Bulletin of Pharmaceutical Research 2025;15(3):201
An Official Publication of Association of Pharmacy Professionals
ISSN: 2249-6041 (Print); ISSN: 2249-9245 (Online)
DOI: 10.21276/bpr.2025.15.3.1

RESEARCH PAPER

ASSESSMENT OF PRESCRIBING PRACTICES IN GENERAL SURGERY WARDS OF A TERTIARY CARE HOSPITAL USING WHO/INRUD PRESCRIBING INDICATORS

Bavneet Kaur[1], Sharon Elizabeth[1], Joshua Varghese[1], Cyriac Tom[1], B J Sharath Chandra[2], Rashmi Mahale[3], Vaishali Sinha[4], Madhan Ramesh[1]*, Sri Harsha Chalasani[1] and Jehath Syed[1]

[1]Department of Pharmacy Practice, JSS College of Pharmacy, JSS Academy of Higher Education and Research, Mysuru-570015, Karnataka, India
[2]Department of General Medicine; [3]Department of Microbiology, JSS Medical College and Hospital, JSS Academy of Higher Education & Research, Mysuru-570015, Karnataka, India
[4]Department of Biological Sciences, National Institute of Pharmaceutical Education and Research, Hyderabad-500037, Telangana, India

**E-mail*: mramesh@jssuni.edu.in
Tel.: +91 9901218640.

Received: Jan 21, 2025 / Revised: Oct 25, 2025 / Accepted: Oct 27, 2025

The main objective of present study was to assess rational drug prescribing practices in the surgical wards of a tertiary care hospital. A prospective observational study was conducted in general surgery ward of a tertiary care hospital over a six-month period. Patients of any gender, aged ≥ 18 years and a hospital stay exceeding 24 hours were included. Patients and prescriptions details were collected from patients' case notes and treatment charts. The drug prescribing performance was measured using World Health Organization/International Network of Rational Use of Drugs core prescribing indicators. The average number of drugs per encounter was 9.26. Only 14.22% of drugs were prescribed by generic name. The percentage of patient encounters with antibiotics and injections was 99.53% and 85.14% respectively, and drugs from the NEML accounted for 63.5%. The study revealed substantial deviations from WHO guidelines with high rates of polypharmacy, low generic prescribing, and excessive antibiotic use.

Key words: Rational drug use, Antimicrobial resistance, Stewardship, WHO prescribing indicators.

INTRODUCTION

The appropriate use of medicines is a cornerstone of effective healthcare delivery, yet irrational prescribing practices remain a pervasive challenge globally. According to the World Health Organization (WHO), it is estimated that over half of all medicines are prescribed, dispensed or sold inappropriately. The overall irrational use of medications results in wastage of scarce resources and health hazards [1]. Irrational medicines use includes polypharmacy, inappropriate antimicrobial use, overuse of injectable, failure to prescribe in accordance with clinical guidelines, in-appropriate self-medication, and non-adherence to dosing regimens [2]. The impact of this can vary widely from risks of adverse drug reactions (ADRs), drug dependence to certain medications, sub-therapeutic dosing leading to treatment failure, increased morbidity and mortality, and antimicrobial resistance (AMR) [3,4]

AMR occurs when bacteria, viruses, fungi and parasites no longer respond to antimicrobial medicines. It is a natural process that occurs over time through genetic changes in pathogens; however, its emergence and spread has been

accelerated by the misuse and overuse of antimicrobial agents [5]. In order to limit irrational antimicrobial use, the extent to which it is occurring, must be quantified. In 1993, the WHO in collaboration with the International Network of Rational Use of Drugs (INRUD) developed core indicators to measure irrational medicine use in healthcare facilities [6]. Measured values can serve as benchmarks among health care facilities and as a baseline for continuous monitoring of rational drug prescribing.

Antimicrobial use is one of the highest in surgical wards attributed to surgical antibiotic prophylaxis (SAP), extended hospital stays increasing risk of developing hospital-acquired infections (HAIs) requiring antimicrobial therapy, and post-operative complications like surgical site infections (SSIs), urinary tract infections (UTIs) & respiratory infections [7-9].

The objective of the current study was to assess rational drug prescribing practices in surgical wards of a tertiary care hospital. This would be used to identify whether the defined norms of practice are within the guidelines and to obtain baseline information for continuous monitoring.

MATERIALS & METHODS

Setting and study population

This was a prospective observational study carried out in general surgery wards in a tertiary care hospital over a period of six months. Patients of any gender admitted to surgery ward, a hospital stay of more than 24 hours, and aged ≥ 18 years were included in the study after obtaining their written informed consent. Terminally ill patients, medico-legal cases, patients transferred to another department, and patients discharged against medical advice were excluded.

Data collection

An approval was obtained from Institutional Ethics Committee, JSS Medical College, Mysuru (JSSMC/IEC/260822/21NCT/2022-23) prior to commencement of the study, and confidentiality of the data was maintained. All relevant details including patients' demographics, clinical and lab data and prescriptions medications were collected from medical records of the patients admitted to surgery ward. All the collected data were further scrutinized and documented in a suitably developed data sheet and transcribed to Excel format while ensuring no transcribing errors. All medications used to treat the patients were recorded with complete regimen details such as dose, frequency, route, and duration of therapy, as well as specific indications.

A standard prescribing indicators form was used to collect required variables. The following WHO/INRUD prescribing indicators were used in this study and were calculated using standard methods [6]:

- Average number of drugs prescribed per encounter. Optimal level: ≤ 3
- Percentage of drugs prescribed by generic name. Optimal level: 100%.
- Percentage of patient encounters with an antibiotic prescribed. Optimal level: ≤ 30%
- Percentage of patient encounters with an injection prescribed. Optimal level: ≤ 10%
- Percentage of drugs prescribed from the national EDL/NEML. Optimal level: 100%

Data analysis

The rational drug prescribing was assessed for each of the WHO/INRUD core prescribing indicators. Average number of drugs per encounter calculated by dividing total number of different drug products prescribed, by the number of encounters surveyed. It is not relevant whether the patient actually received the drugs.

The percentage of drugs prescribed by generic name calculated by dividing the number of drugs prescribed by generic name by the total number of drugs prescribed, multiplied by 100. The percentage of encounters with an antibiotic prescribed and the percentage of encounters with an injection prescribed were calculated by dividing the number of patient encounters during which antibiotic prescribed and an injection are prescribed by the total number of encounters surveyed, multiplied by 100 respectively. The percentage of drugs prescribed from essential drugs list or formulary was calculated by dividing the number of products prescribed which are listed on the essential drugs list by the total number of products prescribed, multiplied by 100. For index of non-polypharmacy, index of rational antibiotic use and index of safe injection use, the following formula was used:

Index = Optimal value / Observed value

For index of generic name, index of EDL, the following formula was used:

Index = Observed value / Optimal value

The optimal index for all indicators was set as 1. The values closer to 1 indicated rational drug use. Observed value is the calculated value of each of the indicators. For optimal values in a range, average of upper limit and lower limit was considered.

RESULTS

Demographic characteristics

Of the 554 patients admitted to the study site, 249 (44.95%) were found to be eligible and enrolled into the study. Of the 249 patients, majority [n=141 (56.62%)] of them were male (**Figure 1**). The mean age and length of hospital stay was 47.54.2±17.39 years and 7.15±3.65 days respectively. At least 33% of the patients presented with more than three comorbid conditions. The demographic details of the study population are presented in **Table 1**.

Prescribing indicators

The most frequently prescribed antibiotic was Metronidazole [n=74 (20.05%)] followed by Cefoperazone + Sulbactam [n=45 (12.19%)] (**Table 2**). Of the total number of drugs (n=2011) prescribed, only 286 (14.22%) drugs were prescribed by generic name (calculated optimal index 0.14). The mean number of drugs per encounter was 9.26 ± 3.72, or approximately 9 drugs. The percentage of encounters with injection was 85.14% (optimal value 13.4%-24.1%), and the percentage of drugs prescribed from the national essential medication list (NEML) was 63.5% (optimal value 100%) or calculated optimal index was 0.63 (optimal value 1). The calculated extent of non-polypharmacy prescriptions was 0.18. Of the 554 patients admitted to the surgery ward, the percentage of encounters with antimicrobial prescription was 99.53% (optimal value 20.0%-26.8%) or calculated optimal index was 0.14. The calculated and optimal indexes are shown in **Table 3**.

DISCUSSION

Antimicrobial resistance (AMR) has become a major public threat, with the rates of resistance developing faster than newer drugs can be added to the medical repertoire. This rapid emergence of resistance can be attributed to

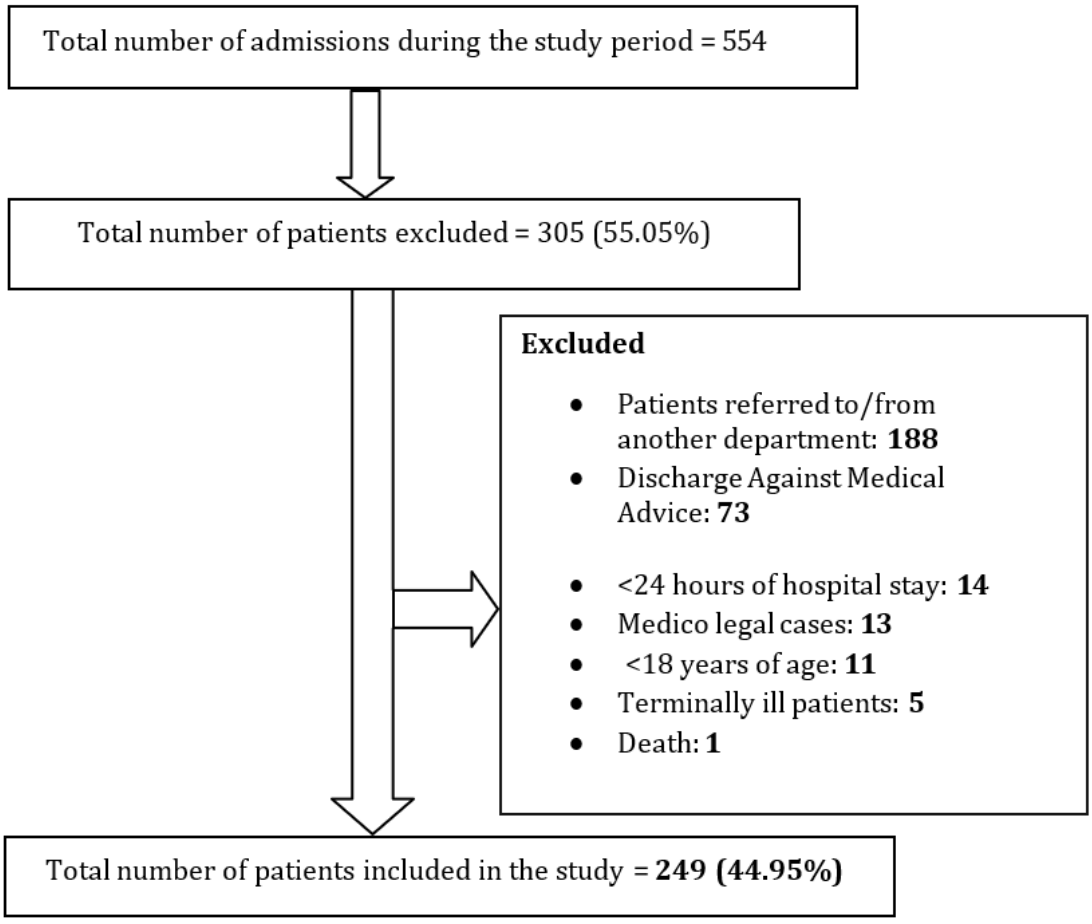

Fig. 1. Flow of chart depicting patient enrollment

Table 1. Demographic characteristics of study population

Characteristics		Number of Patients (%) (n = 249)
Gender	Male	141 (56.63)
	Female	108 (43.37)
Age (in years)	18-20	12 (4.82)
	21-30	41 (16.47)
	31-40	36 (14.46)
	41-50	48 (19.28)
	51-60	54 (21.69)
	61-70	34 (13.65)
	71-80	17 (6.83)
	>80	7 (2.81)
Length of hospital stay (in days)	1-5	83 (33.33)
	6-10	137 (55.02)
	>10	29 (11.64)
Number of comorbidities	1-3	4 (1.60)
	>3	73 (29.31)
	Nil	172 (69.07)
Social history	Smoker	47 (18.87)
	Non-smoker	202 (81.12)
	Alcoholic	56 (22.49)
	Non-alcoholic	193 (77.51)

Table 2. Details of individual antibiotics

Antibiotics	Number (%) (n=369)
Metronidazole	74 (20.05)
Cefoperazone + sulbactum	45 (12.20)
Ceftriaxone + sulbactum	39 (10.57)
Ceftazidime + tazobactum	38 (10.30)
Cefuroxime	37 (10.03)
Amoxicillin clavulanate	23 (6.23)
Cefuroxime + sulbactum	18 (4.88)
Piperacillin + tazobactum	18 (4.88)
Linezolid	14 (3.79)
Ciprofloxacin	11 (2.98)
Ceftriaxone	10 (2.71)
Ciprofloxacin + tinidazole	9 (2.44)
Ciprofloxacin + tazobactum	5 (1.36)
Amikacin	4 (1.08)
Cefpodoxime proxetil	3 (0.81)
Meropenem	3 (0.81)
Ofloxacin	3 (0.81)
Cefotaxime	2 (0.54)
Cefpodoxime + ofloxacin	2 (0.54)
Doxycycline	2 (0.54)
Fusidic acid	2 (0.54)
Amoxicillin	1 (0.27)
Azithromycin	1 (0.27)
Cefexime	1 (0.27)
Cefexime + ofloxacin	1 (0.27)
Cefepime	1 (0.27)
Ceftazidime	1 (0.27)
Polymixin B	1 (0.27)

Table 3. WHO/INRUD prescribing indicators

Prescribing Indicator	Calculated value	WHO optimal	Mean optimal value	Optimal index
Average number of drugs per encounter	9.267 ± 3.724	1.6-1.8	1.7	0.1834
Percentage of drugs prescribed by generic name	14.221	100	100	0.1422
Percentage of encounters with an antibiotic prescribed	99.539	20-26.8	23.4	0.2350
Percentage of encounters with an injection prescribed	85.140	13.4-24.1	18.8	0.2208
Percentage of drugs from NEML	63.5007	100	100	0.6350

selective pressure from unrestrained use, non-adherence to dosing regimens and irrational prescribing practices. According to the 2014 WHO global surveillance report on antimicrobial resistance, there is a significant lack of data from low- and middle-income countries, making it difficult to properly assess their economic and health burden [10]. Additionally, it highlighted the importance of a comprehensive global surveillance system that can slow down the rapid emergence of AMR. Studying prescribing patterns of antibiotics can be an effective surveillance strategy, since it can help track irrational antibiotic use and devise intervention schemes to combat it.

In the present study, we investigated the antibiotic prescription pattern in 249 patients in the general surgery wards of a tertiary care hospital and found that 99.54% were prescribed at least one antibiotic. This is much higher than the WHO-recommended limit of 30%. This limit was set in accordance with the fact that countries like India have a higher incidence of infectious diseases. However, studies show that the actual trend is consistently higher than 30% across various geographical and healthcare settings, pointing towards a serious concern [11-13]. In our study, this could additionally be attributed to the general practice of higher antibiotic prescription in surgical wards for prophylaxis and surgical site infection prevention [14]. Even so, prescribing antibiotics in surgery wards is often done without any obvious sign of infection, and without culture and sensitivity tests [15,16]. In this study, 64.97% of antibiotics were prescribed for prophylaxis, while the remainder were for various infections such as skin (29.03%) and gastrointestinal infections (29.03%). Only 19 cases were given definitive therapy after testing, with the rest being empirical. These results are in line with a prospective observational study done in two hospitals in Central India that reported an increase in the use of Watch antibiotics in both hospitals over ten years [16]. It is worth mentioning here that antimicrobial stewardship programs worldwide recommend empirical antibiotics use at first, especially in regions where the risk of infection is high with an adjustment in dose based on cultures and even discontinuation when there is no evidence of an infection [17]. The antibiotic regimens must nonetheless be adjusted based on local epidemiology and antibiograms.

The percentage of prescriptions with injectable was found to be 85.14%, which exceeds the standard values of 13.4-24.1%. A study assessing antibiotic prescribing practices in the general medicine ward of a tertiary care hospital found a much higher value (96%) [18] while few other studies reported lower rates of injectable per encounter [12,19,20]. The higher rate of injectable is commonly seen in surgery wards due to factors such as reduced abdominal absorption, inability of patients to swallow drugs or patient unconsciousness. Oftentimes, antibiotics need to be administered during surgery to prevent surgical site infections (SSIs).

The degree of polypharmacy was found to be quite high, with an average of 9.27 drugs per encounter. The optimum value for this number is ≤ 3. This finding is similar to studies conducted earlier with 8.2 drugs per prescription and 6.54 drugs per encounter respectively [18,21]. Several studies have also reported a low rate of polypharmacy [22,23]. However, in this study, about 33% of the patients presented with more than three comorbid conditions, explaining the high number of drugs per encounter. Nevertheless, a high degree of polypharmacy is alarming since it significantly increases the chances of adverse drug events, drug-drug

interactions, healthcare costs and impairs quality of life. Furthermore, polypharmacy greatly increases the chances of developing antimicrobial resistance. Therefore, suitable guidelines/policy must be put in place to reduce use of polypharmacy and antimicrobial resistance.

In this study, only 14.22% of the drugs were prescribed by their generic name that is much lower than the WHO prescribed optimum level of 100%. In contrast to this finding, other studies have reported a higher degree of generic prescriptions (62.3% and 73.4% respectively) [24,25]. The percentage of drugs prescribed by generic names varies greatly based on the healthcare setting, patient demographics and economical status as well as physician training and awareness.[26] A study conducted even reported a rate as low as 0.05% [19]. A low rate of generic prescribing can be attributed, in part, to increased marketing by pharmaceutical companies and a general distrust in the quality of generic drugs in India [12,18,27]. Moreover, generic prescribing is difficult in case of combination medicines and nutraceuticals.

The percentage of drugs prescribed from the NEML was found to be 63.5% that is promising but lower than the WHO recommended value of 100%. Several studies report a higher rate ranging from 72-99% [18,19,28] while another study report a much lower range of 20-40% [26]. However, a study conducted earlier reported a value of 62% which is similar to the finding of the present study [29]. Prescribing drugs from the NEML is recommended since it promotes rational drug use, affordable healthcare and aids in promoting standard care protocols. Interestingly, in India, the capping of drug prices aimed at making essential medicines more affordable has driven pharmaceutical companies to spend less money on marketing them since the profit margins are low. This has led to a shift in prescription practices towards unregulated ones with same indications especially among non-formally trained medical practitioners in rural areas [30].

In summary, the present study highlights significant deviations from WHO guidelines with a high degree of polypharmacy and a low level of generic prescribing. Although the findings also indicate a very high degree of antibiotic and injectable prescribing practice, it is not uncommon in surgery wards. Nonetheless, such practices lead to a higher risk of antimicrobial resistance and thus point towards the need for robust antimicrobial stewardship programs. The WHO indicators have inherent limitations such as, a lack of sensitivity to specific healthcare challenges faced by different regions and no focus on the qualitative aspects of prescribing. However, this data provides a basis for comparison between different healthcare settings and allows medical practitioners and health planners to devise and implement appropriate intervention strategies.

CONCLUSION

Antimicrobial stewardship programs play a vital role in rational prescription of antimicrobial agents to ultimately improve patient care and combat antimicrobial resistance. Multiple antimicrobial metrics should be utilized to appropriately evaluate a stewardship program as most antimicrobials are administered at a higher or adjusted dose that is often dissimilar from World Health Organization Defined Daily Dose (DDD) recommendations. Hospitals should decide on their main goals with respect to antimicrobial use and select more than one method to achieve the set goals.

ACKNOWLEDGEMENTS

We extend our sincere thanks to all the medical and non-medical staff of the General Surgery Wards of JSS Hospital, Mysuru for their co-operation and support in collecting the data.

REFERENCES

1. Antimicrobial resistance. Who.int. Available from: https://www.who.int/health-topics/antimicrobial-resistance
2. Laxminarayan R, Chaudhury RR. Antibiotic resistance in India: Drivers and opportunities for action. *PLoS Med*. 2016;13(3):e1001974. doi:10.1371/journal.pmed.1001974
3. Baubie K, Shaughnessy C, Kostiuk L, Joseph MV, Safdar N, Singh SK, et al. Evaluating antibiotic stewardship in a tertiary care hospital in Kerala, India: A qualitative interview study. *BMJ Open*. 2019;9(5):e026193. doi:10.1136/bmjopen-2018-026193
4. de With K, Bergner J, Bühner R, Dörje F, Gonnermann C, Haber M, et al. Antibiotic use in German university hospitals 1998–2000 (Project INTERUNI-II). *Int J Antimicrob Agents*. 2004;24(3):213-8. doi:10.1016/j.ijantimicag.2004.03.015
5. Vijay S, Ramasubramanian V, Bansal N, Ohri VC, Walia K. Hospital-based antimicrobial stewardship, India. *Bull World Health Organ*. 2023;101(1):20-27A. doi:10.2471/blt.22.288797
6. World Health Organization. How to investigate drug use in health facilities: Selected drug use indicators. Geneva: World Health Organization; 1993.

7. Kaye KS, Pogue JM. Antimicrobial stewardship in surgery: A review of the role of antibiotic prophylaxis and the risk of resistance. *Surg Infect*. 2017;18(6):696-707.
8. Saiman L, Gerding DN. Antimicrobial prophylaxis for the prevention of surgical site infections. *Infect Dis Clin North Am*. 2006;20(4):747-66.
9. Rolfe R Jr, Kwobah C, Muro F, Ruwanpathirana A, Lyamuya F, Bodinayake C, et al. Barriers to implementing antimicrobial stewardship programs in three low- and middle-income country tertiary care settings: findings from a multi-site qualitative study. *Antimicrob Resist Infect Control*. 2021;10(1):60. doi:10.1186/s13756-021-00929-4
10. World Health Organization. Antimicrobial resistance: global report on surveillance. Geneva: World Health Organization; 2014.
11. Hazra A, Tripathi SK, Alam MS. Prescribing and dispensing activities at the health facilities of a non-governmental organization. *Natl Med J India*. 2000; 13(4):177-82.
12. Chakraborty D, Debnath F, Kanungo S, Chakraborty N, Basu R, Das P, et al. Pattern of prescription practices in Acute Respiratory Infection and diarrhoea cases in outpatient department of tertiary care hospitals in West Bengal, India; A cross-sectional analysis through Rational Use of Medicine Consensus approach. *Res Square*. 2021;1-23. doi:10.21203/rs.3.rs-799005/v1
13. Lalan BK, Hiray RS, Ghongane BB. Drug prescription pattern of outpatients in a tertiary care teaching hospital in Maharashtra. *Int J Pharm Bio Sci*. 2012;3(3): 225-9.
14. Charani E, de Barra E, Rawson TM, Gill D, Gilchrist M, Naylor NR, et al. Antibiotic prescribing in general medical and surgical specialties: A prospective cohort study. *Antimicrob Resist Infect Control*. 2019;8(1):151. doi:10.1186/s13756-019-0603-6
15. Cusini A, Rampini SK, Bansal V, Ledergerber B, Kuster SP, Ruef C, et al. Different patterns of inappropriate antimicrobial use in surgical and medical units at a tertiary care hospital in Switzerland: A prevalence survey. *PLoS One*. 2010;5(11):e14011. doi:10.1371/journal.pone.0014011
16. Skender K, Machowska A, Dhakaita SK, Lundborg CS, Sharma M. Ten-year trends of antibiotic prescribing in surgery departments of two private sector hospitals in Central India: A prospective observational study. *BMC Public Health*. 2024;24(1):310. doi:10.1186/s12889-024-17817-2
17. Kourbeti I, Kamiliou A, Samarkos M. Antibiotic stewardship in surgical departments. *Antibiotics (Basel)*. 2024;13(4):329. doi:10.3390/antibiotics13040329
18. Vineel S, Sathish Y, Yogananda. Assessment of antibiotics prescription pattern by using WHO prescribing indicators in general medicine ward of a tertiary care hospital. *Int J Curr Pharm Res*. 2024;16(1): 21-5. doi:10.22159/ijcpr.2024v16i1.4001
19. Chandelkar U, Rataboli P. A study of drug prescribing pattern using WHO prescribing indicators in the state of Goa, India. *Int J Basic Clin Pharmacol*. 2017;3(6):1057-61. doi:10.5455/2319-2003.ijbcp20141221
20. 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(1):74-8. doi:10.4103/jfmpc.jfmpc_527_21
21. Chandika G, Shabnum S, Sudheerkumar D, Kishore P. Assessment of prescription pattern in paediatric patients using WHO indicators. *Int J Res Rev*. 2019;6(7): 48-52.
22. Mandal P, Asad M, Kayal A, Biswas M. 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. *Perspect Clin Res*. 2023;14(2):61-7. doi:10.4103/picr.picr_22_22
23. Tassew SG, Abraha HN, Gidey K, Gebre AK. Assessment of drug use pattern using WHO core drug use indicators in selected general hospitals: a cross-sectional study in Tigray region, Ethiopia. *BMJ Open*. 2021;11(10):e045805. doi:10.1136/bmjopen-2020-045805
24. Vishwanath M, Reddy SN, Devadas S. Assessment of drug utilization in hospitalized children at a tertiary care teaching hospital. *J Chem Pharm Res*. 2014;6(2): 592-8.
25. Karande S, Sankhe P, Kulkarni M. Patterns of prescription and drug dispensing. *Indian J Pediatr*. 2005;72(2):117-21. doi:10.1007/BF02760693
26. Chakraborty D, Debnath F, Kanungo S, Mukhopadhyay S, Chakraborty N, Basu R, et al. Rationality of prescriptions by rational use of medicine consensus approach in common respiratory and gastrointestinal infections: An outpatient department based cross-sectional study from India. *Trop Med Infect Dis*. 2023;8(2):88. doi:10.3390/tropicalmed8020088
27. Akhmad AD, Kristina SA, Sabiti, Endarti DWI. A systematic review of pharmaceutical situation on access, quality, and rational drug use. *Int J Pharm Res*. 2021;13(2):243-57. doi:10.31838/ijpr/2021.13.02.057
28. Aravamuthan A, Arputhavanan M, Subramaniam K, Sam Johnson Udaya Chander J. Assessment of current prescribing practices using World Health Organization core drug use and complementary indicators in selected rural community pharmacies in Southern India. *J Pharm Policy Pract*. 2017;10(1):1-6. doi:10.1186/s40545-016-0074-6
29. Gujar AG. Evaluation of rational drug use based on World Health Organization core drug use indicators at a private hospital of western India: A cross-sectional study. *J Med Pharm Allied Sci*. 2021;10(6):4045-9. doi:10.22270/jmpas.v10i6.2405
30. Jaikumar S, Chintagunta PK, Sahay A. Do no harm? Unintended consequences of pharmaceutical price regulation in India. *J Mark*. 2024;88(6):1-23. doi:10.1177/00222429241242685

*****