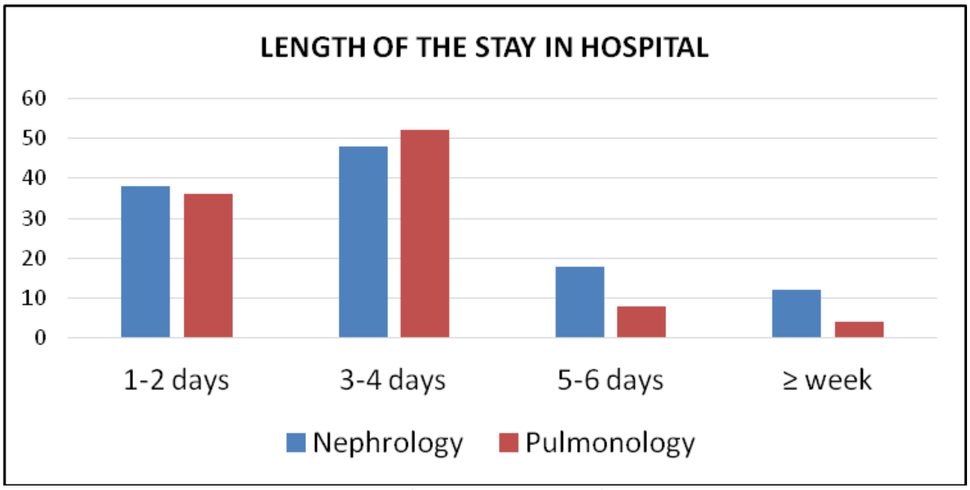


Figure 2. Length of stay in the hospital for in-patients.

5.3. Count of patients diagnosed with the infection

In the present study, 177 (80.45%) patients were actually treated for infection, and the remaining 43 (19.54%) patients received antibiotic treatment as prophylaxis.

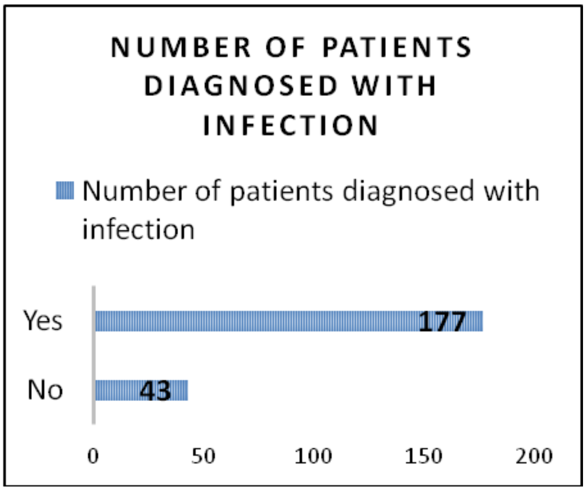


Figure 3. Count of patients diagnosed with infection.

5.4. Route of administration of antibiotics prescribed

The most common route of administration of antibiotics to the subjects in our study was the intravenous route (64.54%) followed by oral route (35.45%).

Table 2. Route of administration of antibiotics.

Route of administration	Percentage
IV - Intravenous	64.54%
PO - per oral	35.45%

5.5. Prescription pattern of Antibiotics among in-patients

5.5.1. Number of Antibiotics per prescription

The number of antibiotics prescribed during the period of stay of patients in pulmonology and nephrology was analyzed.

Out of 120 pulmonology cases, the majority (n=63) received 1 antibiotic followed by 45 patients with 2 antibiotics and the remaining with 3 or 4 antibiotics.

Out of the 100 renal cases, the majority (n=48) received 2 antibiotics followed by 40 patients with 1 antibiotic and 6 patients with 3 antibiotics.

The distribution of patients according to the number of antibiotics prescribed is illustrated in detail in table 3 and figure 4.

Table 3. Distribution of patients according to the number of antibiotics prescribed to them.

Department	No. of antibiotics	No. of patients	Percentage (%)
Pulmonology	1	63	52.5
	2	45	37.5
	3	7	5.83
	4	5	4.16
Nephrology	1	48	48
	2	40	40
	3	6	6
	4	4	4

Hence, out of 220 patients, majority (n=111) were prescribed with 1 antibiotic followed by 103 patients with 2 antibiotics.

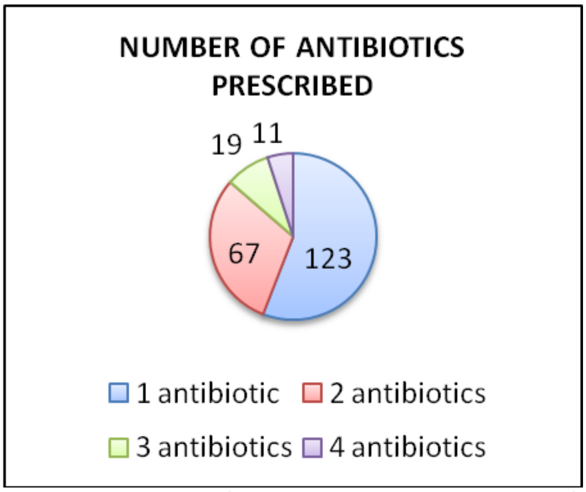


Figure 4. Distribution of patients according to the number of antibiotics prescribed to them.

5.5.2. Prescription frequency of individual antibiotic prescribed in the selected departments

The data obtained from this study highlights the use of Piperacillin/Tazobactam (30.06%) as the most prescribed antibiotic followed by Amoxicillin/Clavulanic acid 17.64%) and Ceftriaxone (14.37%) in the pulmonology department. Ceftriaxone (22.92%) was the most prescribed antibiotic followed by Piperacillin/Tazobactam (19.74%) in the Nephrology department. Hence, out of 220 subjects, Piperacillin/Tazobactam was the most prescribed antibiotic followed by Ceftriaxone.

The prescription frequency of individual antibiotic prescribed is illustrated in Table 4.

Table 4. Prescribed pattern of antibiotics.

Antibiotic	No. of prescriptions (n)		Percentage (%)	
	N	P	N	P
Piperacillin/tazobactam	31	46	19.74	30.06
Ceftriaxone	36	22	22.92	14.37
Amoxicillin+ Clavulanic acid	19	27	12.10	17.64
Azithromycin	13	14	8.28	9.15
Cefoperazone/sulbactam	12	13	7.64	8.49
Metronidazole	16	8	10.19	5.22
Cefipime	9	8	5.73	5.22
Vancomycin	8	1	5.09	0.65
Amikacin	8	1	5.09	0.65
Cefotaxim	6	8	3.82	5.22
Meropenem	7	2	4.45	1.30
Linezolid	2	3	1.27	1.96
Total	157	153		
	310			

5.5.3. Dosing pattern of antibiotics in infection

The most commonly prescribed antibiotics was found to be Piperacillin/ Tazobactam, out of which 49 were with 4.5g and 28 were with 2.25g, followed by Ceftriaxone. For Ceftriaxone, 12 were with 500g, 19 were with 1gm, and 27 were with 1.5gm. Amoxicillin/Clavulanic acid was prescribed for 46 in-patients out of which, 30 were with 635mg and 16 with 1g. Azithromycin was prescribed for 27 times of which 14 were with 500mg and 13 with 1g.

Table 5. Dosing pattern of most commonly prescribed antibiotics.

Antibiotics	Dose	Prescription frequency (%)
Piperacillin/ tazobactam N=77	4.5g	49 (63.63%)
	2.25g	28 (36.36%)
Ceftriaxone N=58	500mg	12 (20.68%)
	1g	19 (32.75%)
	1.5g	27 (46.55%)
Amoxicillin/ Clavulanic acid N=46	625mg	30 (65.21%)
	1g	16 (34.78%)
Azithromycin N=27	500mg	14 (51.85%)
	1g	13 (48.14%)

5.6. Types of organisms identified from In-patients laboratory reports

In the present study medical records of 220 patients were referred to check whether they underwent culture sensitivity test prior to prescribing of the medication. Out of the 177 infectious cases, culture tests were performed in 113 (63.84%) of in-patients diagnosed with infection and from which 28% of the infectious cases had samples isolated and 36% not isolated. (Fig.5) The culture test was not performed in the remaining 64 (36.16%) in-patients diagnosed with infection.

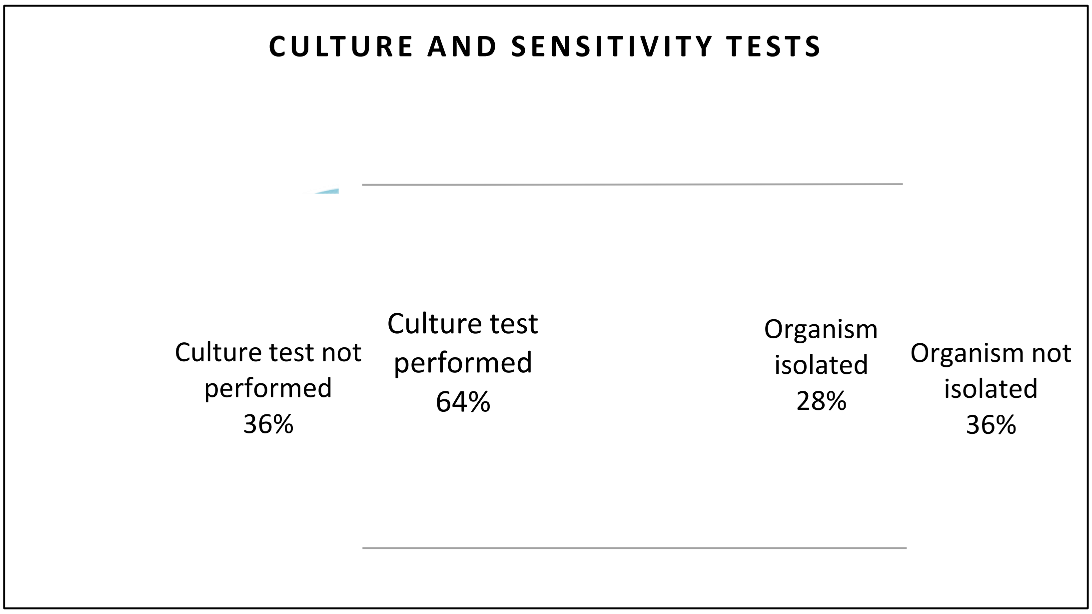


Figure 5. Count of the number of patients diagnosed with infection undergone culture sensitivity testing prior to antibiotics administration.

Table 6. Various organisms identified from infectious in-patients.

Gram-positive N=20 (17.69%)	Staphylococcus spp.	11
	Enterococcus feacalis	7
	Streptococcus agulactae	1
	Viridans streptococci	1
Gram-negative N=93 (82.30%)	Klebsiella spp.	30
	Escherichia coli	27
	Acinetobacter spp.	10
	Pseudomonas aeruginosa,	9
	Coagulase negative	7
	staphylococci	3
	Enterobacter spp.	3
	Citrobacter	2
	Protease vulgaris	2

Out of 113 culture sensitivity tests, organisms were identified and categorized as gram-positive and gram-negative organisms (Table 6). Gram-negative organisms comprised 93(82.30%) and gram-positive organisms were 20 (17.69%). Among them, microorganisms were grouped into different categories like coagulase-negative Staphylococci species, Enterobacter species, Klebsiella species. Among the organism isolated, Klebsiella species, a gram-negative bacterium was the predominant (n=30, 26.54%) cause of pulmonary infections in adults. Escherichia coli were the predominant (n=27, 23.89%) cause of renal infections (Table 6).

Table 7. Distribution of bacteria among clinical isolates.

Bacteria		**Frequency (n)**	**Percentage (%)**
Escherichia coli	ESBL producer	8	23.89
	Non ESBL producer	19	
Klebsiella spp.	ESBL producer	8	26.54
	Non ESBL producer	22	
Acinetobacter	-	10	8.84
Pseudomonas spp.	-	9	7.96
Enterococcus spp.	-	7	6.19
Staphylococcus spp.	MRSA	3	9.73
	MSSA	3	
	CONS	5	
Streptococcus spp.	Group D streptococci	1	0.88
Enterobacter spp.	-	3	2.65
Citrobacter	-	2	1.50
Proteus spp.	-	2	1.50
Total		113	100

5.7. Specimens used for culture sensitivity

In the prospective study, the organisms were detected from various specimens like blood, sputum, throat swab, urine midstream sample and endotracheal aspirates. The data obtained suggested that most of the organisms were isolated from urine midstream, which was found to be the highest amount of the sample taken 58 (51.32%).

The second frequent sample was found to be sputum 26 (23.00%) followed by blood samples 18 (15.92%). The specimen used for culture sensitivity is illustrated in Fig. 6.

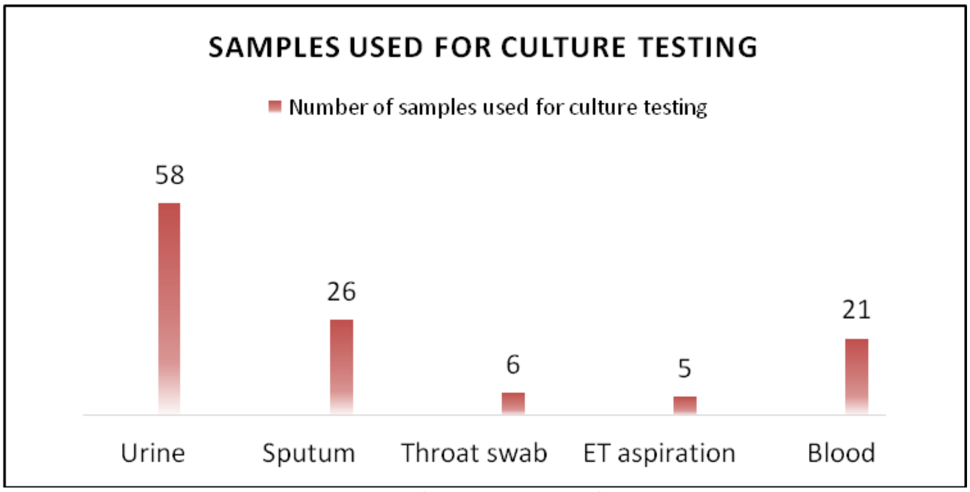


Figure 6. Various types of samples obtained for culture sensitivity test

Table 8. Distribution of clinical isolates in different clinical specimens

Organism	Blood	Urine	Sputum	ET aspiration	Throat swab
Ecoli	6	21	0	0	0
Klebsiella spp.	5	7	17	2	3
Enterococcus faecium	0	3	3	0	2
Pseudomonas aeruginosa	1	1	2	1	0
Staphylococcus aureus	5	2	1	1	0
Enterobacter spp.	0	3	1	0	0
Citrobacter	2	3	0	0	0
Streptococcus spp.	0	1	0	0	1
Acinetobacter	1	1	3	2	0
Proteus spp.	0	3	0	0	0
Total	18	58	26	5	6

5.8. Antibiotic sensitivity and resistance pattern

Table 9. Sensitivity and Resistance towards antibiotics

Organism	E. coli		Klebsiella spp.		Enterococcus spp.		P. aeruginosa		Streptococcus spp.		Citrobacter		Acinetobacter		Staphylococcus spp.	
Antibiotic	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Ampicillin	2	25	1	36	9	5	0	2	1	22	0	4	1	31	1	28
Amoxicillin	0	1	0	1	0	0	0	1	0	0	1	0	0	3	0	0
Amikacin	17	8	7	1	1	0	8	7	12	4	4	0	7	19	12	4
Azithromycin	5	8	2	4	1	0	4	2	1	1	4	0	1	2	1	1
Cefuroxime	3	23	2	25	0	1	0	2	13	11	2	2	0	30	13	11
Ceftriaxone	2	12	1	10	0	2	0	1	10	13	2	0	0	20	10	13
Gentamycin	15	15	13	25	4	8	8	6	21	28	4	0	12	8	27	22
Meropenem	25	5	13	17	5	8	10	4	0	0	0	0	9	20	0	0
Vancomycin	0	0	2	0	1	0	1	1	17	0	0	0	2	0	17	0
Linezolid	0	0	1	0	15	0	1	0	16	1	0	0	2	0	16	1
Cefotaxim	1	18	3	16	0	1	0	1	9	8	2	2	0	21	9	8

Table 9 (contd.). Sensitivity and Resistance towards antibiotics

Organism	**E. coli**		**Klebsiella spp.**		**Enterococcus spp.**		**P. aeruginosa**		**Streptococcus spp.**		**Citrobacter**		**Acinetobacter**		**Staphylococcus spp.**	
Antibiotic	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Cotrimoxazole	13	14	7	20	0	1	3	4	18	9	2	2	9	2	18	7
Chloramphenicol	0	0	2	2	0	0	0	0	1	0	0	0	1	1	1	0
Clindamycin	0	0	0	0	1	0	0	1	16	8	0	0	0	0	20	8
Ciprofloxacin	6	2	9	31	3	9	9	5	9	11	4	0	7	18	9	13
Tetracycline	0	0	2	0	0	0	0	0	3	3	0	0	0	0	3	3
Tazobactum	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Levofloxacin	7	14	9	26	7	5	11	5	9	11	4	0	11	17	9	11
Doxycycline	1	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0
Penicillin	0	0	0	0	0	1	0	0	0	8	0	0	0	0	0	8
Nitrofurantoin	10	2	0	5	4	0	1	1	3	1	0	0	0	4	3	1

Table 9 (contd.): Sensitivity and Resistance towards antibiotics

Organism	**E. coli**		**Klebsiella spp.**		**Enterococcus spp.**		**P. aeroginosa**		**Streptococcus spp.**		**Citrobacter**		**Acinetobacter**		**Staphylococcus spp.**	
Antibiotic	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Piperacillin/Tazobactam	21	7	12	21	4	0	9	3	0	0	2	0	7	24	0	0
Cefaperazone/sulbactum	16	8	9	12	0	0	7	4	0	0	1	0	7	10	0	0
Amoxicillin/clavulanic acid	4	20	7	20	10	3	0	0	0	9	0	3	1	23	0	10

During the study period, 113 culture sensitivity tests were analyzed in which 9 types of organisms were analyzed to 31 antibiotics.

Staphylococcus spp., Klebsiella spp., E. coli, Acinetobacter, P. aeruginosa. were the most common organisms isolated. The sensitivity and resistance pattern of antibiotics analyzed are mentioned in the Table 9.

Among the various antibiotics, it was found that Meropenem and Gentamicin were predominant and also highly effective towards most of the microorganisms along with combination antibiotics like piperacillin / tazobactam, cefoperazone / sulbactam, etc.

E.coli was found to be sensitive to Meropenem (100%) and also found to be sensitive to antibiotics like Imipenem (83.3%) and Nitrofurantoin (83.30%). It is resistant to antibiotics Amoxicillin (100%) and Aztreonam (100%).

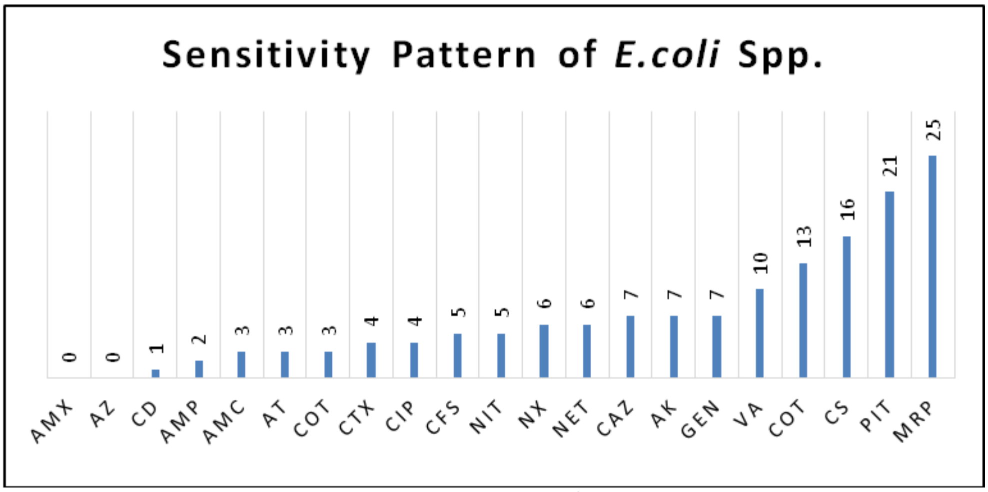


Figure 7. Sensitivity pattern of E. coli spp.

Klebsiella spp. Was found to be highly sensitive to Piperacillin/Tazobactam and Cefoperazone/sulbactam and resistant to antibiotics like Amoxicillin, Ampicillin, Cefazoline.

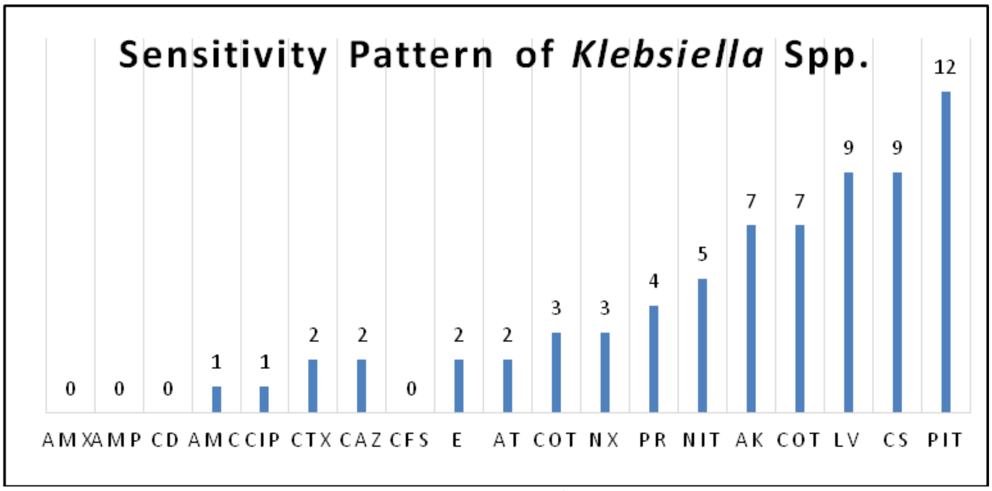


Figure 8. Sensitivity pattern of Klebsiella spp.

DISCUSSION

Antibiotics are essential for treating bacterial infections, and antibiotic resistance inhibits an antibiotic from working effectively against bacterial infections and they become refractory to the regimen. The burden of infection and its consequences due to antibiotic resistance has been increasing globally.

Prescriptions of 220 patients who met the eligibility criteria were analyzed for Antibiotic trends, usage patterns, and sensitivity. The demographic data of the patients revealed that the number of females (56%) were more than the number of males (44%) in the pulmonology as well as in the nephrology cases respectively. This was similar to the results demonstrated in the study conducted by Harrington RD et al [34] and Falagas M et al [35] that women had more incidence of renal infections and upper respiratory infections respectively.

In the present study, it was found that most (43.33%) of in-patients in pulmonary cases belonged to 36-60 age group and (39%) of patients in renal cases belonged to 18-35 age group which was found similar to study conducted by Srishyla MV et al [36] , Thomas M. Hootan et al [37] respectively. This could be due to more amount of smokers in this age group making them more prone to infections. Urinary tract infections are usually common in women of child-bearing age.

In this study, it was observed that most of the patients (N=100) had 3-4 days as the length of the stay at the hospital. This is similar to the comparison of length of hospital stay conducted by D Armstrong Briley et al [38] was the average length of stay was 5 days.

The most preferred route of administration was the intravenous route compared to the oral route of administration. This is similar to similar studies done by Khan M et al [39], Pandiamunian J et al [40], and Zhang L et al [41]. However it depends on the patient's condition and an early switch to oral antibiotics can help in reducing the treatment cost.

Among the pulmonary cases, the majority (N=63) were prescribed with 1 antibiotic and among the renal cases, the majority (N=48) received 2 antibiotics.

The frequently used antibiotic in the pulmonary/respiratory cases was found to be Piperacillin / Tazobactam (30.06%) followed by Amoxicillin / Clavulanic acid (14.37%) and third-generation cephalosporin ceftriaxone (14.37%). In a study conducted by Y Mouton et al [42], the majority of the patients under Piperacillin /Tazobactam treatment were found to have a favorable clinical response.

Ceftriaxone (22.92%) was found to be the most frequently prescribed antibiotic in the nephrology department followed by Piperacillin/Tazobactam (19.74%). This is comparable to the study conducted by Hui K et al [43] where ceftriaxone, amoxicillin / clavulanic acid and piperacillin / tazobactam were the most commonly preferred antibiotics in urinary tract infections and for prophylactic use as well. Piperacillin / Tazobactam combination is also recommended in International and German guidelines for treating pneumonia as concluded by Bodmann KF [44] in his study.

In the present study it was found that the antibiotic Piperacillin-Tazobactam, the broad spectrum anti-pseudomonal antibiotic Piperacillin with the beta-lactamase inhibitor Tazobactam was prescribed in 77 patients, out of which 49 (63.3%) of them were of 4.5g and 28 (36.36%) of them were of 2.25g. According to Felton TW et al [45] study, suggested that prolonged infusion regimen with an initial dose of 4.5gm IV over 30 minutes is the preferred dose. Ceftriaxone, a 3rd generation parenteral cephalosporin prescribed 58 times comes second, of which 12 (20.68%) was 500mg, 19 (32.75%) of 1g, and 27 (46.55%) of 1.5g.

Among the organisms isolated from various specimens in the current study, various gram-positive organisms and gram-negative were found to be the cause of infection and hospitalization. Organisms isolated were categorized according to their species. Among the isolates Klebsiella spp. (26.54%) was the predominant cause of infection in adults. The second isolated gram-negative organism was E.coli (23.89%) followed by Staphylococcus spp (9.73%) and Acinetobacter spp. (8.84%). This finding was similar to study done by Hui K et al [43] reported were gram-negative organisms were the commonly isolated organism than Gram-positive organisms.

In the present study 9 organisms were isolated and the predominant antibiotics were Meropenem and Gentamicin. They were quite sensitive to E.coli, Klebsiella spp, Acinetobacter spp., P aeruginosa, and it was also found Ampicillin as highly resistant towards E. coli (97.2%) and Klebsiella spp. (100%). However, E.coli was found to be sensitive to Imipenem and Nitrofurantoin. These results were found to be similar to the study done by V. Niranjan et al [46] and Zhijie Z et al [47], where these organisms are shown to be susceptible to antibiotics like Meropenem, Colistin, Gentamicin, etc leaving them to be the most sensitive and preferable antibiotics that can be used for treatment.

CONCLUSION

The demand for antibiotics in the treatment of various infections is increasing rapidly due to the development of resistance of the microorganisms towards the antibiotics.

From the present study, it was shown that Piperacillin/tazobactam and Ceftriaxone are the frequently used antibiotics in both the departments irrespective of the indication/s. Culture tests were done in the majority of the patients while the sensitivity resistance pattern test was limited to only certain antibiotics.

Analysis of sensitivity pattern revealed an increase in the emergence of resistance to common antibiotics which has led to the rise in the use of broad-spectrum antibiotics like meropenem and potentially toxic therapeutic options like colistin. It is also important to make sure that the patient completes the course of antibiotic therapy and maintains compliance as this might also lead to resistance and failure of treatment.

So it was concluded that the sensitivity of antibiotics towards the species is dwindling and it is an unpleasant warning of the emergence of resistance. Antibiotic stewardship programs can be practiced to tackle the crisis of antibiotic resistance. It can be anticipated in the developing society and routine culture and sensitivity testing should be performed to detect the appearance of resistance to provide appropriate antibiotic regimen.

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