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Research Article

A STUDY OF ANTIBACTERIAL UTILIZATION PATTERN IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Objectives: The objective of the study was to analyze the utilization pattern of antibacterials in a tertiary care hospital.

Methods: A cross-sectional, prospective, observational study was conducted on patients admitted in inpatient departments of a tertiary care hospital for 6 months.

Results: In the study, 152 prescriptions being assessed contained 17.2% antibacterials. The most commonly prescribed drug class among antibacterials was β-lactams (50%). Ceftriaxone and amikacin (10.58%) were the highly prescribed antimicrobials. Maximum number of antibacterials were prescribed as monotherapy and given as parenteral dosage forms. Among the fixed-dose drug combinations, the most commonly used combination was Cefoperazone + Sulbactam (10.58%).

Conclusion: This study highlighted an overall pattern of antibiotic prescription in a tertiary care hospital. The most common infection for which the antimicrobials were prescribed was lower respiratory tract infection. Physicians preferred initiating prophylactic treatment than waiting for culture sensitivity test results. The most common antimicrobials prescribed were ceftriaxone and amikacin. Maximum number of prescriptions contained only one antimicrobial which is a favorable observation. Majority of prescriptions contained brand name which needs to be changed by an intervention.

Keywords: Antimicrobial resistance, Ceftriaxone, Amikacin, Cefoperazone, Sulbactam, Utilization pattern.

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INTRODUCTION

Antibiotic discovery had been the turning point in human history and has contributed a lot by saving millions of lives. However, the recent emergence of antibiotic resistance in bacterial pathogens, both nosocomial and in the community, is a very serious development that threatens the end of the antibiotic era [1].

Antibiotic resistance is not only a problem for the individual patient level but it also reduces the effectiveness of established antibiotic treatment regimen [2]. As a result of reduced effectiveness of the current treatment, the use of expensive second- and third-line agents such as linezolid and colistin becomes mandatory which may not be affordable by the majority of patients in a developing country like India. Additionally, resistance has been reported with these second- and third-line agents. The slow pace with which new molecules of antimicrobials are introduced into the market is inadequate to meet the needs of this global threat [3].

Various reasons for antibiotic resistance include overuse, inappropriate prescribing/irrational use, and non-compliance by the patient (gives more time for the bacteria to acquire resistance). Rational use of drugs is the use of a right, a right dosage, and at right cost which is well reflected in the World Health Organization (WHO) definition: "Rational use of drugs requires that patients receive medications appropriate to their clinical needs, in doses that meet their individual requirements for an adequate period at the lowest cost to them and their community" [4].

Irrational usage of antibiotics has become a global problem, especially in developing countries resulting in an increased emergence of resistance to most common bacteria, higher cost of treatment, prolonged hospitalization, and adverse drug reactions.

To tackle this problem, a global initiative is trying to promote the rational use of antimicrobials [5]. The knowledge of antibiotic utilization patterns is necessary for a constructive approach to problems of antimicrobial resistance. A highly representative data help in strengthening the antibiotics policy of hospitals which intern can aid the prescribers in rational antibiotics use to improve the quality of patient care [6].

Drug utilization research was defined by the WHO in 1977 as the marketing, distribution, prescription, and use of drugs in a society, with special emphasis on the resulting medical, social, and economic consequences. Drug utilization research in itself does not necessarily provide answers, but it contributes to rational drug use in important ways [7].

Drug utilization research may provide insights into the pattern of use, quality of use, determinants of use, and outcomes of use, which are the important aspects of drug use and drug prescribing and thereby helps to monitor and prevent antibacterial resistance by facilitating the rational use of drugs in population [7]. The objective of this study was to analyze the use of antimicrobials in a tertiary care hospital. The data generated in this study can be a guiding tool to understand the sensitivity pattern of microbes, usage frequency of antimicrobials in the study site, thereby helping to decide on appropriate interventions to identify the problems in prescribing practices and also in promoting rational use of drugs in the community.

METHODS

A cross-sectional, prospective, observational study was carried out for a period of 6 months on patients admitted to inpatient departments of a tertiary care hospital. Before commencing the study, the study protocol

Table 1: General distribution of drugs

Number of prescriptions	Total number of drugs prescribed	Total number of antibacterials prescribed	Drugs other than antibacterials
152	1482	255	1227

Table 2: Gender-wise distribution of the study population

Gender	Number of patients	Percentage of patients
Males	82	53.2
Females	70	46.7

Sample size=152

Table 3: Prescribing pattern of antibacterials

Parameters for prescription analysis	Number of antibacterials	Percentage of antibacterials
Pattern of prescription		
Monotherapy	163	63.9
Combination therapy	92	36.1
Antibacterial utilization based on ROA*		
Parenteral	231	90.6
Oral	24	9.4
Distribution of antibacterials per prescription		
1	73	48.0
2	60	39.5
3	15	9.9
4	3	2.0
5	1	0.7
Antibacterial utilization based on generic and brand name		
Brand name	198	77.6
Generic name	57	22.4

*ROA: Route of administration, Sample size=255

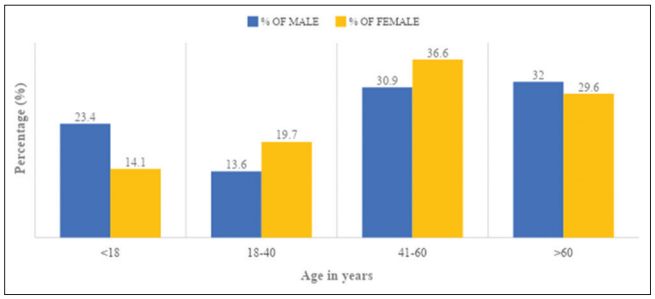

Fig. 1: Age-wise distribution of the study population (Sample size = 152)

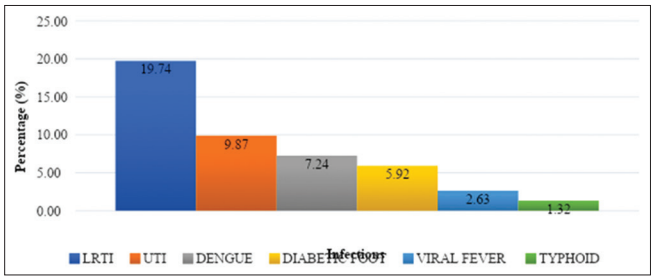

Fig. 2: Distribution of infections among the study population (Sample size = 152)

was submitted to the ethical committee of the institution for approval. After obtaining ethical committee clearance, the study was initiated.

The data required for the study were collected from patient case sheet, laboratory investigations, and oral information from the patient or attenders. All the inpatients prescribed with antibiotics were included in the study and outpatients, patients prescribed with topical antibiotics, pregnant and lactating women, mentally retarded, and unconscious patients were excluded from the study.

Method of data collection and data analysis: Patients were selected based on the inclusion and exclusion criteria. After taking the informed consent from each patient, patients details including demographic details, final diagnosis, laboratory data, culture sensitivity test and data on drugs administered, date of administration, dose and frequency, and route of administration were collected from the date of admission till their discharge from the patient's case records and documented in specially designed patient profile forms.

RESULTS

Results are based on the 152 prescriptions selected as per the inclusion and exclusion criteria during the study period.

Among 152 prescriptions, the total number of drugs prescribed were 1482, of which 255 (17.2%) drugs were antibacterials and 1227 (82.8%) belonged to other classes of drugs (Table 1).

According to the study, males (53.2%) were predominantly prescribed with antibacterials when compared with females (46.7%) (Table 2).

Age group of the study population was classified into four groups, i.e., <18 years, 18–40 years, 41–60 years, and >60 years. Patients belonging to the age group between 41 and 60 years contributed to the highest number (33.5%) followed by the age group of >60 years (30.9%) and the least number of patients were found in the age group between 18 and 40 years (Fig. 1).

Comparatively lower respiratory tract infection (LRTI) was the most common infection seen followed by urinary tract infection (UTI) and dengue (Fig. 2).

In this study, of 152 prescriptions, culture sensitivity was done for 79 (51.9%) prescriptions (Fig. 3).

This study was conducted in nine departments, in which general medicine is found to have the highest percentage of antibacterial utilization (27.1%) followed by surgery (23.9%) and pulmonology (23.1%). Minimal antibacterial utilization was found in urology, nephrology, cardiology, neurology, and dermatology department with the least percentage of utilization in the dermatology (1.2%) (Fig. 4).

As shown in Table 3, of 152 prescriptions that were analyzed a total of 255 antibacterials were present, of which a majority of antibacterials (63.9%) were prescribed as monotherapy and the rest (36.1%) of the antibacterials were prescribed as combination therapy and 73 (48%) prescriptions contained only one antibacterial and only one prescription (0.7%) contained five antibacterials. Maximum number of antibacterials prescribed were in the parenteral form (90.6%), oral form of antibacterials was few in number (9.4%). The prescription was by brand name in most of the cases (77.6%) (Table 3).

In this study, β-lactams were predominantly prescribed (60.8%) followed by aminoglycosides (11%) and quinolones (10.2%) (Fig. 5).

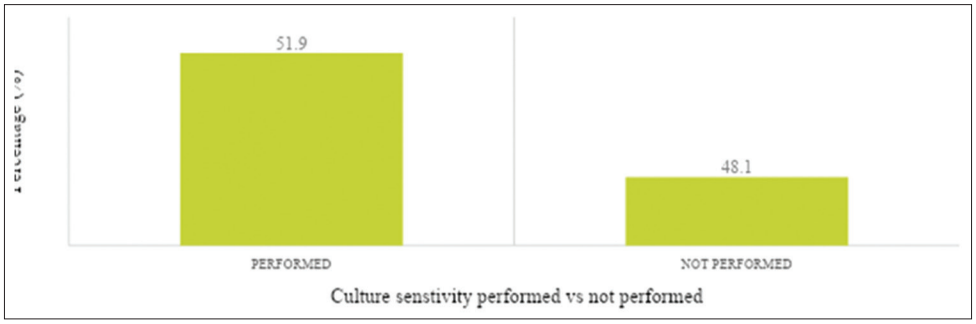

Fig. 3: Performing culture sensitivity test (Sample size = 152)

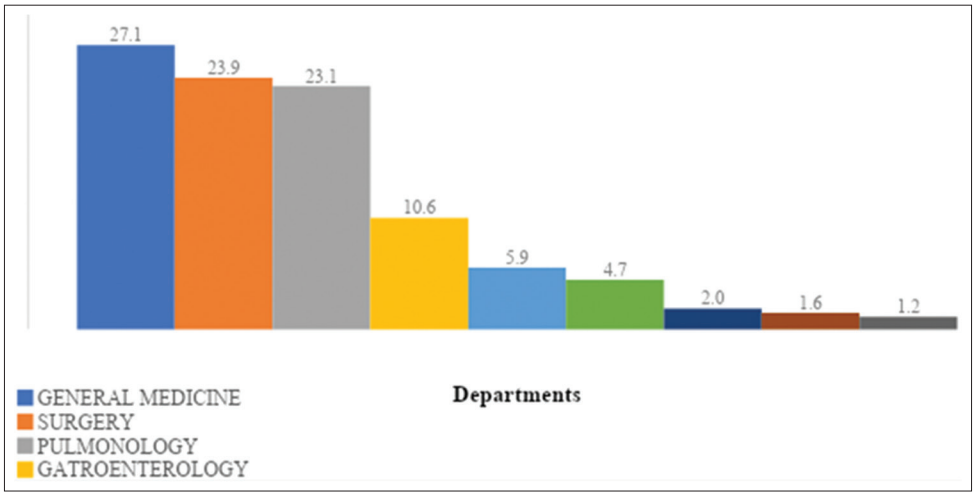

Fig. 4: Department wise distribution of antibacterials (Sample size = 255)

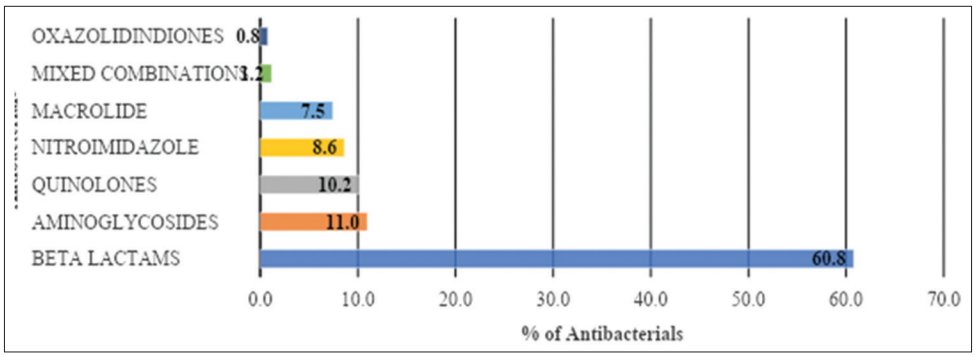

Fig. 5: Prescribing frequency of different classes of antibacterials (Sample size = 255)

Ceftriaxone and amikacin were the most commonly prescribed antimicrobials followed by cefuroxime and metronidazole. In fixed-dose drug combination (FDC), piperacillin+tazobactam was the most commonly prescribed combination of antimicrobial followed by amoxicillin+clavulanic acid (Table 4).

DISCUSSION

This study was conducted to observe the antibacterial utilization in various departments of a tertiary care hospital.

A total of 152 patients were enrolled in the study based on the inclusion and exclusion criteria. Of the total number of drugs prescribed, 17% of drugs were antibacterials. In a similar study by Ramesh *et al.*, 37% of drugs were antibiotics [8]. We observed a controlled use of antibiotics among this study population which indicates increased awareness of antimicrobial usage among physicians. In this study, male patients were more in number (81) than female patients (71), which was similar to the study conducted by Rajalingam *et al.*, which also observed a higher number of male (63) patients than female (37) patients [9]. Higher susceptibility of the male population to bacterial infections may explain the above observation.

The mean age of patients was found to be 45 years. The greatest number of patients was found in the age group of 41–60 years and the least number of patients was found in the age group between 18-40 years. The results are contrasting with the study conducted by Muniza *et al.*, which concluded that substantial number of patients belonged to the age group between 18-40 years followed by the age group of 41–60 years [10]. The higher incidence in years age group range might be due to the presence of higher exposure to pathogens, concomitant chronic diseases such as diabetes and low immunity in this age group.

In this study, the most common infections observed were LRTI and UTI. This observation gives the overall picture of the prevalence of

Table 4: Common antibacterials prescribed

Class	Antibacterials	Antibacterials	
		n	Percentage
Beta-lactams (155)	Cephalosporins (95)		
	Ceftriaxone	27	10.58
	Cefoperazone+Sulbactam	27	10.58
	Cefuroxime	21	8.23
	Cefotaxime	8	3.13
	Cefixime	6	2.35
	Cefepime	2	0.78
	Cefepime+Tazobactam	2	0.78
	Cefoperazone	1	0.39
	Cefpodoxime+Sulbactam	1	0.39
	Penicillins (53)		
	Piperacillin+Tazobactam	27	10.58
	Amoxicillin+Clavulanic acid	24	9.41
	Ampicillin	2	o. 78
	Carbapenems (6)		
	Meropenem	5	1.96
	Imipenem	1	0.39
	Monobactam (1)		
	Aztreonam	1	0.39
Aminoglycosides (28)	Amikacin	27	10.58
	Rifamycin	1	0.39
Quinolones (26)	Levofloxacin	11	4.31
	Ofloxacin	7	2.74
	Moxifloxacin	6	2.35
	Ciprofloxacin	1	0.39
	Nitrofurantoin	1	0.39
Nitroimidazoles (22)	Metronidazole	20	7.84
	Ornidazole	2	0.78
Macrolides (19)	Clarithromycin	12	4.7
	Clindamycin	7	2.74
Mixed	Ofloxacin+Ornidazole	2	0.78
combinations (3)	Sulfamethoxazole+TMP	1	0.39
Oxazolidinones (2)	Linezolid	2	0.78
Grand total		255	100

Sample size=255

different infectious diseases around the study site. Similarly, in a study conducted by Khanam *et al.*, maximum patients were suffering from upper respiratory tract infections [11]. In a prospective study conducted by Muniza *et al*., gastrointestinal and renal infections were predominant [10].

It was found that of 255 prescriptions observed, culture sensitivity was performed for 51.9% of the prescriptions. However, these results were inconsistent with the study results of Khanam *et al*. and Ahmed *et al*., where the number of prescriptions with culture sensitivity was low (24% and 14.1%, respectively) [11,12]. Culture sensitivity test helps clinicians in deciding the best antibacterial and helps in providing better patient care. Most of the physicians prefer initiating prophylactic therapy instead of waiting for the culture report to avoid deterioration of symptoms.

The study involved nine departments of a tertiary care hospital. Most antimicrobial prescriptions were from the medicine department. In most of the studies, general medicine department prescribed the highest number of antimicrobials as infectious cases will be admitted to this department [8,9,13]. Carrying out study in various departments will add to the advantage of getting a better picture of utilization pattern of antibacterials by different medical specialists.

It was observed that 63.9% antibacterials were given as a monotherapy, whereas combination therapy constituted to only 36.1% of the total prescribed antibacterial. These results were correlated with the study conducted by Anjan A *et al.*, in which results revealed that 76% of antibacterials were given as a monotherapy, while 23% were given as fixed-dose combination [14]. A study by Gowthami *et al.* also observed the use of FDCs in the medicine department of a tertiary care hospital where half of the prescriptions contained two antibiotics [15]. On the other hand, these results differ from the study conducted by Chaitanya *et al.*, where results showed that a major contribution of combination therapy was 56% and monotherapy constituted for just 44% [4]. This observation shows the preference of monotherapy by the practicing physicians of the study site. Although the combination of antimicrobials in advantageous to combat the emergence of resistance and for broader organism coverage, newer antibiotics cover the wide spectrum of organisms. In addition, monotherapy is relatively non-toxic and possibly less costly than combination therapy.

Combination therapy is required in patients with Gram-negative bacillary infection with profound granulocytopenia, mycobacterial infections, enterococcal endocarditis, and deep-seated pseudomonal infections.

The results showed that parenteral therapy is the prime route of administration. These results were similar to the results demonstrated by Chaitanya *et al.*, which also showed that parenteral route of administration was the most frequent route of administration. This observation can be supported by the fact that in hospitalized patients, parenteral route is preferred for better absorption and efficacy, when the patients are discharged, antibiotic therapy is continued through oral regimen [4].

According to the study results, most of the prescription consisted of only one antibacterial. These results were in agreement with the study conducted by Chaitanya *et al.*, which also showed that highest number of prescriptions contained only one antibacterial (41%) [4]. This result contradicts the study done by Gowthami *et al.*, where majority of prescriptions contained two or more antimicrobials [15]. This is a favorable observation as the increased number of antimicrobials per prescription can reduce the safety of the regimen and increase the chances of the development of antimicrobial resistance.

In this study, the practice of prescribing through brand names was seen more commonly than the prescriptions through generic name, similar to the studies conducted by Ramesh *et al.* and Rajalingam *et al.* [8,9]. Generic prescribing is generally more cost-effective than prescribing by brand name. Additionally it allows any suitable product to be dispensed, reducing the delays in supplying medicines to the patient.

In the study, it was observed that cephalosporins were most widely used when compared to other classes of antibacterials which correlated with the study by Chaitanya *et al.* and Gauthami *et al.* [4]. Among cephalosporins, the third generation was the most commonly prescribed one. However, this result does not correlate with the results of the study by Khanam *et al.*, where fluoroquinolones followed by penicillins were the most commonly prescribed antimicrobial class [12]. Cephalosporins are preferred group of antibiotics due to their broad spectrum of activity, safety, and wide availability. Due to their activity against most Gram-positive organisms, the third-generation cephalosporins are most commonly used. The usage pattern also depends on the susceptibility of the microbes at the study site.

The highest number of prescriptions contained ceftriaxone and amikacin followed by metronidazole. A study conducted by Rode *et al.* and Gowthami *et al.* showed maximum use of ceftriaxone [15,16]. Ceftriaxone is a broad-spectrum third-generation cephalosporin antibiotic for intravenous or intramuscular administration. It has high antibacterial potency, wide spectrum of activity, and low potential for toxicity. It is effective in complicated and uncomplicated UTIs, RTIs skin, soft tissue, bone and joint infections, bacteremia/septicemia, meningitis, infections in immunosuppressed patients, acute bacterial otitis media, genital infections, disseminated Lyme's disease, and in surgical prophylaxis of infections [17].

Extensive use of amikacin was not observed in other studies [4,10,15]. Aminoglycoside is used due to their low cost and reliable activity against Gram-negative aerobes. Amikacin is particularly effective when used against bacteria that are resistant to other aminoglycosides since its chemical structure makes it less susceptible to inactivating enzymes [18].

Piperacillin + tazobactam was the most commonly prescribed FDCs followed by amoxicillin + clavulanic acid. Similar trend has been found in a study by Gauthami *et al.* Piperacillin + tazobactam has a wide variety of antimicrobial activity and is active against the organisms which have shown resistance to cephalosporins. Amoxicillin + cavulanic acid is also a wide spectrum FDC effective against wide range of infectious diseases [19].

CONCLUSION

This study highlighted the overall pattern of antibiotic prescription in a tertiary care hospital. The most common infection for which the antimicrobials were prescribed was LRTI. Physicians preferred initiating prophylactic treatment than waiting for the culture sensitivity. The most common antimicrobials prescribed were ceftriaxone and amikacin. Maximum number of prescriptions contained only one antimicrobial which is a favorable observation. Majority of prescriptions contained brand name which needs to be changed by suitable intervention.

AUTHORS' CONTRIBUTIONS

Jahnavi Simhadri, Komal Kulkarni, and SV Asish have recruited the subjects, collected, and analyzed the data. Sapna K Dongre and Neetu S George guided the work. Deviprasad Hegde supervised the case collection in the hospital. All authors have equal contribution toward the work.

CONFILCTS OF INTEREST

The authors declare that they have no conflicts of interest toward this work.

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