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Improving Rational Use of Antimicrobials for Inpatients at Tertiary Care Hospital

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HARSHA BALAKRISHNAN S[1], POOJA VS[1], SUJAY BR[2], R SRINIVASAN*[3]

[1]Pharm D Interns, Department of Pharmacy Practice, PES College of Pharmacy, Bengaluru, Karnataka, India-560 050.

[2]Professor, PES Medical College, Kuppam, Andhra Pradesh, India-517 425.

[3]Chairperson, Department of Pharmacy Practice, Faculty of Pharmaceutical Sciences, PES University, Bengaluru, Karnataka, India-560 050.

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ABSTRACT

Introduction: Anti-microbials are the most commonly used and misused medications worldwide. **Objectives:** The objectives of our study were to determine the dose frequency and use of anti-microbial drugs, to determine the dose and dosing pattern of anti-microbial therapy and to determine the incidence of nosocomial infections. **Methodology:** A prospective hospital based observational study was carried out for a period of 6 months at the Tertiary Care Hospital, Bengaluru. The subjects were included after obtaining the informed consent. The research student attended ward rounds on a daily basis and collected the cases which were mentioned in inclusion criteria. All the relevant data of patient's demographic factors, antimicrobial use or prescribing pattern, culture sensitivity analysis data, isolation of microbes in cultures etc. were observed and analysed. **Results:** A total number of 120 patients were enrolled in the study, majority being female and of age group 71-80 years. Most of therapy was done empirically, with only 12 organisms isolated from cultures where sensitive anti-microbial was prescribed. A total of 16 drug-drug interactions occurred. No mortality was reported. Infectious cases were well diagnosed. **Conclusion:** We conclude the study by stating that the infectious diseases are well diagnosed and treated at the study centre as occurrence of adverse reactions and period of stay for treatment to effectively work was in line with best practices.

INTRODUCTION

The discovery and usage of anti-microbial agents is one of the most important and significant contribution to therapeutics in 20th century. Apart from being frequently used, they are often misused. The unintended consequence of their widespread use and misuse has been the emergence of the antibiotic-resistant pathogens, fuelling an ever-increasing need for new drugs at a time when the pace of antimicrobial drug development has nearly ceased. For new drugs reducing inappropriate anti-biotic use is thought to be imperative to control resistance.

Reducing inappropriate antibiotic use is thought to be imperative to control resistance. Successful antimicrobial therapy of an infection ultimately depends on the correct choice of antimicrobial agent (that targets the pathogen responsible), administered at the right dosage such that it achieves the right concentration of the antibiotic at the site of infection for the right duration of time. The drug concentration at the site of infection must be high enough to inhibit the organism but also must remain below the level that is toxic. After having established the need for using a systemic anti-microbial agent in a patient by assessing that the condition is due to a treatable (mostly bacterial) infection and that it is not likely to resolve by itself or by local measures (anti-septics, drainage of pus) only, anti-microbial agents should be selected based on patient factors (age, renal and hepatic function, pregnancy, genetic factors), organism-related factors and drug factors (spectrum of activity, sensitivity of the organism, relative toxicity, route of administration)[1-3].

Irrational use of medicines is a major problem worldwide. WHO estimates that more than 50% of all medicines are prescribed, dispensed or sold inappropriately, and that half of all patients fail to take them correctly. The overuse, underuse or misuse of medicines results in wastage of scarce resources and widespread health hazards. The Rational Use of Medicines (RUM) is defined as "Patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their community"[3,4].

The overuse of antibiotics, especially taking antibiotics even when they're not the appropriate treatment or not completing the course of treatment, promotes antibiotic resistance. There are serious problems concerning the inadequate prescription of antibiotics and overuse of injections in primary care. Overuse of antibiotics, particularly broad-spectrum antibiotics, in primary care is a major contributing factor to reduced drug efficacy, increased prevalence of resistant pathogens in the community and the appearance of new co-infections[5,6].

More than 60%of the bacteria associated with hospital-acquired infections in India are resistant to one or more of the drugs previously used to treat them. Infections are also associated with increased costs, arising from the need to use more expensive antibiotics as therapy, prolonged hospital stay and expenses related to screening and surveillance, eradication regimens and consumables (the gloves, gowns and aprons used to prevent cross-infection). The term antibiotic stewardship is used capture the twin aims of ensuring effective treatment of patients with infection and minimizing collateral damage from anti-microbial use[4,7,8].

The 1ndian Council of Medical Research (ICMR), New Delhi, India, has launched the Anti-Microbial Resistance Surveillance and Research Network (AMRSN) across the country in 2013 with an avowed purpose of rationalizing AMSP in India. Changing anti-microbial use in hospitals is complex and challenging and requires an organised approach, such as an anti-microbial management program, also termed anti-microbial stewardship (AMS). AMS involves a systematic approach to optimizing anti-microbial use. Successful hospital AMS programs have been shown to improve the appropriateness of anti-microbial use, and to reduce institutional resistance rates and in-turn, morbidity and mortality.

Aim:

To study the pattern of use of anti-microbials at a Tertiary Care Hospital.

Objectives:

- To determine the frequency, time and predictors of de-escalation and escalation of anti-microbials after empiric therapy.
- To determine the dose and dosing patterns of empiric anti-microbial therapy.
- To determine the Incidence of nosocomial infection if any acquired during hospital stay.

MATERIALS AND METHODS

Study design:

Hospital based prospective observational study.

Study site:

The study was conducted at a Tertiary Care Hospital in Bengaluru, Karnataka, India.

Study duration:

The study was conducted for six months from October 2018 to May 2019.

Inclusion criteria

- All in-patients who received anti-microbials in the medicine wards and intensive care wards.
- All in-patients of both gender of all age groups

Exclusion criteria

- Pregnant and lactating women
- Patients not consenting in the study
- Paediatric patients.

Sources of data:

- ✓ Patient case sheets
- ✓ Interview with patient/attender

Method of study:

The research students attended ward rounds and collected the cases which were prescribed with anti-microbial agents in all Medical and Intensive Care Wards. A detailed study was carried out to identify the prescribing nature of anti-microbials (frequency, time, dosing pattern) and other common problems with anti-microbials prescription such as nosocomial infections acquired by the patient during the hospital course. The resistance and susceptibility pattern and the choice of appropriate anti-microbials were systematically studied. Data was pooled analysed.

RESULTS

The study has been carried out for a period for 6 months during which 120 patients prescribed with anti-microbial drugs were randomly recruited from medicine, paediatric, intensive and surgical wards at the study site. Patient consent form was taken from each patient.

Table No. 1: Distribution of patients with respect to gender

S. No.	Gender	No. of patients	Percentage
1	Male	54	45
2	Female	66	55
Total no. of patients		**120**	**100%**

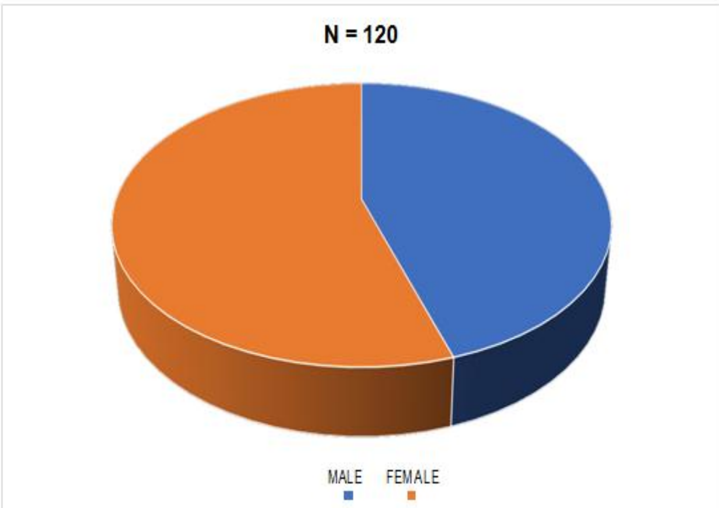

Figure No. 1: Distribution of patients with respect to gender

Table No. 2: Distribution of patients with respect to age

S. No.	Age (in years)	No. of patients	Percentage
1	11-20	1	0.83
2	21-30	11	9.17
3	31-40	7	5.83
4	41-50	10	8.33
5	51-60	20	16.67
6	61-70	25	20.83
7	71-80	28	23.33
8	81-90	17	14.17
9	91-100	1	0.83
Total no. of patients		**120**	**100%**

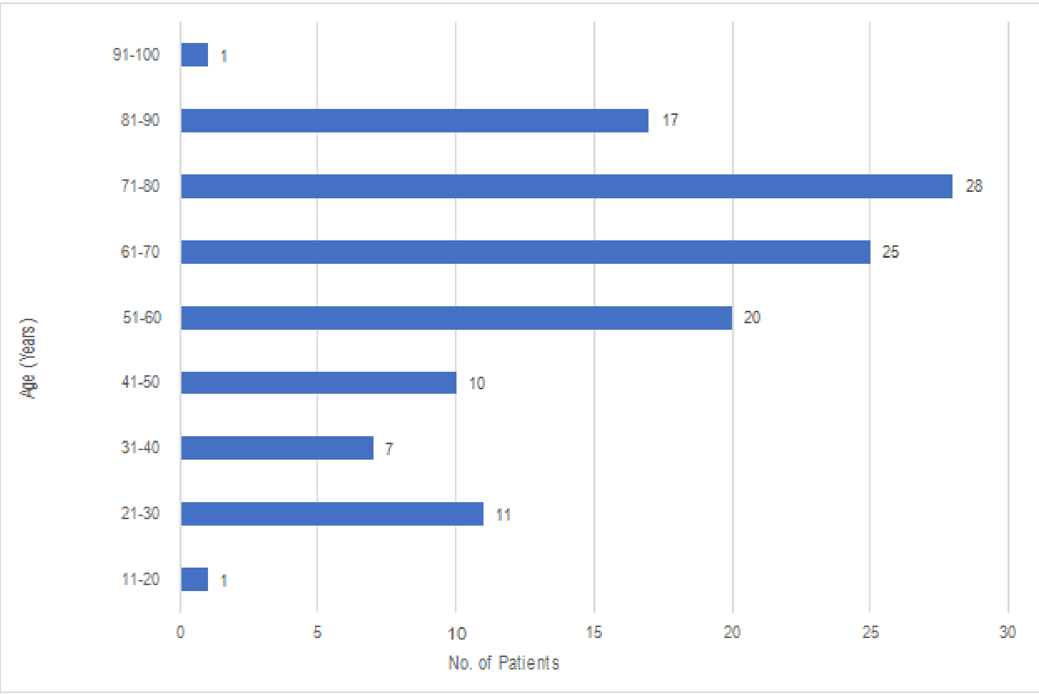

Figure No. 2: Distribution of patients with respect to age

Table No. 3: Distribution of patients based on wards recruited

S. No.	Wards	No. of patients	Percentage
1	Pulmonology	59	49.17
2	General Surgery	11	9.17
3	General Medicine	15	12.50
4	Urology	10	8.33
5	Oncology	12	10.00
6	Orthopaedics	9	7.50
7	Med-Assist	2	1.67
8	Cardiology	1	0.83
9	Anaesthesia	1	0.83
Total no. of patients		**120**	**100%**

Table No. 4: Choice of use anti-microbial drugs

S. No.	Types of anti-microbials	No. of anti-microbials drugs	Percentage
1	Anti-bacterial	100	89.2
2	Anti-fungal	4	3.57
3	Anti-viral	8	7.14
Total no. of anti-microbials drugs		**112**	**100%**

Table No. 5: Distribution of various classes of anti-microbials prescribed

S. No.	Drugs	No. of anti-microbials drugs	Percentage
Anti-bacterial drugs			
1	Combination 1 (Cefoperazone + Sulbactam)	14	10.85
2	Cefixime	29	22.48
3	Cefuroxime	14	10.85
4	Combination 2 (Piperacillin + Tazobactam)	2	1.55
5	Norfloxacin	4	3.10
6	Combination 3 (Amoxicillin + Clavulanic acid)	18	13.95
7	Doxycycline	8	6.20
8	Ciprofloxacin	5	3.88
9	Ofloxacin	1	0.78
10	Cefixime	16	12.40
11	Levofloxacin	1	0.78
12	Clarithromycin	2	1.55
13	Moxifloxacin	4	3.10
Total no. of anti-bacterial drugs		**118**	**91.47%**
Anti-viral			
14	Anti flu	6	4.65
15	Fluvir	1	0.77
16	Albavir	1	0.77
Total No of anti-viral drugs		**8**	**6.19%**
Anti-fungal			
17	Fluconazole	1	0.77
18	Candid Mouth Paint	1	0.77
19	Voriconazole	1	0.77
Total No of anti-fungal		3	2.31%
No. of anti-microbial drugs		**129**	**100%**

Table No. 6: Distribution of patients based on provisional diagnosis

S. No.	Type of infectious disease pattern	No. of patients	Percentage
1	Cardiovascular	5	4.17
2	Central Nervous System	3	2.50
3	Circulatory	1	0.83
4	Genitourinary	13	10.83
5	Gastrointestinal	4	3.33
6	Prophylactic	5	4.17
7	Respiratory	58	48.33
8	Skeletal	12	10.00
9	Skin and Soft Tissue	2	1.67
10	Others	17	14.17
Total no. of patients		**120**	**100%**

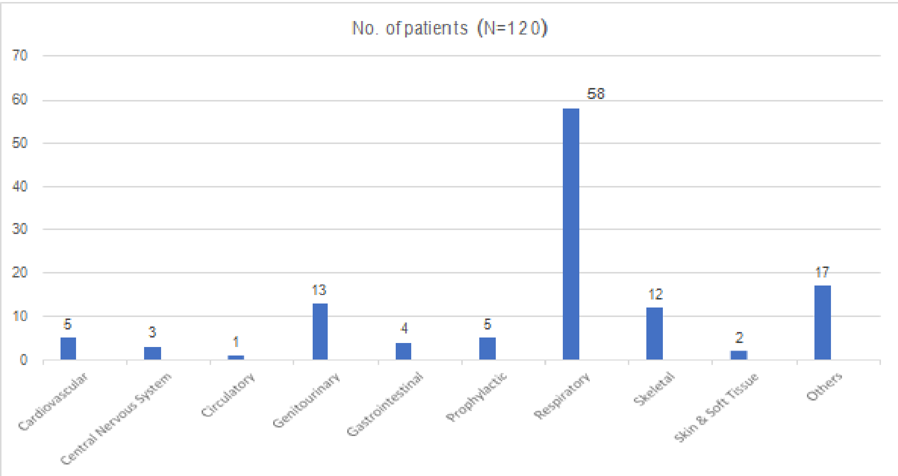

Figure No. 3: Distribution of patients based on provisional diagnosis

The disease pattern classified based on provisional diagnosis includes infectious diseases involved with cardiovascular system, central nervous system, circulatory (sepsis, lymphatic etc), gastrointestinal (acute GE, diarrhea etc), genitourinary (UTI, CKD ETC), prophylactic (pre/post/intra-operative), respiratory (LRTI, pneumonia, asthma) and others (viral, fungal, ENT, more than one organ system involved etc.) illustrated in Table 6 and Figure 3.

Table No. 7: Route of administration of treatment

S. No.	Route of administration	No. of anti-microbials drugs	Percentage
1	IV	16	15.69
2	PO	86	84.31
Total no. of anti-microbials drugs		**102**	**100%**

Table No. 8: Culture sensitivity test

S. No.	Culture test performed	No. of anti-microbials drugs	Percentage
1	Yes	42	35
2	No	78	65
Total no. of anti-microbials drugs		**120**	**100%**

Table No. 9: Time to initiation of treatment

S. No.	Time of initiation of treatment of anti-microbial	No. of anti-microbials	Percentage
1	Day 1	94	74.01
2	Day 2	13	10.23
3	Day 3	6	4.72
4	Day 4	4	3.14
5	Day 5	2	1.57
6	Day 6	4	3.14
7	Day 7	2	1.57
8	Day 8	1	0.78
9	Day 10	1	0.78
Total no. of anti-microbial		**127**	**100%**

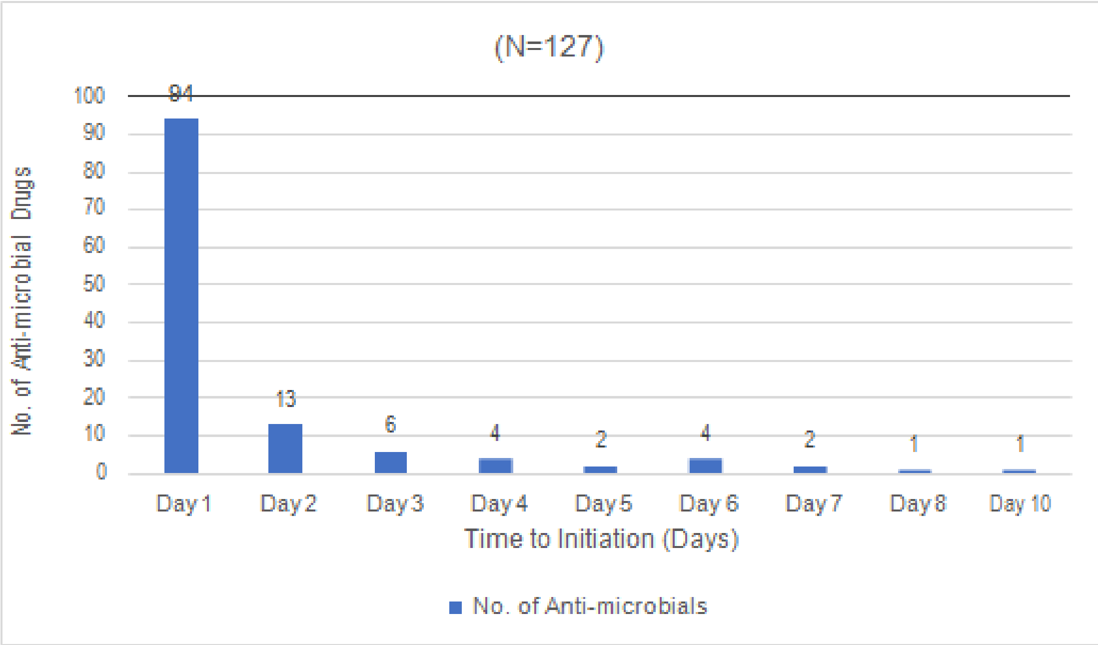

Figure No. 4: Time to initiation of anti-microbial drugs

Table No. 10: Types of culture specimen sent

S. No.	Types of cultures specimen sent	No. of cultures	Percentage
1	Sputum	29	69.05
2	Urine	3	7.14
3	Blood	7	16.67
4	Pus	3	7.14
Total no. of culture specimen sent		**42**	**100%**

Table No. 11: Culture reports

S. No.	Culture Reports	No. of specimen	Percentage
1	Growth	32	88.89
2	No Growth	4	11.11
Total no. of culture specimen		**36**	**100%**

Table No. 12: Types of organism isolated

S. No.	Organism Isolated	No. of isolated
1	Resistant *Klebsiella pneumoniae*	1
2	Isolate *Escherichia coli*	3
3	*Enterococcus faecalis*	1
4	Isolate *Pseudomonas aeruginosa*	4
5	*Candida albicans*	1
6	Isolate methylene sensitive *Staphylococcus aureus*	2
	Total no. of organisms isolated	**12**

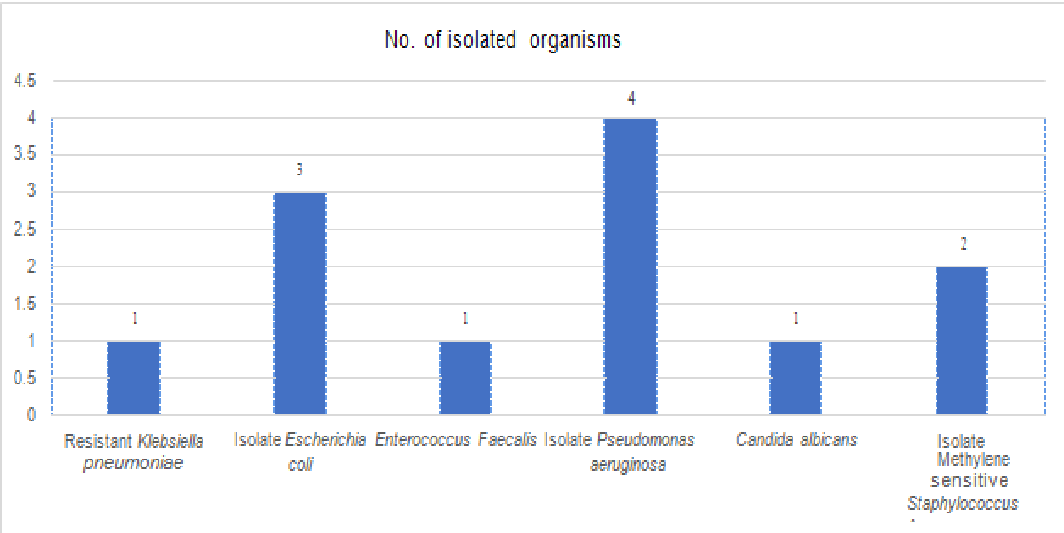

Figure No. 5: Types of organism isolated

Table No. 13: Culture-organism correlation

S. No.	Types of culture specimen	Type of isolation	No. of culture specimen
1	Sputum	Isolate *Escherichia coli*	**3**
		Isolate *Pseudomonas aeruginosa*	**4**
		Isolate methylene sensitive *Staphylococcus aureus*	**2**
Total no. of sputum specimen sent			**9**
2	Pleural fluid	*Candida albicans*	**1**
Total no. of pleural fluid specimen sent			**1**
3	Urine	Resistant *Klebsiella pneumoniae*	**1**
		Enterococcus faecalis	**1**
Total no. of urine specimen sent			**2**
Total no. of culture specimen sent			**12**

Table No. 14: Anti-microbial sensitivity toward organism isolated

S. No.	Organism	Drug Sensitivity	No. of specimens
1	*Enterococcus faecalis*	Macrolide antibiotics, Lincosamide anti-biotics, Quinolones and Aminoglycosides	1
2	*Escherichia coli*	Carbapenems and Aminoglycoside anti-biotics	3
3	Isolate *Klebsiella pneumoniae*	Carbapenems, Aminoglycosides Antibiotics and Azole derivatives	1
4	*Candida albicans*	Nucleoside Analog Anti-fungals and Azole derivatives	1

The drugs identified as sensitive towards the tested organism are listed based on their classification such as Penicillins (Amoxicillin, Ampicillin), beta-Lactamase inhibitors (Amoxicillin/Clavulanic acid, Cefoperazone/Sulbactam, Piperacillin/Tazobactam), Aminoglycosides (Gentamicin, Amikacin), Macrolides (Azithromycin, Erythromycin, Clarithromycin), Tetracyclines (Doxycycline, Minocycline, Tigecycline), Fluoroquinolones (Ciprofloxacin, Levofloxacin), Cephalosporins (Ceftriaxone, Cefuroxime, Cefuroxime Axetil, Cefepime), Carbapenems (Meropenem, Imipenem, Ertapenem, Doripenem, Aretopenem), Oxazolidinone (Linezolid), Glycopeptide (Vancomycin), Polymyxin (Colistin), Lincosamide (Clindamycin), Sulfonamides (Trimethoprim/Sulfamethoxazole) shown in Table 14.

Table No. 15: Drug-drug interactions monitored in anti-microbials

S. No.	Drugs	Interactions	No. of patients	Percentage
1	Clarithromycin+Theophylline	Theophylline increases toxicity of clarithromycin serum concentration	1	6.25
2	Amoxicillin+Aspirin	Amoxicillin either increases or decreases aspirin clearance	1	6.25
3	Piperacillin+Doxycycline	Decreases anti-bacterial effectiveness	1	6.25
4	Amoxicillin+Doxycycline	Amoxicillin antagonizes the bacterial effect	2	12.50
5	Amoxicillin+Amikacin	Amoxicillin reduces efficacy of amikacin	1	6.25
6	Levofloxacin+Aspirin	Levofloxacin will increase clearance of aspirin	1	6.25
7	Ciprofloxacin+Ondansetron	Ciprofloxacin increases QT Interval	1	6.25
8	Ciprofloxacin+Pyridoxine	Ciprofloxacin alters intestinal flora	1	6.25
9	Ciprofloxacin+Sitagliptin	Ciprofloxacin causes hyper/hypoglycemia	1	6.25
10	Clarithromycin+Glimepiride	Clarithromycin increases glimepiride concentration	1	6.25
11	Amoxicillin+Hydrochlorothiazide	Amoxicillin affects renal clearance	1	6.25
12	Prednisolone+Moxifloxacin	Increases chances of tendon rupture	2	12.50
13	Clarithromycin+Amoxicillin	Pharmacodynamic antagonism	1	6.25
14	Clarithromycin+Theophylline	Increase level of theophylline	1	6.25
15	No interactions seen		104	86.67%
Total no. of drug-drug interactions in antimicrobials out of 120 patients			**16**	**13.33**
Total no. of patients			**120**	**100%**

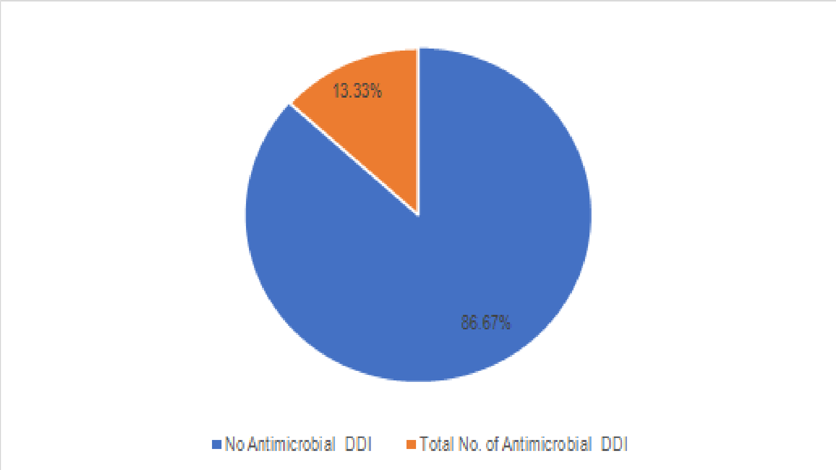

Figure No. 6: Anti-microbial drug-drug interactions monitored

Table No. 16: Choice of use anti-microbial drugs

S. No.	Severity scaling	No. of drug-drug interactions	Percentage
1	A	37	38.14
2	B	33	34.02
3	C	26	26.80
4	D	1	1.03
Total no. of drug-drug interactions		**97**	**100%**

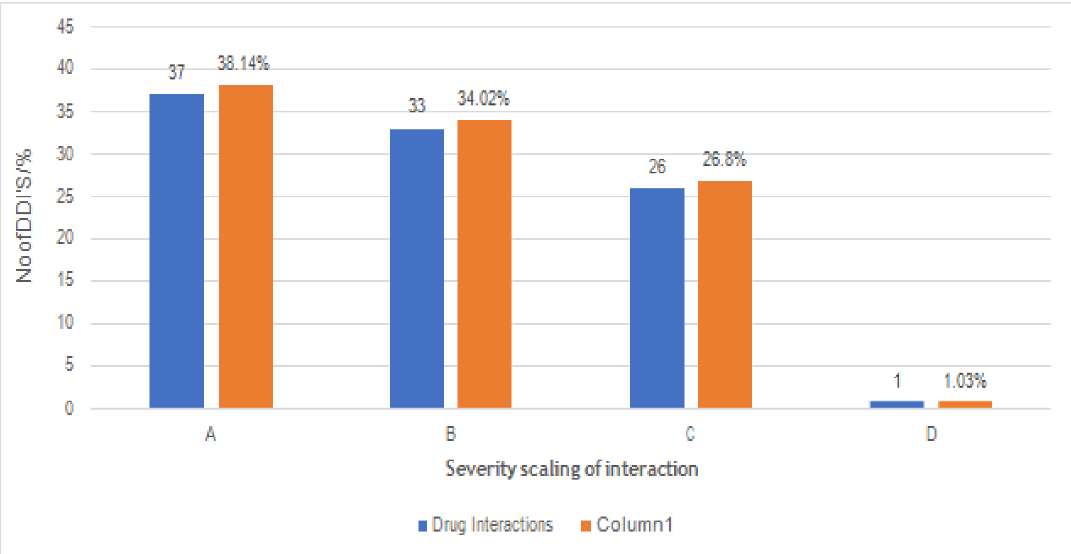

Figure No. 7: Severity scaling of interaction

DISCUSSION

Anti-microbials are the most commonly used and misused drugs all over the world. Unnecessary prescribing or overprescribing can lead to resistance of anti-microbials. Thus, a prospective observational study on "Improving Rational Use of Anti-microbials for Inpatients at a Tertiary Care Hospital" was carried out at Tertiary Care Hospital for a period of 6 months. A total of 120 patients were recruited and assessed for anti-microbial usage from inpatient wards of Tertiary Care Hospital. Out of which 66 were female (55%) and 54 were male (45%) [Table 1 and Figure 1].

Among 120 patients included 28 patients (23.33%) were found to be in the age group of 71-80 years followed by 25 patients (20.83%) were found to be in age group 61-70 years, 20 patients (16.67%) between age group 51-60 years, 17 patients (14.17%) between age group of 81-90 years, 11 patients (9.17%) between age group 21-30 years, 10 patients (8.33%) between age group 41-50 years, 7 patients (5.83%) between age group of 31-40 years and 2 patients (0.83%) between age group of 91-100 years and 11-20 years respectively [Table 2 and Figure 2].

The next parameter taken into consideration was ward distribution. Among 120 patients the majority of patients were recruited from Pulmonology 59 (49.17%) followed by General Surgery 11 (9.17%) [Table 3].

The need for an optimal use of antimicrobial drugs is of growing importance all over the World, to attain remission and reduce the resistance of the bugs towards old and new anti-microbial drugs[3]. As per ICMR guidelines the choice of anti-microbials is always in need. Thus, the choice of anti-microbials is more crucial. In our study 120 patients 112 anti-microbials were prescribed empirically. Among which Anti-bacterial 100 (86.2%) were found to be the highest followed by anti-viral 8 (7.14%) and anti-fungal 4 (3.57%). The study was found to be similar to the studies carried out by Abhishek Pratap Singh et.al.[9,10] [Table 4].

The prescription pattern of these drugs in our study population among which cephalosporins were found to be highest in number 64 (37.9%) followed by combination of cephalosporin and beta-lactamase inhibitors 32 (24.8%), anti-viral 8 (6.19%) and anti-fungal 3 (2.31%) [Table 5].

India has a growing burden of infectious diseases and is the 5th leading cause of mortality[1]. And the rate of resistance is growing more than that of mortality[3].In the distribution of patients based on provisional diagnosis, the majority of patients were ill of respiratory diseases (48.3%) followed by genitourinary (10.83%) and skeletal (10%), other diseases (14.17%), these observations are in line with reports from most hospitals as seasonal infections affect the lungs more than other parts of the body. The results were found to be similar to the study carried by Kamini Walia et.al.[6]. [Table 6 and Figure 3].

The treatment is effective only if the drug is administered correctly taking into consideration the time, duration and route of administration. So, based on need and consideration of the patient various routes were used. In our study, the major route of administration was oral 86 (84.31%) as all the patients were inpatients and conscious this route may have been preferred by prescriber [Table 7].

Subjective evidence may give idea about the disease by an objective evidence provides reliable data. So, culture sensitivity test is an essential parameter to be carried out before initiation of anti-microbial therapy. In our study, the sensitivity tests were performed in 42 patients (35%) and in 78 patients (65%) culture tests were not carried out. The study results were compared to that conducted by Abhishek Pratap Singh et.al.[9] and was found that the number of sensitivity tests carried out less often [Table 8].

Majority of anti-microbials prescribed were done on day 1 (74.01%), followed by day 2 (10.23%) and day 3 (4.72%), which is in line with hospital practice of empirical therapy based on complaints, signs and symptoms information given by patient when consulted by physicians, hence care needs to be taken to monitor for adverse reactions or lack of treatment efficacy which may occur as in case of infections were organism could be resistant to the anti-microbials [Table 9 and Figure 4].

The proper collection of a specimen for culture is the most important step in the identification of the pathogenic organism responsible for the infectious disease. A poorly collected specimen may lead to failure of identifying the organism. In our study, sputum sample 29 (69.05%) was the most common, followed by blood 7 (16.67%), followed by urine 3 (7.14%) and pus 3 (7.14%) [Table 10].

Performing culture sensitivity analysis is a crucial aspect for confirming the diagnosis to identify and isolate the causative organism and narrowing the antimicrobial therapy accordingly. In our study, out of 120 patients, 36 culture specimens were analysed for growth. Growth was observed in 32 (88.89%) and 4 (11.11%) did not have significant microbial growth. The results were found to be similar to the study conducted by Abhishek Pratap Singh et.al.[9] [Table 11].

Identifying the exact causative organism makes the therapy more efficient and easier among 12 specimen growth, it was identified that Isolate Pseudomonas Aeruginosa (4) was found to be more predominant followed by isolate *Escherichia coli* (3), followed by isolate methylene sensitive *Staphylococcus aureus*.[Table 12, Figure 5].

The collection of culture specimens and method of isolation determines how targeted the treatment can be, hence the specimens to be tested need to be taken with minimal difficulty. In our study of 12 total culture specimens, sputum (9) was highest followed by Urine (2) and pleural fluid (1) [Table 13].

Obtaining accurate diagnosis and preventing the growing resistance toward anti-microbial limits, the choice to select the proper treatment option in a patient gets tough to treat the bugs. Understanding the resistance pattern helps fight the virulent bugs with ease. In our study, *Escherichia coli* was found to be highly sensitive to carbapenem and aminoglycoside anti-biotics followed *Enterococcus faecalis* resistant to macrolide antibiotics, lincosamide antibiotics and quinolones, followed by isolate *Klebsiella pneumonia* sensitivity to aminoglycoside and azole derivative, followed by *Candida albicans* sensitive to nucleoside analog, anti-fungal and azole derivatives [Table 14].

The drug related errors that can be prevented are considered to be in minimal number but remain a threat during the treatment and sometimes remain undetected, majority of these errors are Adverse Drug Reactions (ADRs) or Drug-Drug interactions (drug-drug interaction). In our study, no drug-antimicrobial ADRs were detected. The observed drug-drug interaction can lead to reduced efficacy of the treatment or cause untoward effects to patients by both synergism and antagonism. Out of 120 prescriptions analysed, 12 (10%) were found to have drug-drug interaction, the most commonly observed drug-drug interaction was found to be Amoxicillin + Doxycycline, this is a drug-drug interaction as in this interaction Amoxicillin antagonizes the bacterial effect. Second, most observed drug-drug interaction was Prednisone + Moxifloxacin because this interaction increases chances of tendon rupture. [Table 15 and Figure 6].

The drug-drug interactions identified can be better understood and studied if we classify them on the potential adverse effect they can induce in the observed population into A, B, C and D in the descending order of severity. Due to good antimicrobial stewardship program adherence in the study site, the incidence of most severe drug-drug interaction being D (1.03%) and C (26.80) were low, and less severe drug-drug interactions were A (38.14%), B (34.02%). Hence, even as the occurrence of severe drug-drug interactions was low, better practices could be implemented to prevent more of the observed drug-drug interactions. [Table 16 and Figure 7].

In the study period of 6 months with observed population of 120 patients, there was no mortality reported, but as majority of patients were above the age bracket of 51- 60 years morbidity was present and these patients were receiving treatment for said morbid diseases such as diabetes mellitus, hypertension etc from before being admitted into inpatient ward of study site.

CONCLUSION

During the study period of 6 months, a total number of 120 patients were enrolled in the study from the inpatient's wards of Tertiary Care Hospital. In our study female patients were higher than male patients and geriatrics were more in number. Majority of the empirical anti-microbials were initiated in intensive wards soon after assessing the subjective symptoms of infection.

It was observed that the incidence of respiratory diseases (LRTI, URTI, pneumonia etc.) was found to be the highest. The choice of antimicrobial therapy is crucial in providing optimal therapeutic benefit to a patient. In empirical therapy it was observed that anti-bacterial were found to be prescribed in the highest numbers among which Cefoperazone and Sulbactam were the most commonly prescribed Antimicrobial drug of choice, followed by Cefixime and Augmentin.

Due to low incidence adverse reactions and negligible failure of therapy we can conclude that the prescription patterns with regards to dose of drug, frequency and administration of anti-microbials are in line with good prescription practices.

Most of these drugs were prescribed by I.V. route and a few by Per Oral. Culture tests were not performed in majority of the cases and in the few cases that it was performed, it was determined that Isolate Pseudomonas Aeruginosa was most common organism isolated. Adverse drug reactions, medication errors and drug interactions observed were minimum in number, which clearly indicate the rational use of Antimicrobials. Occurrence of nosocomial infections was found to be negligible in our study. The mortality and reinfection rate were too less in the entire study period and this reveals a good control of infectious disease at the study centre.

We conclude the study by stating that the infectious diseases are well diagnosed at the study centre and by reducing treatment based empirical therapy and relying more on a targeted treatment regimen based on culture sensitivity tests and regular review of prescription pattern in regards to escalation and de-escalation of anti-microbials, based on our observations, the hospital anti-microbial stewardship program can be further improved.

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CONFLICTS OF INTEREST

The author declares that there is no conflict of interest to disclose.

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