https://doi.org/10.33472/AFJBS.6.9.2024.796-808
Original Article

African Journal of Biological Sciences
Journal homepage: http://www.afjbs.com

Research Paper Open Access

EVALUATION OF ANTIBIOTIC PRESCRIPTION PATTERN AMONG PATIENTS AT TERTIARY CARE HOSPITALS: ANTIMICROBIAL STEWARDSHIP- A NEED OR NOT?

Anisha Sara Anil, Dhanush T, Sevanthi M, Aswin Sarath

Author information:
1. Anisha Sara Anil
Department of Pharmacy Practice,
J.K.K.Nattraja College of Pharmacy, Kumarapalayam – 638183, TamilNadu, India.
ORCID ID: 0009-0008-7933-5554.
Email: anisha.saraanil17@gmail.com
2. Dhanush T
Department of Pharmacy Practice,
J.K.K.Nattraja College of Pharmacy, Kumarapalayam – 638183, TamilNadu, India.
ORCID ID: 0009-0005-0245-545X
Email: dhanushselvam987@gmail
3. Sevanthi M
Department of Pharmacy Practice,
J.K.K.Nattraja College of Pharmacy, Kumarapalayam – 638183, TamilNadu, India.
ORCID ID: 0009-0007-4245-6347.
Email: sevanthim15@gmail.com
4. Dr.. Aswin Sarath, Pharm. D.,
Assistant Professor, Department of Pharmacy Practice,
J.K.K.Nattraja College of Pharmacy, Kumarapalayam – 638183, TamilNadu, India.
ORCID ID: 0000-0002-3981-1682.
Email: aswinsarath95@gmail.com
Corresponding author details
Name of the author: Dr. Aswin Sarath
Email ID: aswinsarath95@gmail.com

Volume 6, Issue 9, 2024

Received: 03 March 2024

Accepted: 11 April 2024

doi: 10.33472/AFJBS.6.9.2024.796-808

Abstract:

Introduction:

Antibiotic resistance poses a global concern due to its impact on treatment efficacy and public health. This study delves into antibiotic prescription patterns and emphasizes the imperative need for Antimicrobial Stewardship Programs (ASPs) in tertiary care hospitals. Analyzing factors contributing to resistance, such as improper usage, underscores the urgency of addressing this issue.

Methods:

A retrospective analysis conducted in Erode Tertiary Care Hospitals over six months scrutinized antibiotic prescriptions for in-patients in the General Medicine department. Data collection involved discharge summaries, extracting information on prescriptions, diagnoses, demographics, and antibiotic details. Culture sensitivity reports and drug interactions were assessed, aligning with WHO's antibiotic categorization (AWaRe).

Results:

Among 325 participants, predominant antibiotic classes included Cephalosporins and Fluoroquinolones. Ciprofloxacin, Metronidazole, and Ceftriaxone emerged as the most frequently prescribed. The majority received therapy for 3–5 days, primarily through injections. Alarmingly, culture sensitivity testing was minimal (1.23%). Comorbidities were prevalent (26.46%), with 37.20% of these prescriptions indicating potential drug-drug interactions.

Conclusion(s):

The study highlights prevalent broad-spectrum antibiotic usage, minimal culture sensitivity testing, and significant potential drug interactions in comorbid patients. Urgent implementation of ASPs in tertiary care hospitals remains crucial to optimize antibiotic use, promote judicious prescribing, and enhance patient-specific treatment strategies. This step is essential for better outcomes and effectively combating antibiotic resistance.

Keywords: Antibiotic resistance, Antimicrobial Stewardship, Culture sensitivity, drug resistant microorganisms.

Introduction:

Antibiotic resistance occurs when bacteria alters in response to the use of antibiotics which are widely used for various bacterial infections. Although the bacterial resistance to antibiotics is a natural process in and of itself, there are a number of other factors that contribute to this resistance such as inappropriate antibiotic prescription, self-medication, and widespread antibiotic usage in agriculture and animal husbandry.[1,2]In every region of the world, antibiotic resistance is increasing to highly dangerous levels and our ability to cure widespread infectious illnesses is being threatened by the emergence and worldwide dissemination of new resistance mechanism. Drug resistant microorganisms strains cause over 0.7 million fatalities worldwide each year. By 2050, the figure is predicted to reach 10 million surpassing cancer i.e., 8.2 million annual fatalities.[3]India has the second-highest global usage of antibiotics, with a 47% rise from 5,411 to 7,976 million defined daily doses between 2010 and 2020. Surprisingly, India has been noted to have one of the greatest rates of drug resistance globally.[4]With a few number of novel antibiotics being released into market, the proper use of existing available antibiotics is now a crucial factor in preventing the formation of drug resistant organisms.[5]

Antibiotics make up around one-third of all prescriptions written in a hospital, about one-third of these prescriptions are often irrational, and about one-third of the hospital pharmacy budget is allocated to antibiotics.[7,8] Despite the fact that viral diseases like the common cold and the flu cannot be treated with antibiotics, patients none the less get prescriptions for them.[9] Antibiotic usage for viral infections and the use of broad-spectrum antibiotics when a more selective and narrow-spectrum drug would be more suited both contribute to the development of antibiotic resistance.[10,11] One of the top five objectives of the World Health Organization's Global Action Plan on Antimicrobial Resistance is to collect statistics on both drug use and resistance (WHO).[13]

Patients with comorbidity and multimorbidity are more likely than healthy patients in the community to acquire and develop antibiotic resistance due to their increased susceptibility to infection, common antibiotic exposure, and contact with secondary care, where drug-resistant microbes are common.[14-16] Despite widespread recognition of the need to minimise antibiotic administration for individuals with diseases such as chronic obstructive pulmonary disease (COPD),[17] few studies have examined prescribing trends or stewardship strategies in comorbid patients.[18-20] Many recent studies have also highlighted improper use of AMs, emphasising the necessity of monitoring antimicrobial use and its influence on improving prescription patterns in healthcare settings.[21-23]

This research aims to evaluate the antibiotic prescription patterns among patients at tertiary care hospitals, with a specific focus on the need for implementing an Antimicrobial Stewardship Program. Furthermore, this research will also delve into the analysis of potential drug interactions between prescribed antibiotics and other medications administered for comorbid conditions which can impact treatment outcomes, patient safety, and the overall efficacy of the therapeutic regimen. Identifying and understanding these interactions will contribute to optimizing antibiotic therapy in the context of patient-specific requirements and

existing medication regimens. The findings of this research will provide valuable evidence regarding the antibiotic prescription patterns at tertiary care hospitals, shedding light on the necessity and effectiveness of implementing antimicrobial stewardship programs where complex patient profiles and severe infections pose unique challenges.

Materials and methods

A retrospective study conducted at Tertiary Care Hospitals over a span of 6 months focused on in-patients within the General Medicine department, encompassing participants of all ages and genders. Notably, pregnant women and patients on antibiotics for surgical prophylaxis were excluded from the study. The data collection process involved obtaining discharge summaries with antibiotic prescriptions. Subsequently, a meticulous data entry procedure was followed, where relevant information was transcribed into a prescription analysis form, adhering strictly to the pre-established inclusion criteria. The comprehensive data analysis aimed to evaluate prescription patterns, encompassing patient demographics, chief complaints, diagnoses, and intricate details of antibiotic usage, including name, class, duration, spectrum, dose, dosage form, and frequency. Additionally, the analysis considered culture sensitivity reports and incorporated the WHO's AWaRe category for antibiotics. The prescription analysis form also accounted for drugs taken for concurrent comorbid conditions, interactions with antibiotics, and the severity of conditions. The entire workflow, designed for systematic data collection and analysis, is expected to provide a nuanced understanding of antibiotic prescription practices in the specified hospital setting. After the comprehensive data collection process, the gathered information was meticulously entered into Microsoft Excel for further analysis. This step involved careful organization and input of the data points extracted from the prescription analysis form, ensuring accuracy and completeness. Descriptive statistics, such as measures of central tendency and variability, were employed to summarize and interpret the collected data, facilitating a clear and concise presentation of the study findings.

Results and discussion:

The study involved a total of 325 participants, categorized by age into three groups: below 20 years (12 participants), 20–50 years (128 participants), and above 50 years (185 participants). The gender distribution showed 132 male participants and 193 female participants. The primary indications for medical attention were diverse, with acute gastroenteritis being the most prevalent (19.38%), followed by chronic obstructive pulmonary disease (COPD) at 8.61%, upper respiratory tract infection and viral fever both at 4.61%, and snake bite at 4.30%.

Prescriptions included a varied number of antibiotics, with 1 antibiotic in 180 prescriptions, 2 antibiotics in 123 prescriptions, 3 antibiotics in 17 prescriptions, 4 antibiotics in 4 prescriptions, and 5 antibiotics in 1 prescription. The duration of therapy was distributed with 49 prescriptions for less than 3 days, 408 prescriptions for 3–5 days, and 33 prescriptions for more than 5 days. In terms of dosage forms, injections were predominant (324 drugs), followed by tablets (130 drugs) and capsules (36 drugs). Notably, culture sensitivity was performed in only 4 out of 325 prescriptions.

The study population was primarily composed of patients above the age of 50 years (56.92%), followed by those aged 20 to 50 years (39.38%), with only a small percentage below 20 years (3.69%). Whereas, in a study conducted by Priyadharshini et al.,[118] most of the patients were in the age group 40-60 years.In this study it was found that in terms of gender, there is a clear gender disparity, with a higher percentage of female participants (59.38%) compared to males (40.61%). Whereas, In a study conducted by Darkwah et al.,[119]Majority of the prescriptions 60.9% (n=112) were for female patients whilst 39.1% (n=72) were for male patients.

The analysis of the number of antibiotics in each prescription revealed that the majority of prescriptions contained only one antibiotic (55.38%). This suggests that, in a majority of instances, healthcare providers followed a conservative approach in antibiotic prescribing. However, a substantial proportion included two antibiotics (37.84%), and a smaller percentage included three or more antibiotics. While this approach may be warranted in severe infections or cases with known multidrug-resistant pathogens, it is essential to ensure that the selection of multiple antibiotics is guided by evidence-based practices to minimize overuse and the associated risks. The results align with a study conducted by Demoz et al.,[120] where it was found that nearly half (49%) of the patients received a single antibiotic, whereas 39% of patients were treated with combination antibiotics.

In terms of culture sensitivity testing, an alarmingly low percentage of prescriptions included culture sensitivity testing (1.23%).This indicates that a vast majority of antibiotic prescriptions are empirical, potentially leading to inappropriate antibiotic use and resistance development. The results were similar to a study conducted by Demoz et al.,[121] where Culture and sensitivity testing were not performed in any of the cases whereas In a study conducted by Ravi G et al.,[122] found that culture and sensitivity tests were done for guiding curative therapy in 34.71% cases.

In this study Ciprofloxacin (20.4 %) emerges as the most frequently prescribed antibiotic, followed closely by Metronidazole (18.16 %) and Ceftriaxone (17.34 %). This pattern suggests a preference for broad-spectrum antibiotics, underlining the importance of promoting judicious antibiotic use to mitigate the emergence of antibiotic-resistant bacteria.In a study conducted by Kaur et al.,[123]. out of the prescriptions analyzed, Ceftriaxone and Amoxicillin-Clavulanic Acid were prescribed most commonly (19.2% and 16.9%, respectively).According to Trikha et al.,[124t]he most frequently prescribed antibiotics in decreasing order of frequency were Amoxicillin-Clavulanic acid (25%), Amoxicillin (21%), Ciprofloxacin (17%), Cefixime (10%), and Ceftriaxone (7%).

Cephalosporins (27.76%), followed by Fluoroquinolones (21.84%) were the predominant drug classes. It is similar to study conducted by Mugada et al.,[125] where the most frequently prescribed antibiotic class was Cephalosporins (81.5%). This indicates that a significant proportion of antibiotics prescribed were broad-spectrum. Injection formulations were the most commonly prescribed (66.12%), suggesting the initial preference for intravenous therapy which was lesser than a study published by Atif et al.,[126] which was found to be (98%). The results are also similar to a study conducted by Alekaw et al., [127]which found that the parenteral route accounted for the administration of most (85.3%) of the prescribed drugs.

The majority of patients (83.26%) received therapy for 3 to 5 days, with a smaller percentage (10%) having therapy lasting less than 3 days, and a minority (6.73%) requiring therapy for more than 5 days.A significant proportion of patients presented with comorbidities (26.46%), and among them, over a third (37.20%) received prescriptions with potential drug-drug interactions. This highlights the importance of considering comorbidities and potential interactions when prescribing antibiotics, as they can impact treatment efficacy and patient safety.Among prescriptions for patients with comorbidities, 37.20% contained potential drug-drug interactions. This finding emphasizes the importance of vigilance when prescribing antibiotics, especially in conjunction with medications commonly used by patients with comorbidities.The majority of potential drug-drug interactions (DDIs) in the study were categorized as major (50%), followed by moderate (47.7%), with minor interactions being rare (2.27%).The majority of drugs (62.44%) in the analyzed dataset fall under the "Watch" category, indicating a need for prudent use and monitoring, and 37.55% fall under "Access," suggesting availability for essential healthcare needs.The absence of antibiotics in the "Reserve" category is reassuring, as this category is reserved for critically important antibiotics. Similar results were also found in studies conducted by Mandal et al., [128] in Eastern India and Meena et al.,[119] in South Indian Union Territory. The results also align with results obtained from a study conducted at Ghana by Darkwah et al.,[120]The spectrum of activity analysis demonstrates that all antibiotics prescribed in this study belong to the "Broad" spectrum category. While broad-spectrum antibiotics are indispensable for treating a wide array of infections, their overuse can expedite the emergence of antibiotic-resistant strains. This aligns with results obtained by Chem ED et al.,[129] at North West Cameroon where majority of the drugs were broad spectrum. The most common indication for antibiotic prescription in our study was Acute Gastro Enteritis followed by which was contrary to findings reported by Khan et al.,[130] Ravi G et al.,[122] and Gandra et al.,[131] where the common indication for antibiotic was prescribed were for respiratory Tract Infection followed by GIT Infections.

Figures:

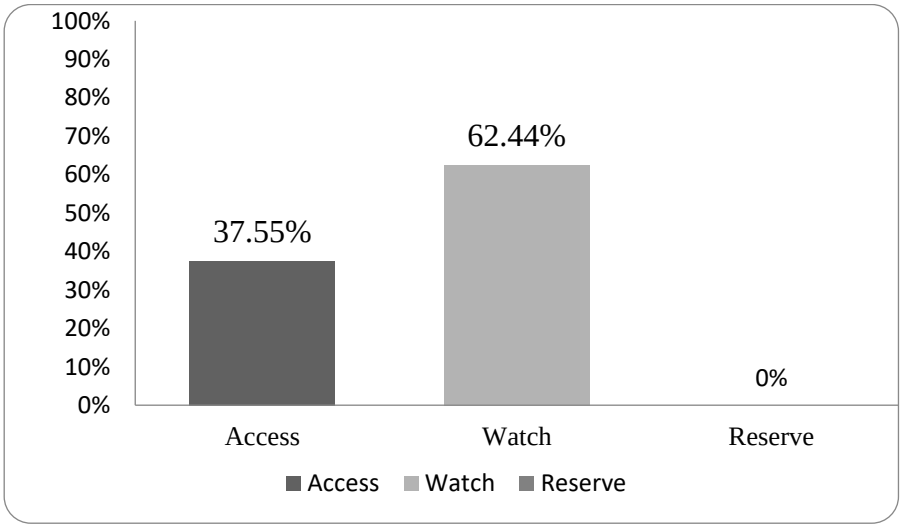

Figure 1. Percentage of drugs in AWaRe Category

Tables:

Class of the drug	**Frequency (n_1 = 490)**	**Percentage (%)**
Cephalosporins	136	27.75 %
Fluoroquinolones	107	21.83 %
Nitroimidazoles	90	18.36 %
Macrolides	47	9.59 %
Beta lactam / Beta lactamase inhibitors	45	9.18 %
Penicillin derivatives	28	5.71%
Tetracyclines	26	5.30 %
Aminoglycosides	5	1.02 %
Sulphonamides	3	0.61 %
Carbapenems	2	0.40 %
Oxazolidinones	1	0.20 %

Table 1. Distribution of Antibiotics among the prescriptions

S. No	Spectrum of Activity	Number of Drugs (n_1 = 490)
1.	Broad	490
2.	Narrow	0

Table 2. Distribution of spectrum of activity of antibiotics among the prescription

S. No	Potential Drug – Drug interactions	Frequency (n_2=44)	Severity
1.	Metformin + Ciprofloxacin	10	Major
2.	Atorvastatin + Azithromycin	8	Moderate
3.	Amlodipine + Ciprofloxacin	8	Moderate
4.	Glimipride + Ciprofloxacin	5	Major
5.	Insulin + Ciprofloxacin	4	Major
6.	Glimipride + Norfloxacin	2	Major
7.	Metformin + Norfloxacin	1	Major
8.	Theophylline + Azithromycin	1	Moderate
9.	Iron sucrose + Norfloxacin	1	Moderate

10.	Phenytoin + Metronidazole	1	Moderate
11.	Carbamazepine + Ciprofloxacin	1	Moderate
12.	Deriphylline + Azithromycin	1	Moderate
13.	Metoprolol + Ciprofloxacin	1	Minor

Table 3: Presence of Potential Drug – Drug interactions between antibiotics and other drugs in the prescriptions

Conclusion:

Our analysis of antibiotic prescription patterns revealed a concerning trend of multiple antibiotics being prescribed, emphasizing the need for evidence-based practices to minimize the risks associated with overuse, including the development of antibiotic resistance. Alarmingly, culture sensitivity testing was rarely performed, posing a risk of inappropriate antibiotic use and resistance. Commonly prescribed broad-spectrum antibiotics, like Ciprofloxacin and Ceftriaxone, emphasize the urgency of promoting judicious antibiotic use. The prevalence of comorbidities among patients and the occurrence of potential drug-drug interactions in antibiotic prescriptions underscore the importance of individualized care. Prescribers must take into account patients' unique profiles when selecting antibiotics to improve both treatment efficacy and safety. The predominance of antibiotics falling under the "Watch" category and the absence of antibiotics in the "Reserve" category in our study is reassuring, but ongoing vigilance is crucial to ensure that antibiotics remain effective and available for essential healthcare needs.In summary, our research emphasizes the urgent need for implementing antimicrobial stewardship programs in tertiary care hospitals. These programs should focus on improving prescription practices, enhancing laboratory support for culture sensitivity testing, promoting the use of narrower-spectrum antibiotics when appropriate.

Acknowledgment:

We acknowledge the invaluable contributions that have supported the completion of this manuscript. Our gratitude extends to the department for its unwavering support, fostering a conducive research environment. Additionally, special thanks go to those who provided technical assistance, enhancing the precision of the research. The general support, resources, and technical guidance received played a pivotal role in the successful execution of this study.

REFERENCES:

1. Ventola, C. L. (2015). The antibiotic resistance crisis. *Pharm Ther*, 40, 277-283.

2. Prestinaci, F., Pezzotti, P., & Pantosti, A. (2015). Antimicrobial resistance: A global multifaceted phenomenon. *Pathog Glob Health*, 109, 309-318. https://doi.org/10.1179/2047773215Y.0000000030.

3. World Health Organization. (2018). Antimicrobial resistance and primary health care. Geneva: World Health Organization. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/326454/WHO-HIS-SDS-2018.56-eng.pdf

4. Center for Disease Dynamics, Economics and Policy, Global Antibiotic Resistance Partnership. (2015). The state of the world's antibiotics 2015. Washington, DC: Center for Disease Dynamics, Economics and Policy. Retrieved from https://www.cddep.org/wp-content/uploads/2017/06/swa_executive_summary_edits_2016.pdf

5. Auta, A., Hadi, M. A., Oga, E., Adewuyi, E. O., Abdu-Aguye, S. N., Adeloye, D., et al. (2019). Global access to antibiotics without prescription in community pharmacies: A systematic review and meta-analysis. *J Infect*, 78(1), 8–18. https://doi.org/10.1016/j.jinf.2018.07.001

6. Laxminarayan, R., & Chaudhury, R. R. (2016). Antibiotic Resistance in India: Drivers and Opportunities for Action. *PLOS Medicine*, 13(3), 1-7. https://doi.org/ 10.1371/journal.pmed.1001974.

7. Uchil, R. R., Kohli, G. S., Katekhaye, V. M., & Swami, O. C. (2014). Strategies to combat antimicrobial resistance. *Journal of Clinical and Diagnostic Research for doctors*, 8(7), 1-4. https://doi.org/ 10.7860/JCDR/2014/8925.4529.

8. Bell, B. G., Schellevis, F., Stobberingh, E., Goossens, H., & Pringle, M. (2014). A systematic review and meta analysis of the effects of antibiotic consumption on antibiotic resistance. *BMC Infect Dis*, 14, 13. https://doi.org/10.1186/1471-2334-14-13.

9. Laxminarayan, R., Matsoso, P., Pant, S., Brower, C., Rottingen, J. A., Klugman, K., et al. (2016). Access to effective antimicrobials: a worldwide challenge. *Lancet*, 387, 168-175.https://doi.org/ 10.1016/S0140-6736(15)00474-2.

10. Bhatia, R., & Narain, J. P. (2010). The growing challenge of antimicrobial resistance in the South-East Asia region – Are we losing the battle? *Indian J Med Res*, 132, 482-486. https://doi.org/ 10.4103/0971-5916.73313.

11. Centers for Disease Control and Prevention. (2013). Antibiotics Resistance Threats in the United States. Retrieved from http://www.cdc.gov/drugresistance/threat-report-2013.

12. Center for Disease Dynamics, Economics & Policy. (2019). Antibiotic Resistance. Resistance Map CDDEP. Retrieved from https://resistancemap.cddep.org/CountryPage.php?countryId=17&country=India.

13. Bisht, R., Katiyar, A., Singh, R., & Mittal, P. (2009). Antibiotic resistance—a global issue of concern. *Asian J Pharm Clin Res*, 2(2), 34–39.

14. Abdul Ghafur, K. (2010). An obituary--on the death of antibiotics*! J Assoc Physicians India*, 58, 143–144.

15. Skoog, G., Struwe, J., Cars, O., Hanberger, H., Odenholt, I., Prag, M., et al. (2016). Repeated nationwide point-prevalence surveys of antimicrobial use in Swedish hospitals: data for actions 2003-2010. *Eurosurveillance,* 21, 13-21. http://dx.doi.org/10.2807/1560-7917.ES.2016.21.25.30264

16. Priyadharsini, R. P., Ramasamy, K., & Amarendar, S. (2022). Antibiotic prescribing pattern in the outpatient departments using the WHO prescribing indication and AWaRe assessment tool in a tertiary-care hospital in South India. *Journal of Family Medicine and Primary Care,* 11(1), 74-78. https://doi.org/ 10.4103/jfmpc.jfmpc_527_21.

17. Darkwah, T. O., Afriyie, D. K., Sneddon, J., et al. (2021). Assessment of prescribing pattern of antibiotic using National Treatment Guidelines and World Health Organization prescribing indication at Ghana police Hospital: A pilot study. *The Pan African Medical Journal*, 39(222), 1-10. https:..doi.org/ 10.11604/pamj.2021.39.222.2956.

18. Demoz, G. T., Kasahun, G. G., Hagazy, K., et al. (2020). Prescribing Pattern of Antibiotics Using WHO Prescribing Indicators Among Inpatients in Ethiopia: A Need for Antibiotic Stewardship Program. *Infection and Drug Resistance,* 13, 2783-2794.

19. Ravi, G., Chikara, G., Bandyopadhyay, A., & Handu, S. (2021). A prospective study to evaluate antimicrobial prescribing pattern among admitted patients in hilly Himalayan region of northern India. *Journal of Family Medicine and Primary Care,* 10(4), 1607-1613. https://doi.org/ 10.2147/IDR.S262104.

20. Kaur, A., Bhagat, R., Kaur, N., et al. (2018). A study of antibiotic prescription pattern in patients referred to tertiary care center in Northern India. *Therapeutic Advances in Infectious Disease*, 5(4), 63-68. https:doi.org/ 10.1177/2049936118773216.

21. Trikha, S., Dalpath, S. K., Sharma, M., & Shafiq, N. (2020). Antibiotic prescribing patterns and knowledge of antibiotic resistance amongst the doctors working at public health facilities of a state in northern India: A cross sectional study. *Journal of Family Medicine and Primary Care,* 9(8), 3937-3943. https://doi.org/ 10.4103/jfmpc.jfmpc_367_20.

22. Mugada, V., Mahato, V., Andhavaram, D., & Vajhala, S. M. (2021). Evaluation of Prescribing Patterns of Antibiotics Using Selected Indicators for Antimicrobial Use in Hospitals and the Access, Watch, Reserve (AWaRe) Classification by the World Health Organization. *Turkish Journal of Pharmaceutical Sciences*, 18(3), 282-288. https://doi.org/ 10.4274/tjps.galenos.2020.11456.

23. Atif, M., Azeem, M., Saqib, A., & Scahill, S. (2017). Investigation of antimicrobial use at a tertiary care hospital in Southern Punjab, Pakistan using WHO methodology. *Antimicrobial Resistance & Infection Control*, 6(1). https://doi.org/ 10.1186/s13756-017-0199-7.

24. Alekaw, H., Derebe, D., Melese, W. M., & Yismaw, M. B. (2022). Antibiotic Prescription Pattern, Appropriateness, and Associated Factors in Patients Admitted to Pediatric Wards of Tibebe Ghion Specialized Hospital, Bahir Dar,North West Ethiopia. *Infection and Drug Resistance*, 15, 6659-6669. https://doi.org/ 10.2147/IDR.S380897.

25. Mandal, P., Asad, M., Kayal, A., & Biswas, M. (2023). Assessment of use of World Health Organization access, watch, reserve antibiotics and core prescribing indicators in pediatric outpatients in a tertiary care teaching hospital in Eastern India. *Perspectives in Clinical Research*, 14(2), 61-67. https://doi.org/ 10.4103/picr.picr_22_22.

26. Meena, D. K., & Jayanthi, M. (2021). Monitoring Antibiotic use in public health Facilities of South India union Territory: A step to promote Rational Use of Antibiotics. *Cureus*, 10, 1-8. https://doi.org/ 10.7759/cureus.18431.

27. Chem, E. D., Anong, D. N., & Akoachere, J. K. T. (2018). 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*, 13(3), e0193353. https://doi.org/ 10.1371/journal.pone.0193353.

28. Khan, F. A., Singh, V. K., Sharma, S., & Singh, P. (2013). A prospective study on the antimicrobial usage in the medicine department of a tertiary care teaching hospital. *Journal of*

Clinical and Diagnostic Research, 7, 1343–1346. https://doi.org/ 10.7860/JCDR/2013/6265.3125.

29. Gandra, S., Singh, S. K., Jinka, D. R., Kanithi, R., Chikkappa, A. K., & Sharma, et al. (2017). Point prevalence surveys of antimicrobial use among hospitalized children in six hospitals in India in 2016. *Antibiotics*, 6, 19. https://doi.org/ 10.3390/antibiotics6030019.