How to Cite:
Tarun, S., Kapil, S., Amit, N., Gaurav, J., Munawwar, H., Gurvinder, S., Maheipeube, N., Malik, A., & Bimal, A. (2022). Assessment of antimicrobial drugs utilization in tertiary care hospital-an antimicrobial stewardship implication. *International Journal of Health Sciences*, *6*(S7), 5474-5483. https://doi.org/10.53730/ijhs.v6nS7.13258

Assessment of antimicrobial drugs utilization in tertiary care hospital-an antimicrobial stewardship implication

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Abstract---Background: Irrational antibiotic usage major cause of spreading antimicrobial resistance therefore goal of this research was to refine prescribing patterns and may aid in addressing issues related to irrational antibiotic usage. Method: This prospective observational research was conducted at Maharishi Markandeshwar Institute of Medical Sciences & Research to assess the prescribing pattern of Antimicrobials Agents (AMAs) as well as the logic of their use. Results: The study enlisted the participation of 100 individuals. Of all 63% were male and 37% were female. The vast majority of participants are between the ages of 41- 60.94% of the 100 subjects receive AMAs.In our study, cephalosporins and β-lactams were found to be the most widely used AMA class (52.6%).Ceftriaxone was prescribed the most (32%), followed by piperacillin and tazobactam (23%).Antibiotics were given to patients for a maximum period up to 7 days in 39% and 5% of patients were given more than 17 days. 59 % patient's urine sample was collected AST from different sites, urine (30), pus and sputum (7), blood (5), wound and et (3), pleural (1), ascitic (1), AFB (1), and abdominal (1).Only 37.8% specimens yielded a positive result, whereas 62.71% yielded a negative result Conclusion: The widespread use of costly AMAs and irrational prescriptions are majorconcerns that must be addressed immediately through the implementation of guidelines, monitoring systems, and antibiotic restriction rules, as well aspublic awareness campaigns at all levels of healthcare. This fundamental & AST data would help in sensitivity for efficient use of antibiotic use.

Keywords---Antimicrobial Stewardship (AMS), Prospective Audit and Feedback (PAF), Drug utilization evaluation (DUE), Anatomical therapeutic intervention (ATC),Defined daily dose (DDD).

Introduction

AMAs are frequently recognized as the twentieth century's greatest discovery. Antibiotic resistance is becoming a severe problem all around the world, necessitating the prudent use of antibiotics, which is becoming increasingly important[1]. The three most common situations for antibiotic use with the commonest causes for antibacterial prescription are sore throat, diarrhoea, and fever. In all these above situations, antibacterial are prescribed irrationally. These are non-bacterial illnesses that destroy defenceless bacteria and promote the formation of resistance strain bacteria, thereby aiding in the spread of bacterial drug resistance. From amongst the 5000 AMAs discovered up to now, only100 are used clinically[3]. Widespread inappropriate use of antimicrobials came out as an emerging factor for the increase in antimicrobial resistance worldwide. All the reissues together for magreatthreat[4]. Prescriptions are one of the most important therapeutic concerns since they are written orders from a practitioner for medicines to be used in the diagnosis, treatment, and prevention of a disorder in a specific patient. These must be safe, effective, widely, and judiciously employed to achieve the desired results. Drug Utilization Studies (DUS) are a sort of prospective system for evaluating healthcare systems. Drug Utilization Evaluation

(DUE)In 1977, the World Health Organization (WHO) defined pharmaceutical marketing, distribution, prescription, or use in society as "the advertising, distribution, prescribed medications, or "community drug usage, with such a related to clinical, societal, and economic consequences."[5] Antibiotics are among one medication classes that have the highest prescription rate in a hospital environment. Study analyses already showed thataround 33% of hospitalizations lead to antimicrobial treatment for patients [6,7]. Drug use evaluation (DUE) is defined by the WHO as a tool for assessing drug use that is systematic, ongoing, and based on criteria to ensure that pharmaceuticals are administered correctly and appropriately at level of each patient[8]. Medicine with a narrow therapeutic index, as well as expensive drugs, which when combined with improper use, cause serious problems and thus are recommended as individual candidates in the DUE studies. DUE studies offer an excellent method for the identification of existing as well as possible drug-related problems that are major hurdles to prevent in achieving the desired outcome of specific pharmacotherapy[9,10]. India appears to have highest prevalence rate of infectious diseases around the world, making the situation more critical and disproportionate in terms of antibiotic use and resistance. Antibiotic usage in India ranges from 24 to 67%, which is responsible for its widespread misuse, which eventually leads to the emergence of resistance[11]. Drug utilization (DU) studies are critical for basically all therapeutic medications, particularly antibiotics[12] which are often utilized in the community and the hospital[13]. Antibiotic was derived from the Greek word antibiosis, which means "against life." Antibiotics were once thought to be organic compounds produced by microorganisms[14].As a result of this concept, an antibiotic was initially defined as a chemical produced by a microorganism [15], or of biological origin [16], that can inhibit the growth of, or be toxic to, other microorganisms in small quantities[14].But, in the latest days, this concept has been broadened to include antimicrobials that are synthesized fully or in part. Some antibiotics can eliminate bacteria, while others just slow their growth. Bactericidal substances are those that are capable of killing bacteria, whereas bacteriostatic substances are those that inhibit bacterial growth[17]. Antibiotics are classified as antibacterials, antifungals, and antivirals based on the microorganisms they combat[14,18]. A major contributor to the rise in antimicrobial resistance is widespread overuse and inappropriate use of antimicrobial medications[19]. It is pivotal to carry on DUE about antibiotics[20]. It can aid to recognize potential and actual drug-related issues, stave off the formation of drug-resistant organisms, and control therapeutic expenses. DUE is an organized process to interpret the method or way of medication administration in a variety of practice settings, including hospitals following criteria or predefined standards. DUE programs will perpetuate the interventions that willpatient accelerate efficient patient outcomes[21].

Tools in Drug Utilization Evaluation:

To improve the quality of drug usage, the World Health Organization (WHO) recommends Anatomical Therapeutic Chemical categorization and defines daily defined dose (DDD) system as the international standard for drug utilization research [22].

ATC Classification: - In ATC Classification system, the drugs were classified based on the organ of the body in which they act, as well as their chemical, pharmacological, as well as therapeutic properties[23].

DDD: -"A medication's projected average daily maintenance dose for its primary usage in humans." according to DDD. DDD is only applied to medications that have already been assigned with an ATC code. These metrics can be used to evaluate medication use at all levels of the healthcare system [22].The formula was used to calculate the DDD per 100 bed-days:[22]

$$\text{DDD/100 bed-days} = \frac{\text{No. of units administered in a given period} \times 10}{\text{DDD} \times \text{number of days} \times \text{number of beds} \times \text{occupancy index}}$$

$$\text{Where occupancy index} = \frac{\text{Total inpatient service days for a period} \times 100}{\text{Total inpatient bed count} \times \text{number of days in the period}}$$

The objective of our research was:

- To evaluate AMA prescribing patterns in terms of frequency of class and agents, as defined by the WHO-ATC categorization.
- Determine the use of AMAs as measured by DDD/100 bed-days. (WHO / DDD).

Material and Method:

With ethical clearance from the Institutional Ethical Committee of Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana for the period of one year from January 2021 onwards, this prospective study was conducted atthe study site with consent from the participants. The data was collected in a designed data collection form, and a total of 100 subjects were enrolled in this study.

Inclusive and Exclusive Criteria:

Inclusive criteria:

1. The inpatient was prescribed antimicrobial drugs.
2. A patient has been prescribed restricted antimicrobial drugs.

Exclusive Criteria:

1. Patient with SARS, H1N1.
2. Epidemic communicable disease.

Statistical Analysis: Using a Excel spreadsheet for data collection then data was statistically analysed with various tools.

Confidentiality:

All patient information is kept safe and confidential patient identities were never revealed to any source

Results:

Total of 100 people were recruited. Out of 100, 63% were male & 37% were female. The majority of the participants belong to age group of 41to 60 years. For Male &female patients' Mean ± SDwas found to be 21 ± 8.6 years and 12.33 ± 4.3 years respectively. Table 01 shows the patient distribution by age and gender.

Table 1: Distribution of the patients according to age and gender-wise

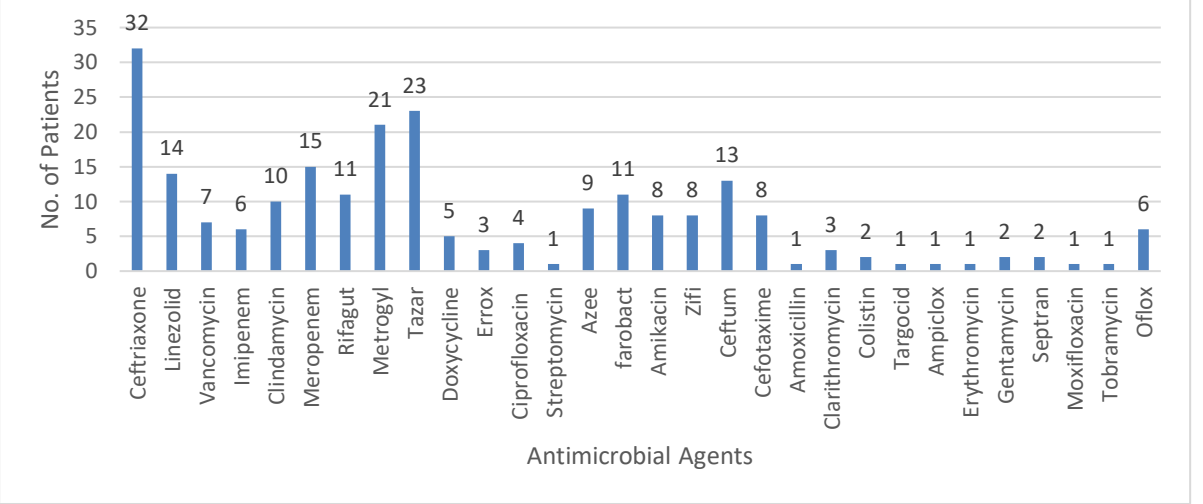
Sr. No.	Age	Frequency	Percentage %	Male %	Female%
1	<40 years	19	19%	10(52.63%)	9(47.36%)
2	41-60 years	49	49%	31(63.26%)	18(36.73%)
3	>60 years	32	32%	22(68.75%)	10(31.25%)
	Total	100(100%)	100%	63(63%)	37(37%)
			Mean ±SD of Age 33.33±12.28	21 ± 8.6	12.33 ± 4.3

There were 230 antimicrobial drugs were prescribed, mean ± SD 2.3 ± 1.41. B-lactam was prescribed in 60 (26%) of prescriptions where as Cephalosporins accounted for 100 of the 230 antimicrobial prescriptions. The most commonly prescribed specific AMA was ceftriaxone, which was prescribed on 32 (13.9%) occasions, followed by piperacillin-tazobactam, which was given on 23 (10%) occasions. Table 2 shows the number of AMAs prescribed/ patient, and Figure 1 shows the frequency pattern of prescribing various AMAs.

β-lactams were the most widely prescribed AMA class (52.6%).

No. of AMAs prescribed	No. of patients	Percentage (%)
1	27	28.72%
2	30	31.91%
3	16	17.02%
4	10	10.64%
5	11	11.70%
No. of patients received AMAs=94		
Average no. of antibiotics per patients who received AMA	2.45±1.76	

Figure 1: frequency pattern of prescription of different AMA



The frequency and cumulative frequency, percentage, and cumulative percentage of the patient's therapy durations are shown in Table 3. Antibiotics were given to patients for a period of 1-6 days in 35.11% individuals, 7-11 days in 39.36% individuals, 12-16 days in 20.21% individuals, and more than 17 days in 5 individuals.

Table 3: Distribution of therapy of hospital patients

Days of therapy	Frequency	Percentage (%)
Less than 7 days	33	35.11%
7—11 days	37	39.36%
12—16 days	19	20.21%
>17 days	5	5.32%

Antibiotics can be administered as a single medicine or as a part of a combination medication. In our study, 37(39.36%) participants were prescribed more than two antibiotics, 30(31.91%) subjects were prescribed two antibiotics and 27(28.72%) subjects were assigned a single or single antibiotic.

Culture isolationdemonstrates that only 59 patients out of 94 had urine (30), pus and sputum (7), blood (5), wound and et (3), pleural (1), ascitic (1), AFB (1), and abdominal (1) samples taken for culture testing. A huge number of urine samples were obtained.

Table 4: WHO DDD per 100 bed days of antimicrobial agents used in patients admitted to the general medicine ward for two months study period

Class	AMAs	ATC code	DDD (MG)	Total (MG)	No. of the patient received
Cephalosporin	Ceftriaxone	J01DD04	2000	391000	32(13.9%)
Penicillin	Piperacillin+ tazobactum	J01CR05	14000	1141275	23(10%)
Imidazole	Metronidazole	J01XD01	1500	49600	21(9%)
Carbapenems	Meropenem	J01DH02	3000	241000	15(6.5%)
Oxazolidinone	Linezolid	J01XX08	1200	121200	14(6%)
Cephalosporin	Cefuroxime	J01DC02	3000	149500	13(5.6%)
Carbapenem	Faropenem	J01DI03	750	18400	11(4.7%)
Intestinal anti Infective	Rifamixin	J07AA11	600	55200	11(4.7%)
Lincosamide	Clindamycin	J01FF01	1800	79200	10(4.3%)
Macrolides	Azithromycin	J01FA10	500	30125	9(3.9%)
Cephalosporin	Cefixime	J01DD08	400	23800	8(3.4%)
Cephalosporin	Cefotaxime	J01DD01	4000	123500	8(3.4%)
Aminoglycoside	Amikacin	J01GB06	1000	54750	8(3.4%)
Glycopeptide	Vancomycin	J01XA01	2000	42700	7(3%)
Fluoroquinolones	Ofloxacin	J01MA01	400	10400	6(2.6%)
Carbapenem	Imipenem	J01DH51	2000	44700	6(2.6%)
Tetracycline	Doxycycline	J01AA02	100	5400	5(2.1%)
Fluoroquinolones	Ciprofloxacin	J01MA	1000	5700	4(1.7%)
Penicillin	Erox	J01CA04	3000	10915	4(1.7%)
Macrolide	Clarithromycin	J01FA09	1000	18000	3(1.3%)
Polymyxin	Colistin	J01XB01	9000	89	2(0.8%)
Aminoglycoside	Gentamycin	J01GB03	240	4920	2(0.8%)
Sulfonamide	Sulfamethoxazole + trimethoprim	J01EE01	2400	5760	2(0.8%)
Glycopeptide	Teicolplanin	J01XA02	400	4000	1(0.4%)
Penicillin	Ampicillin	J01CA01	6000	8000	1(0.4%)
Macrolide	Erythromycin	J01FA01	1000	1000	1(0.4%)
Fluoroquinolones	Moxifloxacin	J01MA14	400	4000	1(0.4%)
Aminoglycoside	Tobramycin	J01GA01	112	3360	1(0.4%)
Aminoglycoside	Streptomycin	A07AA04	1000	2500	1(0.4%)
Total 230(100%)					

Discussion

Antibiotics are frequently prescribed to treat bacterial illnesses. Prescriptions should be reviewed and drugs should be prescribed sensibly to boost therapeutic efficacy and reduce drug-related side effects. There were total of 100 individuals were enrolled in our study, where 63 male patients and 37 female patients, and this result is consistent with those of research conducted in Mangalore, Karnataka, Puducherry, Vadodara, Gujarat, and Bhubaneswar,

respectively[4,24,25,26]. The majority of the people were between the ages of 41 and 60, and this conclusion is consistent with research from another region of India[4,24,26,27].

In our investigation β-lactams were shown to be the most commonly given AMA class (52.6%). 43.42% antimicrobial prescribed were of this group. β-lactam was prescribed in 60 (26%) of the cephalosporin prescriptions.Ceftriaxone was the most often prescribed individual AMA, with 32 (13.9%) of cases prescribing it, followed by piperacillin-tazobactam with 23 (10%) of cases prescribing it.The best period of antibiotic treatment was 1-6 days, while the shortest was 12-16 days. Two antibiotics were prescribed to 30%percent of patients, one antibiotic was prescribed to 27 percent of patients, and more than two antibiotics were prescribed to 37 percent of patients. This information complements Shamshy *et al.*[28], a study in Tamil Nadu, where the majority of subjects (54.58 percent) were prescribed at least one antibiotic, 28.57 percent were prescribed two antibiotics, 15.02 percent were prescribed three antibiotics, and 1.83 percent were prescribed four antibiotics. Urine (30), pus and sputum (7), blood (5), wound and et (3), pleural (1), ascitic (1)and abdominal (1) samples were taken for culture testing on 59 patients out of 100.Only 22 of the 59 specimens yielded a positive result, whereas 37 yielded a negative result. Which was similar to a study performed in Tamil Nadu.[28] for the identification of microorganisms, only 14 out of 273 patients had specimens collected. In this investigation, the no. of Daily Defined Doses for prescribed antimicrobials was estimated, which will be compared in future research using a similar design to discover drug utilisation patterns over time.These statistics can be used to compare drug use in different parts of the country as well as internationally.This study looked into the pattern of AMA use in DDD / 100 bed days. The total number of AMAs used was 298.54 DDD / 100 Bed days, which is consistent with the findings of a previous research[24]. Ceftriaxone, Rifagut, piperacillin-tazobactam, Doxycycline, and Meropenem usage in DDD / 100 Bed days was 66.76, 25.13, 23.86, 20.11, and 18.19 in the current study, respectively, and this utilization pattern is substantially higher than that of other regions of the country[22,27,29].

Conclusion

Antibiotics are the mainstay treatment for a variety of acute and life-threatening illnesses, including septicaemia and septic shock, and can save lives when administered correctly. However, antibiotic resistance is on the rise as a result of abuse and inappropriate use, and microbes are increasingly becoming resistant, posing a persistent hazard.Antibiotic judicious use is one of the most important factors in preventing antibiotic resistance and adverse effects around the world. Recent developments, evolving resistance patterns, and the availability of new AMAs should be communicated to hospital staff frequently. The existence of a clinical pharmacologist in every healthcare division will ensure the rational and cost-effective use of antimicrobials.Every hospital must have an antimicrobial stewardship program. A committee should be formed to develop and ensure the availability of standard treatment protocols, as well as to check the prescription pattern of AMAs on a regular basis to ensure that the institution's antimicrobial policy is strictly followed.This study also highlights the significance of rationalizing medication therapy in the hospital. This study will provide

information on the current AMA prescribing trend and will aid in the development of effective interventions for the rational use of antibiotics.

Conflict of Interest:

None

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