International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Antibiotic Prescribing Pattern in Inpatient Department Using WHO AWaRe Classification and WHO Prescribing Indicators in a Multi-Specialty Hospital

Hafsa Jabeen[1], Ayesha Fatima[2]

[1]Department of Pharmacy Practice, MESCO College of Pharmacy
[2]Department of Pharmacy Practice, RBVRR Women's College of Pharmacy

ABSTRACT

Background: Antibiotics are essential for combating bacterial infections in both humans and animals, functioning by either eliminating bacteria or halting their growth. Although lifesaving, the overuse of antibiotics has contributed to the emergence of antibiotic resistance, a serious global health concern. The WHO updated its Essential Medicines List in 2019, organizing antibiotics into three categories: Access, Watch, and Reserve (AWaRe). The goal of the AWaRe classification is to ensure at least 60% of global antibiotic use falls under the Access group, promoting proper usage and curbing resistance. WHO Core Drug Use Indicators are used to identify issues in drug utilization, evaluate the performance of healthcare institutions, and guide the implementation of antibiotic stewardship programs.

Methodology: This study aimed to evaluate the antibiotic prescribing patterns on patients admitted in a multi-specialty hospital, based on WHO AWaRe Classification and WHO Prescribing Indicators. Conducted as a cross-sectional observational study, data from 152 prescriptions over three months were analyzed. The study included inpatients aged 18 and above, from both genders, each receiving at least one antibiotic. Data were analyzed using descriptive statistics, employing the WHO AWaRe Classification system and WHO Prescribing Indicators to assess prescription patterns.

Results: Across 152 prescriptions, 1,413 drugs were prescribed, averaging 9.2 drugs per prescription, including 319 antibiotics, with an average of 2 antibiotics per prescription. Of the antibiotics prescribed, 90.2% were from the WHO Essential Medicines List, 11.2% were prescribed by generic name, and 98.7% were in injectable form. Male patients accounted for 68% of prescriptions, with the largest age group being 40–50 years (27 prescriptions) and a mean age of 49.7 years. The most frequently prescribed antibiotics were ceftriaxone (68, 21.3%), metronidazole (64, 20.0%), and amoxicillin/clavulanic acid (37, 11.6%). Cephalosporins were the most commonly prescribed class (81, 25.4%). Most antibiotics belonged to the Watch group (198, 62%), followed by the Access group (116, 36.4%), with five antibiotics from the Reserve group.

Conclusion: The study highlights the need to shift prescribing practices toward Access antibiotics and emphasizes the importance of using generic and essential drugs, as guided by the WHO Prescribing Indicators and AWaRe framework, to optimize antibiotic use and combat resistance.

KEYWORDS: AWaRe Classification, WHO Prescribing Indicators, Antibiotics, Antimicrobial stewardship, Antibiotic prescribing pattern.

INTRODUCTION

Antibiotics: Antibiotics are medications designed to treat bacterial infections in humans and animals. They work by either killing the bacteria or hindering their ability to reproduce. Which can be taken orally (by mouth) in the form of pills, capsule or liquid form. Tropically this might be a cream, ointment or spray, eye drop or ear drop. Though antibiotics can be used in the form of injections or intravenously (IV) this is usually used for more serious infections.[1]

Since their invention, antibiotics have shown themselves to be extremely helpful in reducing infectious infections and improving healthcare outcomes.[2] Although antibiotics are life-saving, overuse of them can lead to antibiotic resistance. A major global public health concern is antibiotic resistance [3] This contributes to a heightened risk of adverse effects, increased medical costs, and accelerated development of antimicrobial resistance.

The main organization in charge of carrying out the "National Programme on AMR containment" in India is the National Centre for Disease Control (NCDC), situated in New Delhi. As a crucial step in organizing antibiotic surveillance, the NCDC created "National Antimicrobial Consumption Network (NAC-NET).[4] India has one of the highest levels of antibiotic consumption globally. India now purchases 6.5 billion DDDs (defined daily doses) of antibiotics annually from last 20 years it has been increased from 3.2 billion in 2000 DDDs.

In 2019, India has rated highest on drug resistance index out of 41 countries.[5] It has been predicted that antimicrobial resistance will take an additional two million lives annually. Antimicrobial stewardship is advised to maintain the efficacy of antibiotics used as a last option, lower antimicrobial resistance, and reduce the risk of adverse medication events, treatment problems, and hospital expenses.[6]

WHO AWaRe classification: In 2019, the WHO updated the Essential Medicines List (EML) and classified antibiotics into four categories: Access, Watch, Reserve, and Not Recommended (AWaRe) to optimize antimicrobial use. To develop effective antibiotic stewardship programs that can significantly impact institutional antimicrobial use and the outcomes of antimicrobial resistance, it is essential for institutions to understand their own patterns of antibiotic use and prevent overuse or misuse that contributes to resistance.[7] The quantity of antimicrobial drugs, measured in grams, was converted into defined daily doses (DDDs) per 100 bed-days using the AMC Tool 2019.[8]

ACCESS: Antibiotics that are effective against a variety of infections and have a limited risk for resistance. They need to be broadly accessible and typically less costly.

Examples: Amoxicillin, metronidazole, doxycycline and nitrofurantoin.

WATCH: Frequently high priority agents or at high risk of bacterial resistance are antibiotics having a higher potential for resistance. Monitoring and stewardship efforts ought to concentrate on these antibiotics.

Examples: Broad spectrum antimicrobials such as azithromycin, cefepime, cefixime, ceftriaxone, meropenem, piperacillin/tazobactam and vancomycin.

RESERVE: Antibiotics and classes that should be reserved for treating infections caused by multi-drug-resistant organisms.

Examples: Colistin, linezolid, and tigecycline should be reserved for specific cases when other treatment options have proven ineffective.[9]

The primary aim of the WHO AWaRe classification is to restrict at least 60% of global antimicrobial use to the ACCESS category. The objectives are to encourage the appropriate use of antibiotics, prevent the development of antibiotic resistance, and ensure their judicious use to preserve their effectiveness for future generations.[9]

This study aims to audit antimicrobial prescriptions and assess the effectiveness of the AWaRe classification alongside other process evaluations of antimicrobial use, considering the ongoing challenge of identifying appropriate measures for hospitals and their antimicrobial stewardship programs. Additionally, the study seeks to evaluate prescribing physicians' understanding and opinions on the AWaRe classification and antibiotic resistance. Given the limited research conducted in South India and the rising burden of resistance in the region, this study is particularly important.[11]

WHO Prescribing Indicators:

The WHO Core Drug Use Indicators provide a simple and effective way to quickly identify key aspects of drug use. They help highlight problems with drug use, assess the performance of medical institutions, and guide future efforts to address issues related to antibiotic stewardship and the responsible use of medications.[12]

The main tactics that encourage appropriate pharmaceutical use are supervision, audit, and feedback. Before giving feedback, medications must be reviewed for appropriateness as part of the prescription audit and feedback process. Using WHO drug use indicators to assess drug use trends is a crucial first step in promoting responsible drug use.[14] Researchers must first identify and describe the various ways that drug usage is illogical, such as injectable medications, polypharmacy, and antibiotic misuse, in order to promote rational pharmaceutical use.[15]

WHO core drug indicators are:

1. Prescribing indicators
2. Facility indicators
3. Patient care indicators

The most commonly used indicator is WHO prescribing indicators are used to identify areas of concern in drug use, helping to alert doctors about the importance of using medicines judiciously.[16,17]

Prescribing Indicators: The average number of drugs prescribed per inpatient day (optimal range 1.6-1.8), the average number of antibiotics prescribed/inpatient day, the % of antibiotic prescriptions/inpatient day (optimal range 20.0-26.8%), the percentage of drugs prescribed from the Essential Drugs List (EDL) or formulary (optimal value 100%), the prescribing of medications by their generic names (optimal value 100%), and the number of antimicrobial sensitivity tests performed per hospital admission.

Antibiotic Utilization Patterns: The WHO AWaRe categorization indicates the percentage of antibiotics prescribed from the Access, Watch, and Reserve groups, with the optimal value being more than 60% from the Access group.[18]

OBJECTIVES

The study objective is to evaluate antibiotic prescribing pattern of inpatients general medicine department based on WHO AWaRe Classification and WHO Prescribing indicators in a multi-specialty teaching hospital.

MATERIALS & METHODS

This study is cross-sectional observational research conducted over a 3-month period on inpatients admitted to the general medicine department of a multi-specialty teaching hospital. All the prescriptions containing at least one antibiotic of patients age >18 years of either gender was part of study. The sample size was 153 Patients. Data was collected from patient's medical record which contains detailed information about the patient's demographics, total number of drugs prescribed to patients, detailed laboratory data and diagnosis. All the data was entered in MS Excel, Descriptive statistics were employed to analyze the data. The tools used in the study were WHO AWaRe Classification system and WHO Prescribing indicators to evaluate the prescription patterns of antibiotics. Formal written informed consent was waived as the study involved no direct patient interaction All data collected were kept confidential, used exclusively for this study, and anonymized to protect patient identities.

RESULTS

This study evaluated 152 prescriptions, which contained a total of 1,413 prescribed drugs, included 319 antibiotics from various classes. Data was gathered on factors such as age, gender, antibiotic distribution, the most frequently prescribed antibiotics, the different antibiotic classes used, their dosage forms, the duration of antibiotic use, the WHO AWaRe classification, and the WHO prescribing indicators, all of which were reported.

1. **Distribution of prescriptions according to Gender & Age**: Figure 1 illustrates that of the 152 prescriptions evaluated, 68% were issued to male patients, while 32% were for female patients. Figure 2 indicates that the majority of these prescriptions were for individuals aged 40-50 (27%), followed by those in the 50-60 age group (25%), with a mean age of 49.7 years.

Figure 1: Gender wise distribution of prescription

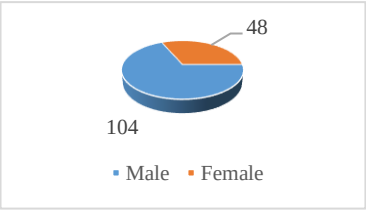
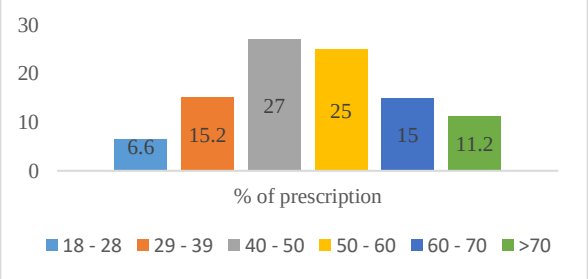


Figure 2: Percentage distribution of prescription according to Age



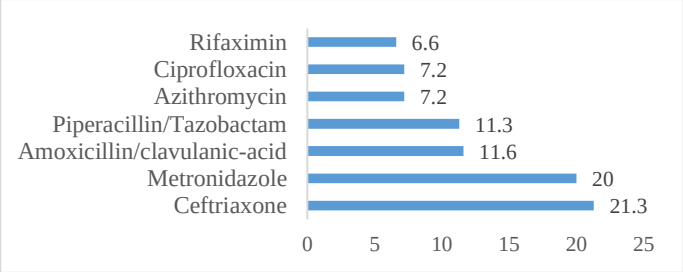
2. **Antibiotic prescribing patterns:** Antibiotic prescribing pattern have been documented in Table 1. Ceftriaxone was the most frequently prescribed antibiotic, with 68 prescriptions (21.3%), followed by Metronidazole with 64 prescriptions (20.0%) and Amoxicillin/Clavulanic acid with 37 prescriptions (11.6%). Amoxicillin (1, 0.3%) and Amikacin (1, 0.3%) were used minimally.

Table 1: Alphabetical list of antibiotics prescribed in the study

Antibiotics Prescribed	No. of Antibiotics Prescribed (n=319)
Amikacin	1
Amoxicillin	1
Amoxicillin/clavulanic-acid	37
Azithromycin	23
Cefixime	5
Cefoperazone/Sulbactam	8
Ceftriaxone	68
Ciprofloxacin	23
Clindamycin	2
Doxycycline	6
Levofloxacin	2
Linezolid	5
Meropenem	8
Metronidazole	64
Nitrofurantoin	5
Piperacillin/Tazobactam	36
Rifaximin	21
Vancomycin	4

3. **Distribution of most commonly prescribed antibiotics**: The seven most frequently prescribed antibiotics are presented in Figure 4, with the detailed results provided in Table 1.

Figure 3: Percentage of Maximum prescribed antibiotics



4. **Distribution of antibiotics according to drug class:** In this study population, cephalosporins were the most frequently prescribed antibiotics, making up 81 prescriptions (25.4%), followed by beta-lactam inhibitors with 73 prescriptions (22.9%). Aminoglycosides were the least prescribed, accounting for just 0.14%. These findings are presented in Table 2.

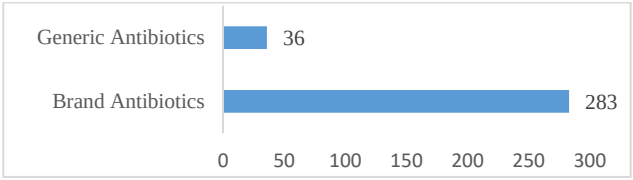
Table 2: Percentage of antibiotics distribution according to drug class

Antibiotic Class	% of Antibiotics Prescribed
Aminoglycosides	0.3
Penicillin	0.3
β Lactamase inhibitors	22.9

Macrolides	7.2
Fluroquinolones	7.8
Lincosamide	0.6
Tetracyclines	1.9
Oxazolidinones	1.6
Carbapenems	2.5
Nitrofuran derivatives	1.6
Glycopeptides	1.3
Imidazole	20
Rifamycin	6.6
3rd Generation Cephalosporins	25.4

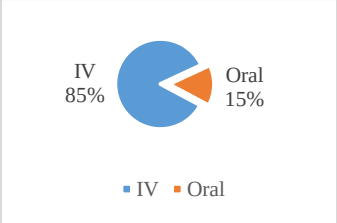
5. **Distribution of antibiotics according to brand and generic names:** Brand name antibiotics (283, 88.7%) were prescribed extensively when compared to the generic medications (36, 11.3%).These findings are presented in Figure 4.

Figure 4: Distribution of antibiotics according generic and brand names



6. **Distribution of dosage form of antibiotics**: Our study found that among the prescribed antibiotics, injections (272, 85%) were more commonly used compared to oral medications (47, 15%). These findings are presented in Figure 5.

Figure 5: Percentage distribution of antibiotics according to route of administration



7. **Distribution of prescription according to duration of antibiotics:** Table 3 illustrates Out of the 152 prescriptions, 62 were given for a duration of 4 to 6 days, followed by 44 prescriptions for 1 to 3 days. A total of 11 prescriptions were used for periods exceeding 10 days.

Table 3: No of days antibiotics prescribed

No of Days Antibiotics Prescribed	No of Prescription
1 to 3	44
4 to 6	62
7 to 9	35
≥10	11

8. **WHO AWaRe classification:** The evaluation showed that most of the antibiotics were from the Watch group (198, 62%), followed by the Access group (116, 36.4%). And, five antibiotics included from the Reserve group. Ceftriaxone, from Watch group was used extensively. Linezolid was used among 5 patients from the reserve group. Figure 6 and Table 5 illustrated the details.

Figure 6: Percentage distribution of drugs according to WHO AWaRe Classification

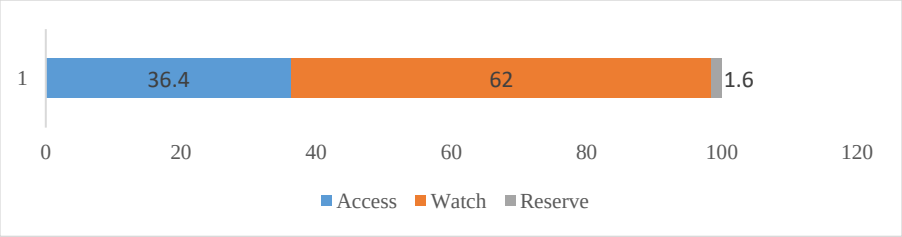


Table 5: Frequency of antibiotics according to WHO AWaRe Classification

Access (n)	Watch (n)	Reserve (n)
Amikacin (1)	Azithromycin (23)	Linezolid (5)
Amoxicillin (1)	Cefixime (5)	-
Amoxicillin/Clavulanic acid (37)	Ceftriaxone (68)	-
Clindamycin (2)	Ciprofloxacin (23)	-
Doxycycline (6)	Meropenem (8)	-
Metronidazole (64)	Piperacillin/Tazobactam (36)	-
Nitrofurantoin (5)	Rifaximin (21)	-
-	Vancomycin (4)	-
-	Levofloxacin (2)	-
-	Cefoperazone /Sulbactam (8)	-

9. **WHO Prescribing indicators:** In the 152 prescriptions, a total of 1,413 drugs were prescribed, with an average of 9.2 drugs/prescription. Of these, 319 antibiotics were prescribed, averaging 2 antibiotics per prescription. Among the 319 antibiotics, 90.2% were from the WHO model list of essential drugs, 11.2% were prescribed by their generic name, and 98.7% of the prescriptions included antibiotics in injectable form. The results are presented in Table 6.

10.

Table 6: Prescription patterns based on WHO prescribing indicators.

WHO Prescribing Indicators	% of drugs/Prescription	Reference Range
Average No of Drugs per prescription	9.3	1.6 - 1.99
Average number of antibiotics per prescription	2.1	2
% of prescriptions with an injection prescribed	98.7%	13.24 - 24.1%
% of antibiotics prescribed from EML	90.3%	100%
% of antibiotics prescribed by generic name	11.3%	100%

DISCUSSION

Our study analyzed antibiotic prescribing patterns in an inpatient department using the WHO AWaRe Classification and WHO prescribing indicators. Data were collected over three months from a multi-specialty teaching hospital, encompassing 152 prescriptions, which included a total of 1,413 prescribed drugs, among which 319 were antibiotics from various drug classes. The study involved patients of both genders, aged 18 to over 70 years.

The results showed that most of the prescribed antibiotics were from the "Watch" category (62%), followed by the "Access" category (36.4%) and the "Reserve" category (1.6%), based on the WHO AWaRe Classification. Ceftriaxone, a cephalosporin from the Watch category, was the most commonly prescribed antibiotic, while linezolid was frequently used from the Reserve group.

The WHO encourages greater use of narrow-spectrum Access antibiotics to minimize the selection pressure from broad-spectrum antibiotics in the Watch and Reserve categories. However, our study found that the consumption of Access antibiotics (36.4%) was much lower than that of Watch antibiotics (62%), which is consistent with the findings of (Grace Jabez Raj et al.,2024). The AWaRe tool is designed to guide prescribers in choosing narrower-spectrum antibiotics from the Access category to help combat antibiotic resistance.

In our analysis, third-generation broad-spectrum cephalosporins alone accounted for 21.3% of all prescribed antibiotics. This significant usage may suggest inappropriate prescribing practices and highlights the need for stricter regulations and robust stewardship programs. Additionally, 98.7% of prescriptions included antibiotics in intravenous form, while 15% were in oral form, both of which exceed the WHO Prescribing Indicators' recommended levels.

Our study illustrates that among 152 prescriptions, a total of 1,413 drugs were prescribed averaging 9.2 drugs per prescription, among these a total of 319 antibiotics were prescribed, averaging 2 antibiotics/prescription. 90.2% were from the WHO model list of essential drugs, 11.2 % were prescribed by generic name and the percentage of drugs prescribed by generic name at Hawassa University Hospital, 98.7%, is almost similar with the standard derived to serve as ideal (100%) stated by (Desalegn AA. et.al 2013).

The study found that the average number of drugs prescribed per encounter, generic prescribing, and the use of the hospital's EDL/formulary were 36 (11.3%). In contrast, a comparative study by (Yilma Z et al, 2020) showed that 225 (58.6%) of prescriptions exceeded the recommended values, making them inappropriate. The study also highlighted excessive prescribing of both antibiotics and injections. On average, antibiotics were prescribed for 6 days in 62 prescriptions, for more than 10 days in 11 prescriptions, and for 3 days in 44 prescriptions.

CONCLUSION

The study emphasizes the critical need for robust antibiotic stewardship programs to address antibiotic resistance in India. It notes that antibiotics classified under the "Watch" category in the AWaRe Classification were consumed more frequently, indicating a need to promote a shift toward the use of "Access" antibiotics. While antibiotic usage aligned with WHO prescribing patterns, other prescribing indicators slightly exceeded WHO standard values. The study underscores the importance of encouraging prescribers to focus on prescribing generic and essential drugs, guided by WHO prescribing indicators and the AWaRe classification framework. Additionally, it emphasizes the need for further

research into antibiotic categorization and consumption trends, as such studies could play a crucial role in designing antibiotic stewardship programs to tackle resistance effectively.

ABBREVIATION

1. AWaRe – Access, Watch and Reserve
2. ATC – Anatomical Therapeutic Chemical
3. DDD – Defined Daily Dose
4. EML/EDL – Essential Medical List/ Essential Drug List
5. NAC-NET - National Antimicrobial Consumption Network
6. NCDC - National Centre for Disease Control
7. WHO – World Health Organisation

CONFLICT OF INTEREST: The authors declare no conflict of interest.

REFERENCES

1. National Library of Medicine; Medline plus; https://medlineplus.gov/antibiotics.
2. H. Kabir, M.K. Hasan, N. Akter et al; Antibiotic administration without prescription; International Society for Infectious Diseases, IJID Regions volume 7, June2013, Pages 11-17.
3. Nadimpalli M, et al. Combating global antibiotic resistance: emerging one health concerns in lower- and middle-income countries. Clinical Infectious Dissease 2018;66(6):963-9 .
4. Mittal, N.; Tayal, A.; Kumar,S.; Dhawan, R.; Goel, N.; Mittal, R.Longitudinal Trends in In-PatientAntibiotic Consumption According tothe WHO Access, Watch, Reserve(AWaRe) Antibiotic Groups and Cost:An Analysis of Data at a National,Antimicrobial Consumption Network(NAC-NET) Site in North India over 7Years (2017–2023). Antibiotics 2024, 13,673 .
5. Bhardwaj A, Kapoor K, SinghV.Trend analysis of antibiotics consumption usingWHO AWaRe classification in tertiary care hospital.International Journal Basic Clinical Pharmacololgy 2020;9:1675-80.
6. McElnay JC, Scott MG, Sidara JY, Kearney P. Auditof antibiotic usage in a medium-sized general hospital over an 11-year period. The impact ofantibiotic policies. Pharm World Sci. 1995;17:207–13.
7. Sharland M, Pulcini C, Harbarth S, Zeng M, GandraS, Mathur S, Magrini N. Classifying antibiotics in theWHO essential medicines list for optimal use –be AWaRe. Lanc Infect Dis. 2018;18(1):18–20
8. World Health Organization. WHO Report onSurveillance of Antibiotic Procurement: 2016-2018 early Implementations. Available at : https://www.who.int/medicines/areas/rational_use/oms-amr-amc-report-2016-2018/en/.
9. World Health Organization. WHO releases the 2019 AWaRe classification antibiotics. World Health Organization: New York, NY, USA. 2019 Oct.
10. L. Moja et al. /1198-743X/© 2024 World Health Organization. Published by Elsevier Ltd on behalf of European Society of Clinical Microbiology and Infectious Diseases. Clinical Microbiology and Infection 30 (2024) S1eS51
11. Point prevalence survey of antibiotic consumption across three hospitals in Ghana PubMed [Internet]. [cited 2023 Jun 5]. Available from https://pubmed.ncbi.nlm.nih.gov/34223086
12. World Health Organization, WHO INN & Medicine Classification, Anatomical Therapeutic Classification System and Defined daily Dose ; 22 May 2024.

13. Wikipedia; https://en.wikipedia.org/wiki/Anatomical_Therapeutic_Chemical_Classification_System
14. World Health Organization Action Programme on Essential Drugs. How to Investigate drug Use in Health Facilities: Selected drug use Indicators. Geneva: WHO; 1993.
15. Sharma A, Shweta O. Assessment of drug prescribing pattern in children: A descriptive study. Natl J Physiol Pharm Pharmacol2016;6:74-80
16. Desalegn AA. Assessment of drug use pattern using WHO prescribing indicators at Hawassa University Teaching and Referral Hospital, south Ethiopia: a cross-sectional study.MC Health Serv Res 2013; 13(1): 170.
17. Yilma Z and Liben M. Assessment of drug prescription pattern in Mekelle general hospital, Mekelle, Ethiopia, using World Health Organization prescribing indicators. Biomed Res Int 2020; 2020: 3809157.
18. Ofori-Asenso R. A closer look at the World HealthOrganization's prescribing indicators. J Pharmacol Pharmacother 2016;7:51-4.
19. Priyadharsini RP, Ramasamy K, Amarendar S.Antibiotic-prescribing pattern in the outpatient departments using the WHO prescribing indicators and AWaRe assessment tool in a tertiary-care hospital in South India. J Family Med Prim Care 2022;11:74-8.
20. S. Mushtaq, F. Javed, M. Falmah et .al ; Assessment of Antibiotics Prescription Pattern Using WHO prescribing Indicators and Aware Categorization of Antibiotics; PJMHS ; volume 15,No 11, Nov 2021.
21. Grace Jabez Raj, Aravinda Kumar Balan, Saranya Rajaram et al. Cross-sectional study to track antibiotic consumption and its appropriateness in an intensive care setting of a tertiary care hospital using AWaRe tool of World Health Organization (WHO)., 13 October 2024, PREPRINT (Version 1) available at Research Square.