ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 11, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

ASSESSMENT OF ANTIBIOTIC STEWARDSHIP IN TERTIARY HEALTH CARE TEACHING MEDICAL INSTITUTION IN CENTRAL INDIA

NATH MANJUSHA[1*], SHARMA DEEPAK[2], NATH SOM[3]

[1]Department of Pharmacology, Index Medical College Hospital and Research Centre, Indore, Madhya Pradesh, India. [2]Department of General Medicine, Index Medical College Hospital and Research Centre, Indore, Madhya Pradesh, India. [3]Department of Community Medicine, Dr Sone Lal Patel Autonomous State Medical College Pratapgarh, Uttar Pradesh, India.
***Corresponding author: Manjusha Nath; Email: manjushanath73@gmail.com**

Received: 27 July 2024, Revised and Accepted: 08 October 2024

ABSTRACT

Objective: The objective of the study was to mitigate the impact of antimicrobial resistance and ensure continued access to effective treatments for bacterial infections. This study was undertaken to explore the hospital status of antibiotic prescription and evaluate the impact of antibiotic stewardship in clinical wards of tertiary health care settings.

Methods: This is hospital-based observational prospective study carried out in a tertiary health care settings. All patients of either sex of any age who came in outpatient department and admitted in inpatient department of medicine, orthopedics, surgery, and pediatric departments and prescribed antibiotics were selected randomly in the study.

Results: Study response rate was male predominance (57%). Empiric antimicrobials were mainly prescribed orally (47.3%), significantly higher than injectable route (22.8%) ($p<0.001$), while the majority were not given an empiric antibiotic by a clinical expert. A significantly high number of patients were prescribed injectable 1st Antimicrobial after surgery/culture, namely, injectable piperacillin+tazobactum (35.5%), followed by injectable cephalosporin (34.0%), amikacin injection/4.5%, and injection carbapenem/1.8% ($p<0.001$). Its frequency is significantly high with BD dose (66.8%) and the majority prescribed for period of 6–10 days (63.5%) followed by 1–6 days (19.5%) ($p<0.001$).

Conclusion: As all prescriptions got optimal dose and duration of therapy, the stay of patients in the hospital was following Indian Council of Medical Research (2019) guideline therefore, it can thus be said that the results of this study revealed precise prescribing pattern of antibiotics. However, emphasis on information technology staff and patient education is vital in incorporating stewardship protocols. Emphasizing the importance of conducting antibiotic time-outs within 48–72 h is crucial for reassessing the necessity and choice of antibiotics. Such stewardship studies are instrumental in monitoring patterns of antibiotic usage and aid in future policy-making steps.

Keywords: Antibiotic stewardship, Antimicrobial resistance, Tertiary health care settings.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i11.51921. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

The term "antibiotic stewardship" (ABS) was first coined in 1996 to address the rising issue of antimicrobial resistance (AMR) in hospitals, emphasizing the importance of evidence-based practices to optimize antimicrobial use [1]. "Antibiotic stewardship" program acts as an umbrella to tackle by describing initiatives designed to optimize the use of diagnostic and laboratory techniques, to detect infections ensuring prompt, targeted, and suitable antimicrobial therapy. Efforts to strengthen healthcare infrastructure and regulatory frameworks are essential to curbing AMR on a global scale. ABS programs are essential for preserving the effectiveness of antibiotics for future generations by promoting responsible use, reducing unnecessary prescribing, and combating AMR. Coordinated efforts at the local, national, and global levels are necessary to implement effective ABS strategies, strengthen healthcare systems, and protect the efficacy of antibiotics as valuable medical resources. By embracing ABS as a cornerstone of healthcare practice, we can mitigate the impact of AMR and ensure continued access to effective treatments for bacterial infections worldwide. In this sequence, there is a need of exploring the hospital status of antibiotic prescription to assess and evaluate the impact of ABS in clinical wards of tertiary health care settings of private medical college of central India.

METHODS

This is an institution-based observational prospective study carried out in a tertiary health care settings in an index medical college, hospital and research center, Indore Madhya Pradesh. Keeping in mind the vast usage antibiotics across different spectrums of disease, the study was conducted with the collaboration of medicine, orthopedics, surgery, and pediatric departments.

Inclusion criteria

All patients of either sex and of any age who came in the outpatient department (OPD) and were admitted in inpatient department (IPD) of medicine, orthopedics, surgery, and pediatric departments and prescribed antibiotics during the above-mentioned time period were included in the study.

Exclusion criteria

Patients who did not satisfy the above inclusion criteria or who did not give the informed consent or not willing to be a part of our research study or not responding/answering the research-related questions, or admitted due to intentional or accidental poisoning/due to the fresh blood/blood products, drug overdose and patients with drug abuse/intoxication. Such patients were excluded from our study.

Sample size

Total 400, calculated by considering the prevalence of AMR against common infectious agent in India, that is, nearly 50% as reported in Annual Report of AMR Research and Surveillance Network, Indian Council of Medical Research (ICMR) January 2021–December 2021. With alpha as 0.05 and an error margin as 5%, the calculated sample size (N) was 400. It was calculated by applying the statistical formula --

$N=4\ p\ q/L^2$ where p=prevalence of AMR against common infectious agent found in India, nearly 50%, q=1-p

L=Allowable error 10% of p.

Duration of study
01 year (January 2022–December 2022).

Study tool
Patients who were attending OPD of a private tertiary health care teaching hospital during the study duration and shifted to indoor clinical department on the day of visit of the researcher and were prescribed antimicrobials and satisfy the inclusion criteria, were considered eligible for this study. All patients as per hospital records, shifted to different clinical wards were selected randomly by applying a systematic random sampling method. By this method, third patient out of ten in serial order of IPD record register was included in this study; similarly, every 3rd patient in the next 10 serial order in succession of IPD register was selected. After achieving the required sample size of our study, the selection of eligible candidates was stopped. A semi-structured, multiple-choice questionnaire was prepared and tested by a pilot study done on five patients admitted in IPD.

Due care was taken to maintain the confidentiality of the data. Furthermore, in case any patient refuses to co-operate, should be excluded from the present study. The ward visits and data collection were carried out for a period of 1 year. Patients from medicine, orthopedics, pediatrics, and surgery departments were included in the study. Apart from the general patient demographic data (like- age and gender); the antibiotic prescribed, its duration, frequency, and diagnosis, of all patients were recorded, date of admission, date of discharge, microbiological finding, antibiotics use with doses and duration, surgical prophylaxis/culture and outcome of the patients. Antibiotics used intravenously or orally with date were noted. In the surgical intervention departments where antibiotics were used before and after surgery/culture, this appropriate pre- and post-details were noted. All the data were collected from the patient record files which were available in the respective wards (bedside or nursing station).

Study procedure
Time and date of administration of antibiotics in appropriate dose and frequency were measured.

a. Surgical prophylaxis: With antibiotics, its dose, frequency, duration, and route of administration were documented.
b. Empirical therapy: Clinical condition was supported by laboratory findings such as antibiotics resistant in some patients, renal function test, liver function test, and viral marker.
c. Definitive therapy: Antibiotics were prescribed by available antimicrobial results in some patients. If the patient not responded well, then an antibiotic resistance test was done for definitive treatment.

Statistical analysis
The information recorded in the pre-designed pro forma and data was analyzed by applying the appropriate recent version of Statistical Packages for the Social Sciences. Mean, standard deviation Chi-square test, and p<0.05 with a 95% confidence interval recorded.

RESULTS

This study was conducted among 400 eligible study patients in clinical departments, namely. Medicine, orthopedics, surgery and pediatrics IPD at Index Medical College, Indore, Madhya Pradesh, from the association of sociodemographic factors, clinical presentation, and insights into the antibiotic prescription practices in a large tertiary-care teaching hospital.

Gender-wise distribution of study subjects depicts male predominance (57%). While no. of female patients of the age group, 1–20 years (38.4%) was slightly higher than males (29.8%) but patients of, more than 60 years, age group were males (15.4%) slightly more than females (9.3%) and patients of age group 21–40 years were nearly similar for both sexes (Table 1).

Majority of the study IPD patients were diagnosed with orthopedic condition (14.5%); followed by respiratory (12.0%); cystitis, urinary tract infection, swelling Rt. Malleolus (Epidermal) with or without comorbid diabetes mellitus (DM), hypertension (HTN), or other non-communicable diseases (10.7%); soft-tissue infection – (10.5%); carcinoma infiltrating ductal Ca breast, post-operative. Lipoma, post-operative etc., (10.0%); septicemia and brain abscess, community-acquired meningitis (8.0%); inguinoscrotal hernia repair, non-healing ulcer, perforated appendix, etc., (7.3%); intra-abdominal infection, acute infective diarrhea (6.5%); while least post-neurosurgery meningitis, etc. (4.0%) (Fig. 1).

Antimicrobials prescribed empirically with their route of administration to admitted patients were, respectively, oral cephalosporin, cefadroxil, cefixime/20.8% more than injectable/12.5% while oral ampicillin/amoxyclav/23.8% more than injectable (8.3%). Antimicrobial used empirically was mainly by oral route (47.3%) significantly higher than the injectable route (22.8%) (p=0.001) (Table 2).

First antimicrobials prescribed to the patients after surgery or culture were mainly by injectable route (75%). A significantly high number of patients were prescribed injectable piperacillin+tazobactum (35.5%), followed by injectable cephalosporin (34.0%), amikacin injection 4.5%, injection carbapenem (1.8%) (p<0.001) (Table 3).

Frequency of 1st antimicrobial prescribed to patients after surgery/culture is significantly high with BD dose (66.8%), followed by TDS dose (23.0%) and OD dose (10.3%). Antimicrobials piperacillin+tazobactum, cephalosporin and aminoglycoside were prescribed mainly in BD form to patients 38.3%, 12.8%, and 8.8%, respectively. Piperacillin+tazobactum was also given in TDS form to 19.5% of cases (Table 4).

According to type and severity of disease, most of the patients were prescribed 1st antimicrobials for a period of 6–10 days (63.5%), followed by period 1–5 days (19.5%), 11–15 days (14.5%) few advised for More than 15 days (2.5%). First antimicrobials were prescribed for time intervals; in similar accordance to patients admitted in different clinical departments. This relation is found to be statistically significant (Table 5).

Study patients with 1st antimicrobial prescribed after surgery or culture shifted to medicine intensive care units (ICU/IPD) were accordingly piperacillin+tazobactum (13.3%), followed by ceftriaxone/+sulbactuam (10.5%), macrolide (4.3%), aminoglycoside (2.5%) and few with linezolid, glycopeptide, carbapenem, lincosamide, urinary antiseptic with 1.0%, 0.5%, 1.3%, and 0.3% 0.3%, respectively, while in surgery department trend was cephalosporine+/sulbactuam/15.5%, piperacillin+tazobactum (5.8%), aminoglycoside (6.0%). In orthopedic and pediatric IPD, piperacillin+tazobactum were mainly prescribed, respectively, in 11.8% and 10.8% of patients, followed by cephalosporin in pediatric IPD (7.3%) (Table 6).

DISCUSSION

The study was conducted among eligible 400 IPD patients of tertiary health care settings of teaching medical college, Uttar Pradesh, with antimicrobial prescription. Response rate was male predominance (57%) and the mean age of IPD patients was 32.86±21.28 years with range of 02 years–81 years (Table 1).

Frequency distribution of study IPD patients were mostly with orthopedic problem (14.5%); followed by respiratory (12.0%); cystitis, urinary tract infection, swelling Rt. Malleolus (Epidermal) with or without comorbid DM, HTN, etc., (10.7%); soft-tissue infection – (10.5%); carcinoma infiltrating ductal Ca Breast, post-operative.

Table 1: Age distribution of the patients according to hospital wards

Gender	Age interval (in years)				Total n (%)	Statistical test	Mean age±SD
	1–20 n (%)	21–40 n (%)	41–60 n (%)	More than 60 n (%)			
Male	68 (29.8)	70 (30.7)	55 (24.1)	35 (15.4)	228 (57.0)	χ^2=5.894	32.8625±21.27982
Female	66 (38.4)	56 (32.6)	34 (19.8)	16 (9.3)	172 (43.0)	p=0.117	02 years–81 years
Total	134 (33.5)	126 (31.5)	89 (22.3)	51 (12.8)	400 (100.0)		

SD: Standard deviation, χ^2: Chi-square

Table 2: Distribution of study subjects according to route of administration of empiric antimicrobials after admission in clinical departments

Antimicrobials prescribed	Route of administration			Total n %	Statistical test
	Injectable n %	Oral n %	NA n %		
Not prescribed	00 0.0	00 0.0	121 30.3	121 30.3	χ^2=424.387 p=0.001
Flouroquinone-ciprofloxacin, ofloxacin, levofloxacin	02 0.5	07 1.8	00 0.0	09 2.3	
Ampicillin, amox+clavulanic acid piperacillin+tazobactum	33 8.3	95 23.8	00 0.0	128 32.0	
Cephalosporin-cefixime, cefadroxil, ceftriaxone, cefotaxime	50 12.5	83 20.8	00 0.0	133 33.3	
Aminoglycoside-gentamycin amikacin,	05 1.3	00 0.0	00 0.0	05 1.3	
Urinary antiseptic-nitrofurantoin	00 0.0	04 1.0	00 0.0	04 1.0	
Total	90 22.5	189 47.3	121 30.3	400 100.0	

χ^2: Chi-square

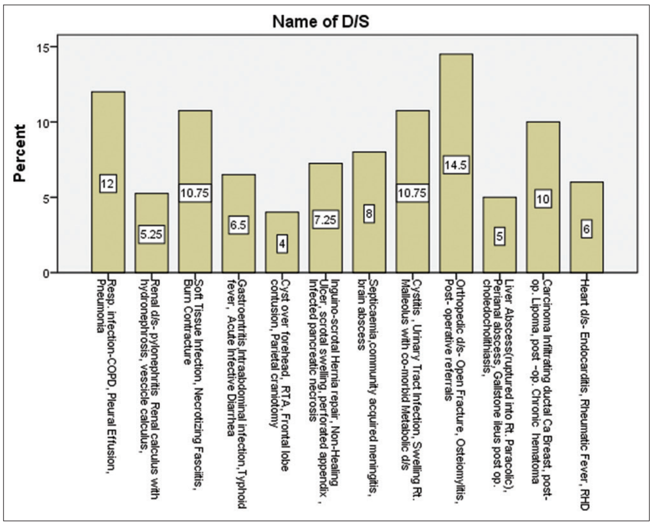

Fig. 1: Frequency distribution of patients according to disease pattern

Lipoma, post-operative, etc., (10.0%); septicemia, brain abscess, community-acquired meningitis (8.0%); inguinoscrotal hernia repair, non-healing ulcer, scrotal swelling, etc., (7.3%); intra-abdominal infection, etc., (6.5%); while least number of patients of post-neurosurgery (4.0%) (Fig. 1).

Antimicrobials prescribed empirically to admitted patients with their route of administration were significantly higher for oral route (47.3%) than injectable route (22.8%) (p<0.001), namely. Oral cephalosporin, cefadroxil, cefixime/20.8% more than injectable/12.5% while oral ampicillin/amoxiclav/23.8% more than injectable (8.3%). Antimicrobial used empirically was mainly by oral route (47.3%) significantly higher than the injectable route (22.8%) (p=0.001) (Table 2).

While first antimicrobials prescribed to IPD patients after surgery or culture were significantly higher for injectable route (75%), patients were prescribed injectable piperacillin+tazobactum (35.5%), followed by cephalosporin (34.0%), amikacin injection 4.5%, injection carbapenem (1.8%) (p<0.001) (Table 3).

Study patients with prescribed 1st antimicrobial after surgery or culture shifted to medicine ICU/IPD were accordingly piperacillin+tazobactum (13.3%), followed by ceftriaxone/+sulbactuam (10.5%), macrolide (4.3%), aminoglycoside (2.5%) and few with linezolid, glycopeptide, carbapenem, lincosamide, urinary antiseptic with 1.0%, 0.5%,1.3%, and 0.3% 0.3%, respectively. While in the surgery department trend was cephalosporine 15.5%, piperacillin+tazobactum (5.8%), aminoglycoside (6.0%). In orthopedic and pediatric IPD, piperacillin+tazobactum was mainly prescribed, respectively, in 11.8% and 10.8% followed by cephalosporin in pedia IPD (7.3%) (Table 4). Most of the patients were prescribed 1st antimicrobials for a period of 6–10 days (63.5%), followed by periods 1–5 days (19.5%), and 11–15 days (14.5%) (p<0.001) (Table 5).

This was according to the prescription of the clinician/surgeon after surgery or getting their culture report of collected sample after 48–72 h of admission. Route of administration of antimicrobial was comparatively more for the oral route than injectable in empirical therapy while after surgery or after getting culture report and clinical diagnosis of the patient group of 1st antimicrobial drugs and pattern of drug administration was shifted to the parentral route.

While the most prevalent indications for prescribing were respiratory tract infections (21.27%), reported by another study [2]. As it is a well-known fact, septic complications have been reported in between 30% and 60% of patients after surgical resection when antibiotic prophylaxis is not used [3]. Therefore, antibiotic prophylaxis should be compulsorily followed. To administer the drug, the most preferred route should be prescribed. Most of the studies conducted by researchers on various modes of drug administration depict that the most preferred mode of drug administration is through intravenous injectables.

Table 3: Distribution of study subjects according to first antimicrobial with their route of administration prescribed in clinical departments IPD/ICU after surgery/culture

1st Antimicrobial after surgery/culture prescribed	Route of administration		Total n %	Statistical tests
	Oral n %	Injectable n %		
Broad-spectrum-doxycycline	07 1.8	00 0.0	07 1.8	χ^2=135.114 p=0.001
Fluoroquinolones	01 0.3	05 1.3	06 1.5	
Beta lactam-piperacillin+tazobactam, amoxiclav	21 5.3	142 35.5	163 40.8	
Cephalosporin-cefadroxil, cefixime, ceftriaxone+sulbactam/tazobactum	30 7.5	136 34.0	166 41.5	
Aminoglycoside-amikacin, gentamycin	00 0.0	18 4.5	18 4.5	
Macrolide- azithromycin, erythromycin, clarithromycin	24 6.0	00 0.0	24 6.0	
Linezolide	02 0.5	02 0.5	04 1.0	
Glycopeptide antibiotic	00 0.0	03 0.8	03 0.8	
Carbapenem	00 0.0	07 1.8	07 1.8	
Lincosamide	00 0.0	01 0.3	01 0.3	
Urinary antiseptic	01 0.3	00 0.0	01 0.3	
Total	86 21.5	314 78.5	400 100.0	

χ^2: Chi-square, ICU/IPD: Intensive care units/Inpatient department

Table 4: Distribution of study subjects according to frequency of first antimicrobial administered after surgery/culture

1st Antimicrobial after surgery/culture prescribed	Frequency of patients			Total n %	Statistical tests
	OD (n %)	BD (n %)	TDS (n %)		
Broad-spectrum-doxycycline	04 1.0	03 0.8	00 0.0	07 1.8	χ^2=293.413 p=0.001
fluoroquinolones	02 0.5	04 1.0	00 0.0	06 1.5	
Cephalosporin	00 0.0	51 12.8	78 19.5	129 32.3	
Beta lactam-piperacillin tazobactam	13 3.3	153 38.3	00 0.0	166 41.5	
Aminoglycoside-amikacin, gentamycin	05 1.3	35 8.8	12 3.0	52 13.0	
Macrolide-azithromycin, clarithromycin, erythromycin	17 4.3	07 1.8	00 0.0	24 6.0	
Linezolide	00 0.0	04 1.0	00 0.0	04 1.0	
Glycopeptide antibiotic	00 0.0	03 0.8	00 0.0	03 0.8	
Carbapenem	00 0.0	07 1.8	00 0.0	07 1.8	
Lincosamide	00 0.0	00 0.0	01 0.3	01 0.3	
Urinary antiseptic	00 0.0	00 0.0	01 0.3	01 0.3	
Total n %	41 10.3	267 66.8	92 23.0	400 100.0	

χ^2: Chi-square

Even records of various wards (medicine, orthopedics, surgery, and pediatrics) depicted that approximately three-fourth patients were administered first antibiotics through injectable route/78.5% rather than oral one after their surgery/culture. The results showed a significant difference between oral and injectable route of administration ($p<0.05$). Hence, this study strongly suggests the fact similar to the findings of [3] wherein the research suggests that oral mode of antibiotic should not be preferred. The application of continuous infusion of beta-lactam antibiotics is based on the pharmacodynamic properties of these drugs, both *in vitro* as well as *in vivo* [4,5].

In this study, above the most preferred choice of antibiotic after surgery/culture was beta-lactam and cephalosporins. Similarly, AIIMS, Delhi also recorded beta-lactam (piperacillin-tazobactam) followed by fluoroquinolones (levofloxacin) as the highest preferable drugs [6]. Whereas in a research survey conducted in a various hospital of USA, fluoroquinolones and penicillin were observed the most frequently

Table 5: Distribution of study subjects according to duration of first antimicrobial prescribed in clinical departments after surgery/culture

Time interval duration of First antimicrobial (in days)	Distribution of patients in department IPD/ICU				Total n %	Statistical test
	Medicine n %	Surgery n %	Orthopedic n %	Pediatric n %		
1–5	75 18.8	00 0.0	00 0.0	03 0.8	78 19.5	χ^2=11.162 p=0.011
6–10	66 16.5	82 20.5	40 10.0	66 16.5	254 63.5	
11–15	05 1.3	29 7.3	16 4.0	08 2.0	58 14.5	
More than 15	01 0.3	02 0.5	00 0.0	07 1.8	10 2.5	
Total	147 36.8	113 28.3	56 14.0	84 21.0	400 100.0	

χ^2: Chi-square, ICU/IPD: Intensive care units/Inpatient department

Table 6: Distribution of study subjects according to first antimicrobial prescribed in different departments IPD/ICU after surgery/culture

1st Antimicrobial after surgery/culture	Patient distribution in department IPD/ICU				Total n %	Statistical tests
	Medicine n %	Surgery n %	Orthopedic n %	Pediatric n %		
Broad-spectrum-doxycycline	07 1.8	00 0.0	00 0.0	00 0.0	07 1.8	χ^2=136.22 p=0.001
fluoroquinolones	05 1.3	01 0.3	00 0.0	00 0.0	06 1.5	
Cephalosporin-ceftriaxone+sulbactam	42 10.5	50 12.5	08 2.0	29 7.3	129 32.3	
Piperacillin- tazobactam, amoxiclav	53 13.3	23 5.8	43 10.8	47 11.8	166 41.5	
Aminoglycoside – amikacin, gentamycin	10 2.5	36 9.0	02 0.5	04 1.0	52 13.0	
Macrolide – azithromycin, erythromycin, clarithromycin	17 4.3	02 0.5	02 0.5	03 0.8	24 6.0	
Linezolide	04 1.0	00 0.0	00 0.0	00 0.0	04 1.0	
Glycopeptide antibiotic	02 0.5	00 0.0	00 0.0	01 0.3	03 0.8	
Carbapenem	05 1.3	01 0.3	01 0.3	00 0.0	07 1.8	
Lincosamide	01 0.3	00 0.0	00 0.0	00 0.0	01 0.3	
Urinary antiseptic	01 0.3	00 0.0	00 0.0	00 0.0	01 0.3	
Total	147 36.8	113 28.3	56 14.0	84 21.0	400 100.0	

χ^2: Chi-square, ICU/IPD: Intensive care units/Inpatient department

used antibiotics [7]. Antibiotic therapy increases the risk of toxicity by making changes in the microbial flora, which leads to the development of defense strategies against these drugs. Hence, the person becomes more resistant which makes the drugs less effective. Main consequences of antibiotic resistance are increased medical expenses, prolonged hospital stays, and a higher death rate [8].

For subjects who were at lower risk of infection, there is ample time to collect data and an initial antimicrobial regime can be targeted instead of targeting the broad ones. However, some country's prescription pattern still depicts broad-spectrum antibiotic [2]. In cases where acuity for infection is high and the outcome is likely to be affected adversely by delay in therapy, it is wiser for the health care workers that they should treat with such an antimicrobial regimen which is broad enough to cover all the plausibly likely pathogens [9]. Empirical therapy is based on patient risk factors which include the site of infection, epidemiological factors, status of immunosuppression, etc. Therefore, the practitioners of health care play a key role in deciding the appropriate antibiotic needed instead of using the broad-spectrum antibiotic [10,11].

Our study is contrary to the findings of [12] where the findings suggest that to aid the future of empiric therapy and decrease the time period for an appropriate therapy and unnecessary exposure to broad-spectrum antibiotics; improvement in rapid diagnostics should be made. Some researchers reported that β-lactams and an extended spectrum of cephalosporins are associated with high morbidity and mortality [13]. For empirical therapy, it may be necessary to use broad-spectrum antibiotics initially. Use of amoxicillin instead of amoxiclav, uses of 3rd generation cephalosporins and reducing fluoroquinolones' use showed decreasing AMR in our study.

Irrational practices are quite frequent regarding prophylactic antibiotic use in pre-operative surgery/pre-culture, like selection of inappropriate broad spectrum and costly antibiotics; high doses of antibiotics; excessive antibiotic combinations of cephalosporin with aminoglycosides, fluoroquinolones and other β-lactam antibiotics [14]. In spite of awareness about the need for an antibiotic, prior or surgery/culture is a dilemma that has been commonly faced by medical experts for the decision regarding the usage of an antibiotic therapy [15].

Average no. of (30.3%) the study population did not receive antibiotics at the time of the admission, that is, before surgery/culture. However, it was so because they were first enrolled mainly for either medicine ward or pediatric ward. In the light of the available data, routine use of antibiotics should be carefully considered, as large retrospective studies are compelling to focus on the consumption frequency of antibiotics. The first antibiotic immediately after surgery/culture was prescribed twice a day to the majority of the subjects/66.8% in our study.

Other study by Ahmad *et al.* with antibiotics prescription as (62.5%) cephalosporins followed by fluoroquinolones (16.5%), penicillin (16%), nitroimidazole (14%) and amikacin (10%). Most prescribed antibiotics were ceftriaxone. Cephalosporins are generally widely prescribed because of their high potent action, available in various formulations within the market, their extended indications, and therefore the activity against Gram-negative to Gram-positive bacteria means broad-spectrum activity from first-generation to 3rd generation of cephalosporins [16].

Study done by Gajbhiye *et al.* has reported most prescribed antibiotic inwards were cephalosporins (38.4%, 140/364) and piperacillin+tazobactum (17.9%, 25/139) followed by cefoperazone+sulbactam (14.3%, 20/139) prescribed generally as fixed-dose combination in ICU [17]. Ceftriaxone was most ordinarily prescribed. This may be as a result of cephalosporins are broad spectrum Antimicrobials, effective against overwhelming majority of organisms, have convenient dosing schedules have fewer adverse effects; therefore, they are being prescribed more often each often each in wards and ICU.

In the present study, no antibiotic was prescribed empirically to a significant number of patients (51.0%) before surgery. Out of the remaining cases, 41 (10.3%) were administered orally, and 155 (38.8%) were administered through injectable route. Whatever the route of the drug chosen, the preferred drug was beta-lactam followed by cephalosporin. A significantly high number (nearly half) of patients received no antibiotics during the 1st time of the survey. All these patients belong to medicine and pediatrics.

Approximately three-fourth patients of each ward were administered first antibiotics through injectable route rather than an oral one after their surgery and the result showed a significant difference between the oral and injectable route of administration.

Frequency of first antibiotic was prescribed 2 times a day to the majority of the patients (68.6%), while 21.4% of patients administered for 3 times a day after the surgery/culture. The result is highly significant.

Demoz *et al.* study reported 17% of beta-lactam (piperacillin-tazobactam) and cephalosporins/cloxacillin as the first choice of antibiotics for infection after surgery [18]. Beta-lactam (amoxicillin) was the most prescribed (29.9%) according to a study of North West Cameroon [2]. An Ethiopian study frequently prescribed injectable and oral antibiotics 24.5% cephalosporins (ceftriaxone) and 12.9% macrolides (azithromycin), respectively [18].

Antimicrobial stewardship can provide all practitioners with tools to stop the overuse of valuable resources and help control the rise in AMR. Although often underappreciated, the rise of AMR has finally caught the attention of influential international healthcare organizations. The get smart campaign, initiated by the center for disease control and prevention in 1995, focused on reducing the utilization of inappropriate antimicrobials within the outpatient setting. In 2010, the center for disease control and prevention launched get smart for healthcare, a campaign focused on improving antibiotic use in inpatient healthcare facilities to stop overuse of antimicrobials and promote the utilization of antimicrobial stewardship. The 2011, World Health Day focused on international AMR.

CONCLUSION

Proper ABS guidelines should be followed up to tackle the problem of antibiotic drug resistance which is growing very fast due to excessive and inappropriate use of these drugs. As all prescriptions got optimal dose and duration of therapy, the stay of patients in hospital was following ICMR (2019) guideline therefore, it can thus be said that the results of this study revealed precise prescribing pattern of antibiotics. Such stewardship studies are instrumental in monitoring patterns of antibiotic usage and aid in future policy-making steps. The Regular daily evaluations of antibiotic therapy, the role of information technology staff and patient education are vital.

ACKNOWLEDGMENT

We are most grateful to all medical faculty members, health professional posted at the clinical study departments of tertiary healthcare settings of teaching institution, for their full cooperation and support in our study. Special appreciation to the nursing staffs and paramedical staffs for contribution in providing detailed treatment information of the admitted patients.

AUTHOR'S CONTRIBUTION

Dr. Manjusha Nath had been involved in Concept of present original research article, collection of data, and also contributed in preparing the study design, analysis of collected data, statistical analysis, preparing manuscript, and editing of the manuscript. Prof (Dr.) Deepak Sharma had participated in the research study with a literature search, definition of intellectual content, and manuscript review. Prof (Dr.) Som Nath had supported in preparing manuscript and applying appropriate statistical analysis.

CONFLICT OF INTEREST

Nil.

FUNDING

No funding was granted for this study

REFERENCES

1. Charani E, Cooke J, Holmes A. Antibiotic stewardship programmes--what's missing? J Antimicrob Chemother. 2010 Sep 16;65(11):2275-7. doi: 10.1093/jac/dkq357, PMID: 20851812
2. Chem ED, Anong DN, Akoachere JK. Prescribing patterns and associated factors of antibiotic prescription in primary health care facilities of Kumbo East and Kumbo West Health Districts, North West Cameroon. PLoS One. 2018 Mar 5;13(3):e0193353. doi: 10.1371/journal.pone.0193353, PMID: 29505584, PMCID PMC5837085
3. Espin-Basany E, Sanchez-Garcia JL, Lopez-Cano M, Lozoya-Trujillo R, Medarde-Ferrer M, Armadans-Gil L, *et al*. Prospective, randomised study on antibiotic prophylaxis in colorectal surgery. Is it really necessary to use oral antibiotics? Int J Colorectal Dis. 2005;20(6):542-6. doi: 10.1007/s00384-004-0736-8, PMID: 15843938
4. Mouton JW, Punt N, Vinks AA. Concentration-effect relationship of ceftazidime explains why the time above the MIC is 40 percent for a static effect *in vivo*. Antimicrob Agents Chemother. 2007 Sep;51(9):3449-51. doi: 10.1128/AAC.01586-06, PMID: 17576831, PMCID PMC2043238
5. Dulhunty JM, Roberts JA, Davis JS, Webb SA, Bellomo R, Gomersall C, *et al*. A protocol for a multicentre randomised controlled trial of continuous beta-lactam infusion compared with intermittent beta-lactam dosing in critically ill patients with severe sepsis: The BLING II study. Crit Care Resusc. 2013 Sep;15(3):179-85. PMID: 23944203
6. Swamy A, Sood R, Kapil A, Vikram NK, Ranjan P, Jadon RS, *et al*. Antibiotic stewardship initiative in a Medicine unit of a tertiary care teaching hospital in India: A pilot study. Indian J Med Res. 2019 Aug;150(2):175-85. doi: 10.4103/ijmr.IJMR_951_17, PMID: 31670273, PMCID PMC6829769
7. Kelesidis T, Braykov N, Uslan DZ, Morgan DJ, Gandra S, Johannsson B, *et al*. Indications and types of antibiotic agents used in 6 acute care hospitals, 2009-2010: A pragmatic retrospective observational study. Infect Control Hosp Epidemiol. 2016;37(1):70-9. doi: 10.1017/ice.2015.226, PMID: 26456803

8. Misganaw D, Linger B, Abesha A. Surgical antibiotic prophylaxis use and surgical site infection pattern in Dessie referral hospital, Dessie, Northeast of Ethiopia. BioMed Res Int. 2020 Mar 18;2020:1695683. doi: 10.1155/2020/1695683, PMID: 32258103, PMCID PMC7104263
9. Strich JR, Heil EL, Masur H. Considerations for empiric antimicrobial therapy in sepsis and septic shock in an era of antimicrobial resistance. J Infect Dis. 2020 Jul 21;222;(Suppl 2):S119-31. doi: 10.1093/infdis/jiaa221, PMID: 32691833, PMCID PMC7372215
10. Kerremans JJ, Verbrugh HA, Vos MC. Frequency of microbiologically correct antibiotic therapy increased by infectious disease consultations and microbiological results. J Clin Microbiol. 2012 Jun;50(6):2066-8. doi: 10.1128/JCM.06051-11, PMID: 22422850, PMCID PMC3372104
11. Raineri E, Pan A, Mondello P, Acquarolo A, Candiani A, Crema L. Role of the infectious diseases specialist consultant on the appropriateness of antimicrobial therapy prescription in an intensive care unit. Am J Infect Control. 2008 May;36(4):283-90. doi: 10.1016/j.ajic.2007.06.009, PMID: 18455049
12. Messacar K, Parker SK, Todd JK, Dominguez SR. Implementation of rapid molecular infectious disease diagnostics: The role of diagnostic and antimicrobial stewardship. J Clin Microbiol. 2017 Mar;55(3):715-23. doi: 10.1128/JCM.02264-16, PMID: 28031432, PMCID PMC5328439
13. Rawat D, Nair D. Extended-spectrum β-lactamases in gram negative bacteria. J Glob Infect Dis. 2010 Sep;2(3):263-74. doi: 10.4103/0974-777X.68531, PMID: 20927289, PMCID PMC2946684
14. Butt SZ, Ahmad M, Saeed H, Saleem Z, Javaid Z. Post-surgical antibiotic prophylaxis: Impact of pharmacist's educational intervention on appropriate use of antibiotics. J Infect Public Health. 2019 Nov-Dec;12(6):854-60. doi: 10.1016/j.jiph.2019.05.015, PMID: 31196776
15. Petursson P. GPs' reasons for "non-pharmacological" prescribing of antibiotics. A phenomenological study. Scand J Prim Health Care. 2005 Jun;23(2):120-5. doi: 10.1080/02813430510018491, PMID: 16036552
16. Ahmad A, Revanker M, Haque I, Pravina A, Ivan R, Dasari R, *et al.* Study the prescription pattern of antibiotics in the medicine department in a teaching hospital: A descriptive study. Int J Toxicol Pharmacol Res. 2014;6(2):43-6.
17. Gajbhiye SB, Gedam DS, Madkey MV, Meshram AN. Study of antibiotic prescribing pattern among hospitalized patients with systemic bacterial infection in a tertiary care hospital of Central India. J Contemp Med Dent. 2019;7(3):8-14.
18. Demoz GT, Kasahun GG, Hagazy K, Woldu G, Wahdey S, Tadesse DB, *et al*. Prescribing pattern of antibiotics using WHO prescribing indicators among inpatients in Ethiopia: A need for antibiotic stewardship program. Infect Drug Resist. 2020 Aug 11;13:2783-94. doi: 10.2147/IDR.S262104, PMID: 32884305, PMCID PMC7440886