

Recent Trends and Prescribing Patterns of Antimicrobial Agents in Patients Admitted in Tertiary Care Hospital During Covid-19 Period

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Abstract

Introduction: Antibiotics are widely used medicines to treat life threatening infections and improving survival. Antibiotic resistance among bacteria is becoming more and more serious Global problem. There is very high prevalence of antimicrobial utilisation in the community.

Aim & objective: To determine the prescribing pattern of antimicrobial agents (AMA) in a tertiary care hospital.

Material and methods: This is a retrospective cross-sectional study conducted in the department of Pharmacology & associated Sanjay Gandhi Memorial Hospital, Rewa, MP between Feb 2020 to Jan 2021. Total 625 treatment sheets were enrolled in the study. The data were collected by obtaining photocopy /print of patient's treatment sheets of various departments from medical record room after getting approval from appropriate authority.

Data Analysis: The data were analysed by using Microsoft word - excel version 2007. All the multiple responses were presented in terms of number and percentage.

Results: Total 625 treatment sheets were enrolled; of these Maximum 130 were belonged to geriatric age group (> 68 yr) and minimum 5 were belonged to <1 (up to 12 month) year of age group. Cephalosporin was the most frequently prescribed group of drugs in various departments except in Paediatric department where Glycopeptide (61.1%) was the most frequently prescribed group. Among the groups, Ceftriaxone (42.6%) was the most frequently prescribed drug in medicine, Ceftriaxone + Sulbactam in surgery (41.1%) and Obstetric & Gynaecolog (Obs & gynae) department (76.5%) and Vancomycin (61.1 %) in Paediatric department.

Conclusion: Cephalosporin was the most frequently prescribed group of drugs in various departments; among the group Ceftriaxone (42.6%) was the most frequently prescribed AMAs. There is average 5.5 drugs were prescribed per encounter which was higher than the WHO standard value of 2. Our study concludes that there is an urgent need to increase awareness among healthcare professionals to reduce unnecessary and unrequired use of antibiotics and makes AMAs Policy in Hospital settings.

Keywords: AMA, Prescribing patterns, WHO, Cephalosporins

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Introduction

Infectious diseases are a prominent cause of mortality in the developing world. [1] The prevalence of antibiotic use is very high in India and ranges from 24 to 67%. [2] Antibiotic consumption in humans is increasing worldwide, driven by rising incomes, health insurance, and a large remaining burden of infectious disease. Between 2000 and 2010, antibiotic consumption increased by 36% in India. [3]

Antibiotics are widely used medicines, to treat life threatening infections and improving survival. Antibiotics are life-saving drugs, should be used safely and effectively. Antibiotic prescription pattern differs from country to country or even from region to region, which is attributable to various factors such as the infecting organisms, their antimicrobial susceptibility, physician preference and costs. [4] It is required that necessary precautions should be taken by health care professionals to minimize the unnecessary prescribing and overprescribing of antibiotics.

Additional precautions should be taken for patients with highly infectious pathogens. The usage of combination therapy would provide prevention against drug-resistant strains. [5] High infectious disease burden, poor living conditions and easy availability of antibiotics are some of the major drivers of rising antimicrobial resistance in India.

Antibiotic resistance among bacteria is becoming more and more serious problem throughout the world. [6] The resistant organisms are not only difficult to treat (due to availability of limited number of antimicrobial choices) but also lead to increased treatment duration and associated costs. [7]

Drug prescribing is an important skill which needs to be continuously assessed and refined. It not only reflects physician's knowledge of pharmacology and pathophysiology but also his or her skills in diagnosis and attitude towards selecting the most appropriate cost-effective treatment. [8]

Many factors which adversely affects the prescribing behaviour are unethical drug promotion, direct to consumer advertising, lack of knowledge and non- availability of drugs.[9] This could be countered to a great extent by drawing up an essential drug list, preparation of treatment guidelines, conducting periodic prescription audits and continuing medical education.

Quality of life can be improved by enhancing standards of medical treatment at all levels of the health care delivery system.[10] The aim of this study is to determine the recent trends and prescribing pattern of antimicrobial agents in a tertiary care hospital, Rewa, MP during COVID-19 period.

Material and Methods

This is a retrospective cross-sectional study conducted in the departments of Pharmacology, and 4 major departments of (Medicine, Surgery, Obstetrics & Gynaecology and Paediatrics) at Sanjay Gandhi Memorial Hospital, Rewa (M.P.) between Feb. 2020 to Jan 2021 after approval from the Review board and institutional ethical committee.

Total 625 in-patients, treatment sheets were collected from medical records section / room of Sanjay Gandhi Memorial Hospital, Rewa (M.P.) who were admitted in above mentioned departments after permission from appropriate authority.

Demographic data and clinical information regarding prescribing pattern and trends of antibiotics prescription were noted.

The data was analysed by using SPSS and Microsoft excel version 2007. All the multiple responses were presented in terms of number and percentage.

Observations & Results

Total 625 treatment sheets were collected from four major clinical departments and analysed and the following observations were made.

Table-1: Demographic characteristic of patients admitted in four major clinical departments of S.G.M.H

S. NO.	AGE	NUMBER	PERCENTAGE%
1.	<1yr (up to 12 month)	05	0.8
2.	1-9yr	07	1.1
3.	10-18yr	22	3.5
4.	19-28yr	103	16.5
5.	29-38yr	82	13.1
6.	39-48yr	81	13
7.	49-58yr	87	13.9
8.	59-68yr	108	17.3
9.	>68yr	130	20.8
SEX			
1	Male	310	49.6
2	Female	315	50.4
WARD			
1	Medicine	505	80.8
2	Surgery	51	8.2
3	Gynaecology	51	8.2
4	Paediatrics	18	2.8

In this study maximum (20.8%) patients were belonged to geriatric age group > 68 yrs and minimum (0.8%) patients were belonged to <1year (up to 12 month) of age group. Among these patients, 50.4% were females and rest 49.6% were males. Most

of cases (80.8%) were belongs to Medicine department followed by Surgery (8.2%), Obs & Gynae (8.2%) and least cases (2.8%) were belonged to Paediatric department. (Table-1)

TABLE-2: Department wise distribution of cases on basis of frequency of prescribed Antimicrobials from various classes of AMAs.

S. NO.	CLASS OF ANTIMICROBIAL	MEDICINE (n=505)		SURGERY (n=51)		GYNAE (n=51)		PAEDIA (n=18)	
		NO	%	NO	%	NO	%	NO	%
1.	CEPHALOSPORINS(CPH)	243	48.1	30	58.8	39	76.5	06	33.3
2.	PENICILLIN(PEN)	224	44.3	06	11.8	15	29.4	01	5.5

3.	MACROLIDE(MAC)	136	26.9	0.0	0.0	03	5.9	0.0	0.0
4.	TETRACYCLINE(TET)	20	4	0.0	0.0	03	5.9	0.0	0.0
5.	FLUOROQUINOLONE S (FQ)	51	10.1	07	13.7	0.0	0.0	0.0	0.0
6.	AMINOGLYCOSIDES (AG)	01	0.2	0.0	0.0	04	7.8	02	11.1
7.	LINCOSAMIDE(LD)	45	8.9	02	3.9	0.0	0.0	0.0	0.0
8.	NITROIMIDAZOLE(N T)	56	11	11	21.6	11	21.6	01	5.5
9.	OXAZOLIDINONE(OXD)	11	2.2	0.0	0.0	0.0	0.0	0.0	0.0
10.	NITROFURANTOIN(N IT)	04	0.8	0.0	0.0	0.0	0.0	0.0	0.0
11.	GLYCOPEPTIDE(GP)	07	1.4	0.0	0.0	0.0	0.0	11	61.1
12.	CARBAPENEM(CPM)	14	2.8	0.0	0.0	0.0	0.0	07	38.9

This table showed prescribing pattern of antimicrobial agents, it reveals that Cephalosporins was the most frequently (48.1%) prescribed group followed by Penicillin's (44.3%), Macrolide (26.9%), Nitroimidazole (11%), Fluoroquinolones (10.1%), Lincosamide (8.9%), Tetracycline (4%), Carbapenem (2.8%), Oxazolidinone (2.2%), Glycopeptide (1.4%), Nitrofurantoin (0.8%) and Aminoglycoside (0.2%) in decreasing order in Medicine department. In Surgery department, Cephalosporins was the most frequently (58.8%) prescribed group followed by Nitroimidazole (21.6%),

Fluoroquinolones (13.7%), Penicillin (11.8%) and Lincosamide (3.9%) in decreasing order. In Obs/Gynae department, Cephalosporins was the most frequently (76.5%) prescribed drug followed by Penicillin (29.4%), Nitroimidazole (21.6%), Aminoglycoside (7.8%), Macrolide (5.9%) and Tetracycline (5.9%) in decreasing order. However, in Paediatric department, Glycopeptide (61.1%) was the most frequently prescribed drug followed by Carbapenem (38.9%), Cephalosporin (33.3%), Aminoglycoside (11.1%), Penicillin (5.5%) and Nitroimidazole (5.5%) in decreasing order.(Table 2)

Table 3: Department wise distribution of cases on the basis of frequency of prescribed antimicrobials agents

S. N O	CLASS OF ANTIMICROBIAL	MEDICINE (n=505)		SURGERY (n=51)		GYNAE (n=51)		PAEDIA (n=18)	
		NO	%	NO	%	NO	%	NO	%
1.	PIPRACILLIN+TAZOBACTAM(P/T)	72	14.2	05	9.8	0.0	0.0	01	5.5
2.	AMOXICILLIN+CLAVULANIC ACID(AMC)	145	28.7	10	19.6	06	11.8	0.0	0.0
3.	CLINDAMYCIN(CD)	45	8.9	0.0	0.0	02	3.9	0.0	0.0
4.	CEFTRIAZONE(CTR)	215	42.6	0.0	0.0	0.0	0.0	06	33.3
5.	AZITHROMYCIN(AZM)	136	26.9	0.0	0.0	03	5.9	0.0	0.0
6.	LEVOFLOXACIN(LE)	36	7.1	07	13.7	0.0	0.0	0.0	0.0
7.	CEFOPERAZONE(CPZ)	26	5.1	0.0	0.0	0.0	0.0	0.0	0.0
8.	METRONIDAZOLE (MT)	56	11.1	11	21.6	11	21.6	01	5.5
9.	BENZYL PENICILLIN	05	1	0.0	0.0	0.0	0.0	0.0	0.0

	(BP)								
10	DOXYCYCLINE(DO)	20	4	0.0	0.0	03	5.9	0.0	0.0
11	CIPROFLOXACIN (CIP)	11	2.2	0.0	0.0	0.0	0.0	0.0	0.0
12	LINEZOLID (LZ)	11	2.2	0.0	0.0	0.0	0.0	0.0	0.0
13	VANCOMYCIN (VA)	07	1.4	0.0	0.0	0.0	0.0	11	61.1
14	CEFTRIAXONE+SULBAC TAM (CIS)	0.0	0.0	21	41.1	39	76.5	0.0	0.0
15	AMIKACIN (AK)	01	0.2	0.0	0.0	04	7.8	02	11.1
16	CEFIXIME (CFM)	03	2.6	08	15.7	0.0	0.0	0.0	0.0
17	MEROPENEM (MRP)	14	2.8	0.0	0.0	0.0	0.0	07	38.9
18	NITROFURANTOIN (NIT)	04	0.8	0.0	0.0	0.0	0.0	0.0	0.0
19	OFLOXACIN+ORNIDAZO LE(OFO)	0.0	0.0	03	5.9	0.0	0.0	0.0	0.0
20	NORFLOXACIN(NX)	01	0.2	0.0	0.0	0.0	0.0	0.0	0.0

This table showed frequency of prescribed antimicrobial agents in various departments.

In Medicine department, Ceftriaxone (42.6%) was the most frequently prescribed drug followed by Amoxicillin + Clavulanic acid (28.7%), Azithromycin (26.9%), Piperacillin + Tazobactam (14.2%), Metronidazole (11.1%), Clindamycin (8.9%), Levofloxacin (7.1%), Cefoperazone (5.1%), Doxycycline (4%), Meropenem (2.8%), Cefixime (2.6%), Ciprofloxacin (2.2%), Linezolid (2.2%), Vancomycin (1.4%), Benzylpenicillin (1%), Nitrofurantoin (0.8%), Norfloxacin (0.2%) and Amikacin (0.2%) in decreasing order. In Surgery Department, Ceftriaxone + Sulbactam (41.1%) was the most frequently prescribed drug followed by

Metronidazole (21.6%), Amoxicillin + Clavulanic acid (19.6%), Cefixime (15.7%), Levofloxacin (13.7%), Piperacillin + Tazobactam (9.8%) and Ofloxacin + Ornidazole (5.9%) in decreasing order. In Obs/Gynae Department, Ceftriaxone + Sulbactam (76.5%), was the most frequently prescribed drug followed by Metronidazole (21.6%), Amoxicillin + Clavulanic acid (11.8%), Amikacin (7.8%), Azithromycin (5.9%), Doxycycline (5.9%) and Clindamycin (3.9%) in decreasing order. In Paediatrics department, Vancomycin (61.1%), was the most frequently prescribed drug followed Meropenem (38.9%), Ceftriaxone (33.3%), Amikacin (11.1%), Piperacillin + Tazobactam (5.5%) and Metronidazole (5.5%) in decreasing order. (Table 3

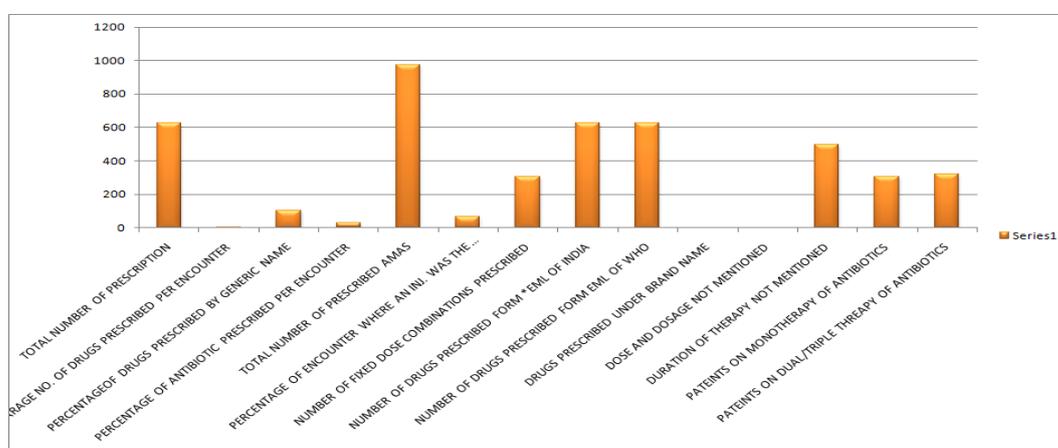


Figure 1: Analysis of prescription pattern at various departments of S.G.M.H

Above Figure showed prescribing pattern analysis, total 625 case sheets were analysed and following results were made. The average no. of drugs prescribed per encounter was 5.5, 100% drugs were prescribed by generic name; percentage of antibiotic prescribed per encounter was 28%. Total 972 AMAs were prescribed for 625 case sheets, 66.67% were in form of injections. The fixed dose combinations were prescribed in 304 cases. 100% AMAs were prescribed from Essential Medicine List (EML) of India and WHO. 100% drugs of each prescriptions were mentioned with dose and dosage form. The duration of therapy was not mentioned in 494 prescriptions. Among total case sheets, 307 prescriptions had only single AMAs and 318 prescriptions had double/triple AMAs combination. (Figure-1)

Discussion

In the present study the demographic characteristics of patients shows that, out of total 625 admitted patients' majority (20.8%) of patients were belonged to geriatric age group > 68yr and minimum (0.8%) in < 1 year (up to 12 month) of age group, this was similar to Mirza beg et al, (2017) [11] and Mahazan H.M et al, (2014) [12] study, in which maximum patients were belonging to age group of > 60yrs. However, result of our study was dissimilar to Ambika VJ et al, (2016) [13] study (in which maximum patients were belong to 33- 42 yr. of age), Amritpal kaur et al, (2018) [14] in which maximum patients were belong to 30–70 yr. of age, PR Shankar et al, (2002) [15] in which maximum patients (54%) were belong to 20-39 yr. of age). The reasons for maximum patients of geriatric age group in our study may be due to poor immunity and compromised organ functions.

In present study, out of total 625 enrolled cases, most (50.4%) were females and rest (49.6%) were males. This was similar to Ambika VJ et al, (2016) [13] study in

which maximum patients 59.29% were females and 40.7% were males and dissimilar to Amritpal kaur et al, (2018) [14] and De Bont EG et al, (2012) [16] studies in which 60% patients were males and 40% were females respectively.

80.8% of cases were belongs to Medicine department followed by Surgery (8.16%), Gynaecology (8.16%) and least were belonged to the Peadiatric department (2.9%). This may be due to heavy patient load in medicine department compared to other departments.

In present study, Cephalosporins were most commonly (50.6%) prescribed group followed by Penicillin (39.7%); Macrolides (22.2%); Nitroimidazole (12.6) and Fluroquinolones (9.3%) in decreasing order in admitted patients, this result is similar to Devesh K Joshi et al,(2017) [17] and Venkateswarlu B et al, (2015) [18] in which cephalosporin was prescribed 86% and 80.5% respectively.

In our study Ceftriaxone was most commonly (22.7%) prescribed drug among cephalosporins followed by Amoxicillin + Clavulanic acid (16.6%), Azithromycin (14.3%), Metronidazole (8.1%), Piperacillin + Tazobactam (8%), Ceftriaxone + Sulbactam (6.2%), Clindamycin (4.8%), Levofloxacin (4.4%), Cefoperazone (2.7%) and Doxycycline (2.4%), this was similar to Sviestina I et al,(2015) [19], In which 38% ceftriaxone was the most common drug among cephalosporin followed by 18% Amoxicillin + Clavulanic acid and Azithromycin.

It was noted that there is some diversity in prescribing pattern of antimicrobial agents among various Departments, as in Medicine department; Cephalosporins was the most frequently (48.1%) prescribed group followed by Penicillin's (44.3%), Macrolide (26.9%) and Nitroimidazole (11%) in decreasing order; among cephalosporins, Ceftriaxone (42.6%) was the most frequently prescribed drug

followed by Amoxicillin + Clavulanic acid (28.7%), Azithromycin (26.9%), Piperacillin + Tazobactam (14.2%), Metronidazole (11.1%), Clindamycin (8.9%) and Levofloxacin (7.1%) in decreasing order. This result was similar to study conducted by Atif et al, (2016) [20] in which Cephalosporin was the most commonly prescribed antibiotic, followed by penicillin and macrolides in medicine department. However, Vinod k mugdaet al, (2020) [21] study showed dissimilar result to our study in which penicillin was the most commonly prescribed antibiotic.

In Surgery department; Cephalosporins was the most frequently (58.8%) prescribed group followed by Nitroimidazole (21.6%), Fluoroquinolones (13.7%) and Penicillin's (11.8%) in decreasing order; among cephalosporins, ceftriaxone + sulbactam (41.1%) was the most frequently prescribed drug followed by Metronidazole (21.6%), Amoxicillin + Clavulanic acid (19.6%) in decreasing order. This was similar to study conducted by Gurtler N et al, (2019) [22] in which among cephalosporins, ceftriaxone + sulbactam (41.1%) was the most frequently prescribed drug followed by Metronidazole (21.6%) and fluoroquinolones.

In Obstetrics / Gynecology department; Cephalosporins was the most frequently (76.5%) prescribed group followed by Penicillin (29.4%), Nitroimidazole (21.6%) and Aminoglycoside (7.8%), in decreasing order; among cephalosporins, Ceftriaxone + Sulbactam (76.5%), was the most frequently prescribed drug followed by Metronidazole (21.6%), Amoxicillin + Clavulanic acid (11.8%), Amikacin (7.8%), Azithromycin (5.9%), Doxycycline (5.9%) and Clindamycin (3.9%) in decreasing order. This was similar to study conducted by Neeta Sawhney et al, (2020) [23] in which

among Cephalosporins was the most frequently (58.4%) prescribed group.

In Pediatric department; Glycopeptide (61.1%) was the most frequently prescribed group followed by Carbapenem (38.9%), Cephalosporin (33.3%) and Aminoglycoside (11.1%) in decreasing order; among Glycopeptide Vancomycin (61.1%), was the most frequently prescribed drug followed by Meropenem (38.9%), Ceftriaxone (33.3%) and Amikacin (11.1%) in decreasing order. This was similar to study conducted by Seah et al, (2014) [24] In which glycopeptide (70%) was the most frequently prescribed drug followed by carbapenem (46%).

In this study; total 625 case sheets were analysed, maximum; 250 prescriptions had 6 drugs while in 210 had 7 drugs and only 15 prescriptions had minimum 4 drug. The average number of drugs prescribed per encounter was 5.5. Similar studies performed by Kumar Raj et al, (2013) [25], Muzammil Hasan Najmi et al, (1998) [26], Saache et al (2017) [27], Mujtaba n syed et al (2014) [28], Aparna Williams et al, (2011) [29] found that average number of drugs prescribed is 4.98, 2.97, 1.6, 1.6, 2.09 respectively. Polypharmacy (≥ 2) was therefore evident in majority of prescriptions we studied. The major drawback of polypharmacy is high risk of drug interactions, reduced patient compliance and high incidence of drug toxicities. [30] Various reasons can account for this deviation from the recommended WHO values. It can be due to unrealistic expectations, quick relief for patients, common practice of irrational drug combinations, unnecessary use of vitamins and aggressive medicine promotions.

Conclusion

In present study, Cephalosporin's were most frequently prescribed group followed by Penicillin and Macrolides. Most of these antibiotics were prescribed without

culture sensitivity which has to make mandatory in the hospital before antibiotic prescription. The antibiotic selection in this hospital is not in accordance with the guidelines of Madhya Pradesh State Action Plan for Containment of Antimicrobial Resistance -2019 (MP-SAPCAR). All antibiotics were prescribed by generic name and all those were available in hospital pharmacy. Results of our study indicate urgent need to increase awareness and understanding; communication and training among healthcare professionals to reduce unnecessary and unrequired use of antibiotics to reduce the drug resistance and interactions.

References

1. Tobgay T, Tandin, Rai M, et al. Prescribing pattern of higher generation antibiotics in the out-patient setting in Bhutan hospitals. *Asian Biomedicine*. 2010; 4(2):349-353.
2. Ahmad A, Parimalakrishnan S, Mohanta GP, et al. A Study on utilization pattern of higher generation antibiotics among patients visiting community pharmacies in Chidambaram, Tamilnadu at South India. *Int J Pharm*. 2012; 2(3): 466-471.
3. Laxminarayan R, Matsoso P, Pant S, et al. Access to effective antimicrobials: a worldwide challenge. *Lancet*. 2015; 387: 168–175.
4. Neu H.C. The crisis in antibiotic resistance. *Science*. 1992 Aug 21;257(5073):1064-73.
5. Leblebicioglu H, Rodriguez-Morales AJ, Rossolini GM, et al. Management of infections in critically ill returning traveler's in the intensive care unit—I: considerations on infection control and transmission of resistance. *International Journal of Infectious Diseases*. 2016 Jul 1; 48:113-7.
6. Muto CA, Jernigan JA, Ostrowsky BE, et al. SHEA guideline for preventing nosocomial transmission of multidrug resistant strains of *Staphylococcus aureus* and *Enterococcus*. *Infect Control Hosp Epidemiol*. 2003; 24:362-86.
7. Bell BG, Schellevis F, Stobberingh E, et al. A systematic review and meta-analysis of the effects of antibiotic consumption on antibiotic resistance. *BMC Infect Dis*. 2014 Jan; 14: 13.
8. Snow V, Mottor PC, Gonzales R. Principles of appropriate antibiotic use for nonspecific upper respiratory tract infections in adults. *Ann. Intern. Med*. 2001; 134(6): 487-489.
9. Hiramatsu K, Hanaki H, Ino T, et al. Methicillin-resistance *Staphylococcus aureus* clinical strains with reduced vancomycin susceptibility. *J. Antimicrob. Chemother*. 1997 Jul; 40: 135-6.
10. WHO: The evolving threat of antimicrobial resistance—options for action. World Health Organization; 2012. available from: <https://apps.who.int/iris/handle/10665/44812> [Accessed 20 april 2022]
11. Beg AM, Dutta BS, Bawa S, et al. Prescribing trends in respiratory tract infections in a tertiary care teaching hospital. *International Journal of Research in Medical Sciences*. 2017;5(6):2588-91.
12. Mahajan HM, Date AP, Badwaik RT, et al. Analysis of Pattern of Antimicrobial use in Respiratory Tract Infections in a Tertiary Care Hospital of Central India-A Drug Utilization Study. *J Cont Med A Dent*. 2014; 2(3):59-64.
13. Ambika V J, Raj Bhupendra, Singh P, Singh A, Shrivastava AK, et al. Frequency, preference and prescribing pattern of antimicrobials in outpatient department of a tertiary care SGM Hospital central India Rewa, MP, India. *European Journal Of Pharmaceutical and Medical Research*. 2016; 3(4):534-53.
14. Kaur A, Bhagat R, Kaur N, et al. A study of antibiotic prescription pattern in patients referred to tertiary care center in Northern India. *Ther Adv Infect Dis*. 2018 Jul; 5(4): 63–68
15. Shankar PR, Partha P, and Shenoy N. Self-medication and non-doctor prescription

- practices in Pokhara valley, Western Nepal: a questionnaire-based study. *BMC Family Practice*. 2002;3:17.
16. De Bont EG, van Loo IH, Dukers-Muijers NH, et al. Oral and topical antibiotic prescriptions for children in general practice. *Arch Dis Child*. 2013 Mar;98(3):228-31.
 17. Joshi DK, Mohd R, Kothiyal P, Joshi Y. Evaluation of prescription pattern of antibiotics for surgical prophylaxis in secondary care hospital. *Int J Basic Clin Pharmacol*. 2017 Aug;6(8):1969-76.
 18. Venkateswarlu B, Swapna. Drug utilization study of antibiotics in surgical ward of a tertiary care hospital. *International Journal of Chemical and Pharmaceutical Sciences*. 2015;6(1):1-7.
 19. Sviestina I, Mozgis D. Evaluation of the Antibiotic Use for Surgical Prophylaxis in Pediatric Acute Appendicitis. *Journal of Young Pharmacists*. 2015;7(1):150-5.
 20. Atif M, Azeem M, Sarwar MR, et al. WHO/INRUD prescribing indicators and prescribing trends of antibiotics in the Accident and Emergency Department of Bahawal Victoria Hospital, Pakistan: Springerplus. 2016;5(1):1928.
 21. Mugada VK, Mahato V, andhavaram D, and Vajhala SM. Evaluation of Prescribing Patterns of Antibiotics Using Selected Indicators for Antimicrobial Use in Hospitals and the Access, Watch, Reserve Classification by the World Health Organization. *Turkish Journal of Pharmaceutical Science*. 2020 Jun; 18(3): 282–288.
 22. Gurtler N, Erba A, Giehl C, et al. Appropriateness of antimicrobial prescribing in a Swiss tertiary care hospital: a repeated point prevalence survey. *Swiss Med Wkly*. 2019;149: w20135.
 23. Sawhney N, Sawhney V, Khajuria V. Prescribing pattern of antibiotics among postoperative patients admitted in gynaecology and obstetrics department of tertiary care hospital in Northern India. *International Journal of Basic & Clinical Pharmacology*. 2020 Feb;9(2):300-304.
 24. Seah XF, Ong YL, Tan SW, et al. Impact of an antimicrobial stewardship program on the use of carbapenems in a tertiary women's and children's hospital, Singapore. *Pharmacotherapy*. 2014;34(11):1141–50.
 25. Kumar R, Kohli K, Kajal H L. A study of drug prescribing pattern and cost analysis among diabetic patients in a tertiary care teaching institute in north India. *Journal of Drug Delivery & Therapeutics*. 2013;3(2):56-61.
 26. Najmi MH, Rehan A, Hafiz RA, et al. Prescribing Practices: An Overview of Three Teaching Hospitals in Pakistan. *Journal of Pakistan Medical Association*. 1998 Mar; 48(3):73-7.
 27. Saache S, Divhare S, Ghongane B, Shaikh S. Antibacterial Prescription Pattern in Medical and Surgical Intensive Care Units of a Tertiary Care Hospital. *JMSCR*. 2017 Mar; 05(3):19472-77.
 28. Syed MHN, Kumar CU, Shobha JC. Prescription Patterns of Antibiotics in Acute Medical Care Unit of a Tertiary Care Hospital in India. *Int. J. Curr. Microbiol. App. Sci*. 2014;3(7):673-79
 29. Williams A, Mathai AS, Phillips AS. Antibiotic prescription patterns at admission into a tertiary level intensive care unit in Northern India. *J Pharm Bioallied Sci*. 2011;3(4):531-36.