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Point Prevalence Study And Assessment Of Antibiotic Consumption Using Defined Daily Dose In A Tertiary Care Hospital

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ABSTRACT

Objectives: By applying the Anatomical and Therapeutic Chemical Classification and the Defined Daily Dose Index, this study aims to detect the use and consumption of antibiotics in tertiary care hospitals.
Material and Methods: Point prevalence study and consumption of antibiotics using Defined Daily Dose was done in a tertiary care hospital. In this study, 212 patients from various medical departments made up the entire sample size. From the patient's medical records, demographic and biological information was gathered. Drugs used to treat infections were categorised using the ATC/DDD index, and antibiotic use was calculated using DDD/100 Patient Days**.**
Results: Overall, 1300.2 DDDs of antibiotics were utilised in the departments with the highest utilisation in General medicine (698.3 DDDs,53.7%) followed by Pulmonology (301.2 DDDs,23.16%), Gastroenterology(202.1 DDDS,15.54%) and Nephrology(98.6 DDDs,7.58%).
Summary and Conclusion: Comparing cephalosporins to other antibiotics, the DDD is higher for cephalosporins. The microbial resistance rises as a result of improper antibiotic use. When there are no other options for antibiotic therapy, prescribers are compelled to utilise wide spectrum antibiotics.

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Keywords: DDD/100 Patient days, ATC classification, Antibacterial drugs, Medical units and microbial resistance.

1. INTRODUCTION

Drugs are chemicals, when administered to living organisms produce a biological effect. The term antibiotic, coined in 1942, was derived from the word "antibiosis", which literally means "against life"(1). Antibiotics, in the past, were considered to be organic compounds produced by one microorganism, which are toxic to other microorganisms by selectively killing or inhibiting the growth of other microorganisms (2). In modern terms, this definition includes "antimicrobials" which refers to natural, semi synthetic and synthetic substances capable of inhibiting the proliferation of microbes and thus leading them to apoptosis. Some antibiotics are able to kill bacteria completely while some only inhibit their growth. Bactericidal are those that kill bacteria while bacteriostatic are those that inhibit bacterial growth (3). Antibiotics are widely being used not only in the treatment of acute and chronic infections, but also in the prophylactic treatment. Although antibiotics generally refers to antibacterials, antifungals, antivirals and antiparasitic drugs to reflect the group of microorganisms they antagonize (4).

For several decades, antibiotics have been critical in the fight against infectious disease caused by bacteria and other microbes. Antimicrobial chemotherapy has been a leading cause for the dramatic rise of average life expectancy in the 20th Century (5). Inappropriate and irrational use of antimicrobial medicines provides favorable conditions for resistant microorganisms to emerge, spread and persist (6). The greater the duration of exposure of the antibiotic, the greater the risk of the development of resistance, irrespective of the severity of the need for the antibiotic (7). Resistant pathogens increase healthcare associated expense, complicate therapy, and make treatment failure more likely. Therefore, there has been a growing attentiveness to the rational use of antimicrobials since the 1990s (8).

The increasing prevalence of antibiotic-resistant bacteria poses a major threat to the health of hospitalized patients (9). Inappropriate use of antimicrobials and lack of surveillance systems are core contributors to the spread of antimicrobial resistance.(10)Although well- defined principles of rational antimicrobial use are available, inappropriate prescribing patterns are reported worldwide. Surveying antibiotic prescribing in hospitals is important to detect the current situation and for policy-making to change incorrect practices (11). However, point prevalence studies of antibiotic prescribing provide a useful insight into patterns of prescribing, potentially reporting a more focused audit on specific agents or specialties (12). Such studies may point to changes in prescribing practices within the hospital over time.

1.1 ANTIBIOTIC CONSUMPTION

Antibiotic consumption is defined as quantities of antimicrobials used in a specific setting (total, community, hospital) during a specific period of time (e.g. days, months, and year). It is an important parameter in the study of antibiotic use (13). The term antibiotic use refers to data on antibiotics taken by the individual patients. Data's are collected at the patient level, which allows a more comprehensive set of data to be gathered, such as information on indication, treatment schemes and patient characteristics (14). In general, the collection of data on antibiotic use requires more resources but provides additional information on prescribing practices, which is important for guiding antimicrobial stewardship activities, which is an another important part of AMR national action plans related to appropriate use of antibiotics (15).
Data on the consumption of antimicrobial medicines can be used to Identify and provide an early warning of problems related to changes in antimicrobial exposure and use, and develop interventions to address the problems identified. Monitor the outcomes of interventions (16) Assess

the quality of prescribing in terms of adherence to practice guidelines (17).
Raise awareness among health professionals, consumers and policy-makers about the problems of the inappropriate use of antimicrobials and its contribution to AMR.Link antimicrobial exposure to the development of AMR (18).
A standard method should be used in the evaluation of in-hospital antibiotic use because each antibiotic has different unit dose of daily administration. The ATC/DDD methodology is used to standardise the data collection and reporting of antimicrobial consumption (19).

1.2 ATC/DDD CLASSIFICATION

The Anatomical Therapeutic Chemical (ATC) classification system and the Defined Daily Dose (DDD) as a measuring unit are tools for exchanging and comparing data on drug use at international, national or local levels (20).
In 1981, the ATC/DDD system was recommended by WHO as the international standard for drug utilization studies, and in 1982 the WHO Collaborating Centre for Drug Statistics Methodology was established and given the responsibility for coordinating the development and use of the ATC/DDD system. In 1996, the Centre was recognized as a global Centre (21). This was seen as important to allow close integration of international drug utilization studies and WHO's initiatives to achieve universal access to needed drugs and rational use of drugs particularly in developing countries (22).
The purpose of the ATC/DDD system is to serve as a tool for drug utilization monitoring and research in order to improve quality of drug use. There is a need for such systems of classification and standard metrics to facilitate comparisons of antimicrobial consumption between health facilities, between countries and between regions (23).

1.3 CLASSIFICATION OF "ATC" SYSTEM

The Anatomical Therapeutic Chemical (ATC) classification system is the most commonly used method for aggregation of medicines data and allows flexibility in reporting by medicine or groups of medicines. In this system, the active substances are divided into different groups according to the organ or system on which they act and their therapeutic, pharmacological and chemical properties (24).

In the ATC classification system, the active substances are classified in a hierarchy with five different levels. The system has fourteen main anatomical/pharmacological groups or 1st levels (Table 1).
Each ATC main group is divided into 2nd levels which could be either pharmacological or therapeutic groups (26). The 3rd and 4th levels are chemical, pharmacological or therapeutic subgroups and the 5th level is the chemical substance (27). The 2nd, 3rd and 4th levels are often used to identify pharmacological subgroups when that is considered more appropriate than therapeutic or chemical subgroups (28).
Only one ATC code will be assigned for each medicine (29). Besides, ATC codes are often assigned according to the mechanism of action rather than therapy (30). An ATC group may therefore include medicines with many different indications, and drugs with similar therapeutic use may be classified in different groups (31).

2. MATERIALS AND METHODS

The study was conducted at VMKV Medical College Hospital which is a 650 bedded hospital with various specialties situated at Salem district of Tamilnadu. The various specialties of the hospital include General medicine, Obstetrics and Gynecology, Nephrology, Pediatrics and neonatology, Orthopedics, Radiology, Pulmonology and critical care, Cardiology and Cardiothoracic surgery, Microbiology, Pathology and Hematology, General and Laparoscopic surgery, ENT, Dental and

Maxillofacial surgery, Neurology, Ophthalmology, Physical medicine and Rehabilitation and Psychiatry. The hospital is also equipped with modern diagnostic features like CT scan, MRI scan, Ultra Sound Sonography, Digital Subtraction angiography, Color Doppler etc.

A Prospective-Observational study was conducted for a period of 9 months that focus on the assessment of Antibiotic consumption using Defined Daily Dose in general medicine, pulmonology, nephrology and gastroenterology departments of tertiary care hospital; at VMKVMCH, Salem The patients were selected based on the inclusion and exclusion criteria.
The study includes both genders of 18 years and above age, in-patients who were admitted in the general medicine, pulmonology, nephrology and gastroenterology departments receiving antibiotic therapy during the study period and surgical and medical ICU. The study excludes pregnant and lactating women, patients with terminal illness, mentally retarded and unconscious patients, day care patients receiving antibiotic therapy and patients who died during the data collection period.
The study was carried out for the period of 9 months, commencing from March 2022 to November 2022 among the inpatients undergoing antibiotic therapy in the general medicine, pulmonology, nephrology and gastroenterology departments of a tertiary care hospital.
This study was approved by the ethical committee of the institution and an official consent was also given for the purpose of performing the study. It was certified by the Institutional Ethics Committee and approved the proposal of the study.

3. RESULTS AND DISCUSSION

Measurement of antibiotic consumption is a first step in increasing the awareness and importance of antibiotic use. The data was obtained from the usual wards within our hospital (gastroenterology, nephrology, pulmonology and general medicine). The consumption of antibiotics in hospital is counted by the number of patient days (admission day and discharge day are both counted as full days).High rate of antibiotic use is adequate because one of the pharmacological therapies used in treatment of infectious diseases are antibiotics. Many reports have represented serious misuse of antibiotics and rational antibiotic practices.

There are more antibacterial drugs available in the market, with a large spectrum of activities and they are better tolerated. The increase in the antibacterial consumption can be explained by the increase in their use for prophylactic therapy. It may not increases the DDD but shows impact on the hospital stay of patients. Broad spectrum antibiotics like cephalosporins, aminoglycosides and β-lactamase inhibitors are prescribed frequently.
In this study, the antibiotic consumption is evaluated using Defined daily dose method with the help of ATC classification.

The study was conducted from March 2022 to December 2022 in VMKV Medical College and Hospitals, Salem. Total 212 patients were included in this study; among them 152 were male (71.7%) and 60 were female (28.3%).

The study includes both I.V and Oral doses of antibacterial agents. The percentage of antibiotics prescribed is varied in different wards due to varying in patient biological data.
Patients using antibiotics were determined according to the suitable dose, indication and administration. Among these cephalosporin’s (ceftriaxone, cefuroxime and cefpodoxime) constitutes maximum number of defined daily doses, followed by β-lactamase inhibitors (tazobactum, clavulanate potassium and sulbactum) and quinolones (Levofloxacin and ciprofloxacin).
From 212 collected prescriptions, distributed based on ATC Code and DDD/100 Patients/day were calculated.Inj.Cefoperazone+sulbactam was with the highest DDD of 465.23g and the lowest was

Inj.Rifampin with 1.32g.DDD/100 Bed days was highest for Inj.Cefoperazone+sulbactam(3.36) and lowest for Tab.Clarithromycin(0.12) and it was shown in Table no.2.

Table no.3 shows the consumption of various antibiotics in various departments by DDD/100 bed days. Cefoperazone+sulbactam with 0.75 in general medicine with highest DDD/100 bed days.

Overall,1300.2 DDDs of antibiotics were utilised in the departments with the highest utilisation in General medicine (698.3,53.7%) followed by Pulmonology (301.2,23.16%), Gastroenterology (202.1,15.54%) and Nephrology (98.6,7.58%) and it was shown in Table no.4.

DDD/100 Bed days was highest in General Medicine (5.6) followed by Pulmonology (3.65), Gastroenterology (2.76) and Nephrology (1.32) and it was shown in Table No.5.

High rate of antibiotic use is adequate because one of the pharmacological therapies used in treatment of infectious diseases are antibiotics. Many reports have represented serious misuse of antibiotics and rational antibiotic practices.

4. CONCLUSION

The DDD of cephalosporins is higher when compared to other antibiotics. Inappropriate use of antibiotics leads to increase in the microbial resistance. Prescribers are forced to use broad spectrum antibiotics when other antibiotic therapy options are not available.

The use of ATC/DDD index improves the evaluation of antimicrobial treatment. This study will be helpful for prescribers to make them aware of their own prescribing practices and better management of infectious diseases. In-appropriate use of antibiotics is causative for increased incidence of microbial resistance and execution of antimicrobial education to prescribers is required to reduce the resistance of antibiotics. When first and second line antibiotic therapy options are unavailable, prescribers are forced to use antibiotics that show more toxic effects and increase the hospital stay of patients. Global policies need to be established to reduce the overuse of antibiotics

5. ACKNOWLEDGEMENT

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6. CONFLICT OF INTEREST

The authors declare no conflict of interest.

7. ABBREVIATIONS

A.T.C: Anatomical Therapeutic and Chemical Classification; D.D.D: Defined Daily Dose; N.L.E.M: National List of Essential Medicines; W.H.O: World Health Organisation; W.H.O.C.C: World Health Organisation Collaborating Centre.

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Table 1: The ATC system: Anatomic classification scheme(25)

Code	Definition (System of Interest)
A	Alimentary tract and metabolism
B	Blood and blood-forming organs
C	Cardiovascular system
D	Dermatologicals
G	Genito-urinary system and sex hormones
H	Systemic hormonal preparations, excluding sex hormones
J	General anti-infectives for systemic use
L	Anti-neoplastic and immunomodulating agents
M	Musculoskeletal system
N	Nervous system
P	Anti-parasitic products
R	Respiratory system
S	Sensory organs
V	Various

Table No.2 ATC Code and DDD/100 Patients/day

S.No	Drug	ATC Code	WHO DDD		DDD(g)	DDD/100 BED DAYS
			(O)	(P)		
1	Tab.Amoxicillin	J01CA04	1.5g	-	59.2	0.92
2	Tab.Amoxicillin+Clavulanic Acid	J01CR02	1.5g	-	55	0.86
3	Tab.Azithromycin	J01FA10	0.3g	-	42.5	0.4
4	Inj.Benzathine Penicillin G	J01CE08	-	3.6g	163.23	1.9
5	Tab.Cefixime	J01DD08	0.4g	-	32	0.65
6	Inj.Cefoperazone+Sulbactam	J01DD62	-	4g	465.23	3.36
7	Inj.Ceftriaxone	J01DD04	-	2g	99.63	0.72
8	Tab.Cefuroxime	J01DC02	0.5g	-	9.6	0.25
9	Tab,Cephalexin	J01DB01	2g	-	13.32	0.18
10	Inj.Ciprofloxacin	J01MA02	-	0.8g	36.3	0.55
11	Tab.Clarithromycin	J01FA09	0.5g	-	8.5	0.12
12	Cap.Doxycycline	J01AA02	0.1g	-	6.02	0.19
13	Inj.Levofloxacin	J01MA12	-	0.5g	14.36	0.22
14	Tab.Moxifloxacin	J01MA14	0.4g	-	7.6	0.41
15	Tab.Nitrofurantoin	J01XE01	0.2g	-	2.3	0.28
16	Inj.Piperacillin+Tazobactam	J01CR05	-	14g	230.65	2.05
17	Inj.Rifampin	J04AM05	-	0.6g	1.32	0.2

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Table No.3 Antibiotic Consumption in Medical Units

S.NO	ANTIBIOTICS	DDD(g)	GENERAL MEDICINE	PULMONOLOGY	NEPHROLOGY	GASTROENTEROLOGY
1	Amoxicillin	59.2	0.56	0.42	0.32	0.39
2	Amoxicillin+Clavulanic Acid	55	0.62	0.59	0.23	0.32
3	Azithromycin	42.5	0.12	0.03	0.03	0.06
4	Benzathine Penicillin G	163.23	0.32	0.23	0.01	0.02
5	Cefixime	32	0.16	0.11	0.02	0.06
6	Cefoperazone+Sulbactam	465.23	0.75	0.55	0.3	0.44
7	Ceftriaxone	99.63	0.22	0.11	0.0	0.0
8	Cefuroxime	9.6	0.12	0.09	0.06	0.07
9	Cephalexin	13.32	0.09	0.02	0.03	0.0
10	Ciprofloxacin	36.3	0.24	0.32	0.01	0.01
11	Clarithromycin	8.5	0.9	0.63	0.23	0.21
12	Doxycycline	6.02	0.25	0.54	0.24	0.65
13	Moxifloxacin	7.6	0.45	0.23	0.13	0.08
14	Nitrofurantoin	2.3	0.4	0.12	0.63	0.0
15	Piperacillin+Tazobactam	230.65	0.49	0.23	0.18	0.16
16	Rifampin	1.32	0.29	0.23	0.0	0.0

Table No.4 Total Consumption of Antibiotics in Medical Departments

S.NO	DEPARTMENTS	TOTAL DDDs USED	TOTAL CONSUMPTION OF ANTIBIOTICS (%)
1	General medicine	698.3	53.7
2	Pulmonology	301.2	23.16
3	Nephrology	98.6	7.58
4	Gastroenterology	202.1	15.54

Table No.5 Antibiotic consumption index in Departments

S.NO	DEPARTMENTS	DDD/100 BED DAYS	TOTAL DAYS OF DRUG USE (%)
1	General medicine	5.6	42.01
2	Pulmonology	3.65	27.38
3	Nephrology	1.32	9.9
4	Gastroenterology	2.76	20.7