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ANTIBIOTIC PRESCRIBING PRACTICES AMONG HOSPITALIZED PATIENTS AT A NATIONAL ANTIMICROBIAL CONSUMPTION NETWORK SITE IN NORTH INDIA: A WHO POINT PREVALENCE SURVEY

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ABSTRACT

Background: Antimicrobial resistance (AMR) is a major global threat driven by inappropriate antibiotic use. Monitoring and analyzing antimicrobial prescribing practices and consumption patterns among hospitalized patients is essential for developing effective strategies to combat AMR.

Objective: This study aimed to evaluate antibiotic prescribing patterns among hospitalized patients at a National Antimicrobial Consumption Network (NAC-NET) site.

Methods: A cross-sectional study was conducted at GSVM Medical College, Kanpur, in February 2022, applying the standard guidelines described by the WHO Methodology for PPS on Antibiotic use among inpatients. Data on antimicrobial use, indications, routes, and WHO AWaRe classification were collected using structured forms and analyzed descriptively.

Results: Of 341 eligible inpatients, 93.3% were on at least one antibiotic, with a total of 586 antibiotics prescribed (average: 1.7 per patient). Injectable antibiotics accounted for 90.1% of use. Surgical prophylaxis (43%) and community-acquired infections (28%) were the most common indications. Only 11.9% of prescriptions included a stop/review date. Third-generation cephalosporins were the most frequently used (42%). The watch group antibiotics comprised 62.9% of prescriptions, while the Access group antibiotics were used in 31.8%—below the WHO target of ≥60%. Double coverage for Gram-negative organisms (28.3%) and double anaerobic coverage (14.1%) was frequently observed. Definitive therapy was rarely documented (0.3%).

Conclusion: The study identified a high rate of antibiotic use accompanied by inadequate adherence to stewardship principles. Findings underscore the need for institutional antibiotic guidelines, promotion of microbiological diagnostics, appropriate surgical prophylaxis, and increased use of Access group antibiotics to align with WHO recommendations.

Key Words- Point Prevalence Survey (PPS), National Antimicrobial Consumption Network (NAC-NET), Antimicrobial resistance (AMR), AWaRe

INTRODUCTION

Antimicrobial resistance (AMR) is an escalating global concern with profound risks to patient care, healthcare systems, and public health worldwide. In 2019, it was estimated that 4.95 million deaths

were associated with bacterial AMR, with 1.27 million deaths directly attributed to it .[1] Estimates suggest that AMR could lead to 10 million deaths annually by 2050, making it the leading global cause of mortality.[2] AMR naturally evolves, typically through genetic alterations in microorganisms. The primary contributors to the rise of antimicrobial resistance include the inappropriate use and overuse of antimicrobials.

Between 2000 and 2015, global per-capita antibiotic consumption increased by 39%, primarily due to increased income levels. Among low- and middle-income countries (LMICs), India saw the greatest increase in antibiotic consumption, with a 65% rise during this period, correlating strongly with per capita gross domestic product.[3] In India, the crude mortality rate from infectious diseases presently stands at 417 per 100,000 individuals, suggesting that the impact of AMR is likely to be more pronounced in the Indian setting. The emergence of resistance is not restricted to older and more frequently used drug classes; resistance to newer and more expensive drugs, such as carbapenems, has also increased rapidly.[4]

Understanding antibiotic prescribing practices and consumption patterns among hospitalized patients is critical for devising effective strategies to combat AMR. The World Health Organization (WHO) launched the ‘‘Global Action Plan on Antimicrobial Resistance (GAP-AMR)’’ in 2015.[5] The WHO’s global strategy to curb antimicrobial resistance includes surveillance of antibiotic use. The Global Antimicrobial Resistance and Use Surveillance System (GLASS) provide a standardized approach to the collection, analysis, interpretation, and sharing of data by countries, territories, and areas. It monitors the status of existing and new national surveillance systems.[6,7]

In 2016, WHO developed a global framework to monitor antimicrobial consumption, including antibiotics, and provides support to countries for establishing national surveillance programs. A limitation of these consumption data is the lack of detailed information on how antibiotics are prescribed and used at the patient level. The challenge of collecting data on antibiotic use at the patient level arises from fragmented data sources and the complexity of compiling prescribing data from various healthcare providers. Although continuous monitoring is challenging due to the substantial workload and resource demands, a practical alternative is the use of point prevalence surveys (PPS), which have been successfully implemented to assess antibiotic prescribing at specific intervals.[8]

In India, the Ministry of Health and Family Welfare launched the “National Action Plan on Antimicrobial Resistance” (NAP-AMR) in 2017 for the period 2017–2021, which emphasizes the surveillance of antimicrobial use in healthcare settings as part of its fourth strategic priority.[4]

The National Centre for Disease Control (NCDC) is the nodal agency for the National Programme on AMR Containment in India. Antibiotic usage surveillance is a key component of the national programme. The NCDC established the National Antibiotic Consumption Network (NAC-NET), which includes 35 tertiary healthcare institutions to achieve this goal. These institutions gather and report antibiotic consumption data to the NCDC.[9]

This study presents the findings of a PPS conducted at GSVM Medical College, Kanpur, a participant in the NAC-NET initiative. The primary objectives of this research were to describe the current antibiotic prescribing patterns and propose strategies for improving antibiotic stewardship, based on the findings from this investigation.

MATERIALS AND METHODS

Study design and setting

The study followed the "WHO methodology for PPS on antibiotic use in hospitals." The study was reviewed and approved by the institute's ethics committee under approval number EC/293/Dec./2021, and permission was obtained from hospital management for conducting the survey.

The PPS was performed at GSVM Medical College and Associated Hospitals. It’s a premier tertiary care institute that serves patients from all over Uttar Pradesh and the adjacent states. The institute includes a Medical College, LLR Hospital, and a Super-specialty Centre. It was included in the First phase of the National Antibiotic Consumption Network (NAC-NET) under the National Antimicrobial Resistance Containment Programme of the Government of India. The total number of

beds in the hospital is around 1779 with 857 acute beds and 124 ICU Beds. The previous year's admissions in the hospital were 45982 patients. As of now, there are no local guidelines for the prescription of antibiotics in this institute, and consultants often prescribe antibiotics as per national and international guidelines.

This cross-sectional study was conducted in February 2022, applying the standard guidelines described by the WHO Methodology for Point Prevalence Survey on Antibiotic Use in Hospitals (Version 1.1.2018).[8] A structured, predesigned and pretested survey questionnaire was adapted from the WHO-PPS design to assess the extent of antimicrobial prescribing patterns among hospitalized patients in various hospital wards.

The survey was conducted among inpatients of medicine, surgery, gynaecology and obstetrics, paediatric, and ENT wards. All patients admitted to selected wards before 8:00 AM on the day of data collection were included in the survey. Patients admitted in the selected wards after 8:00 AM or discharged before 8:00 AM and waiting for their attendants or due for discharge on the survey day were excluded. The survey did not include outpatients or day-care patients such as endoscopy and dialysis, psychiatric wards, long-term care wards, and patients admitted to emergency departments and intensive care units (ICUs).

Data collection

A set of forms was used to collect various types of data, including the hospital form, ward form, and patient form. The information was gathered using Google Forms. The hospital form filled by the survey coordinator; collects information about the type of hospital, the number of wards and beds, and bed occupancy. The ward form data were collected by Junior residents about the wards, including the dates of the survey, the number of patients admitted to the ward, the type, and the capacity of the ward. The patient forms, filled with the help of medical interns and pharmacists; gathered information on the demographic characteristics and diagnosis of the patient, site of infection, antibiotics prescribed, route, dose, duration, indication for therapy, and microbiology lab data.

The Google forms had a provision for entry of up to five antimicrobials; for cases where the number of antimicrobials exceeded five, manual data recording on paper was required. Data collection was limited to antibiotics administered via non-topical routes only. All study data was completely anonymised, and no unique identifiers were collected.

Statistical analyses

The following parameters were analyzed –

1. Number and percentage of patients on antimicrobials.
2. Number and percentage of antimicrobials used as empiric, prophylactic, and definitive therapy.
3. Number and percentage of antimicrobials used for Community-Acquired Infections (CAI), Hospital Acquired Infections (HAI), Medical Prophylaxis (MP), Surgical Prophylaxis (SP), Unknown or others.
4. Number of patients receiving double anaerobic cover (DAC) and Double cover for Gram-Negative Infections (DGNI).
5. Prevalence of antibiotic use according to WHO AWaRe (Access, Watch, Reserve) classification 2021.[10]

All data collected through Google Forms were analyzed and illustrated in figures and tables. Descriptive statistical analysis was performed using Microsoft Excel. Data were expressed as discrete parameters, namely counts or percentages. No statistical hypothesis was tested.

RESULTS

A total of 350 admitted patients were screened for the study and 341 patients were found to be eligible. The number of male and female patients was 157 and 184 respectively. The distribution of patients in adult and paediatric age groups was 272 and 69 respectively. Out of these 341 eligible patients, 318 (93.3%) were on at least one antibiotic with 66 patients receiving 3 or more antibiotics (20.8%). The

total number of antibiotics prescribed was 586, averaging 1.7 per eligible patient (range of antibiotics prescribed: 0–5) (Table 1).

The highest percentage of antibiotic use was reported in the surgery department (100%) followed by medicine (96%), obstetrics/gynaecology (95.3%), paediatrics (93.3%), and others (83.1%) (Figure 1). The injectable route (90.1%) was the most popular route of drug administration, with the maximum number in paediatrics (100%), and the minimum number in

Table 1: Distribution of patients on antibiotics (ABs)

Wards	Eligible patients	Patients on Antibiotics (ABs)				Total AB	Average antibiotics	
		1 AB	2 AB	≥ 3 AB	Total		per eligible patient	per patient on ABs
Medicine	101	54	27	16	97	167	1.6	1.7
Surgery	39	19	10	10	39	72	1.8	1.8
OB-GYN *	85	42	34	5	81	126	1.5	1.6
Paediatrics	45	32	5	5	42	62	1.4	1.5
Others**	71	8	21	30	59	159	2.2	2.7
Total	**341**	**155**	**97**	**66**	**318**	**586**	**1.7**	**1.8**

* OB-GYN: Obstetrics and Gynaecology, **Others: ENT, Orthopaedics

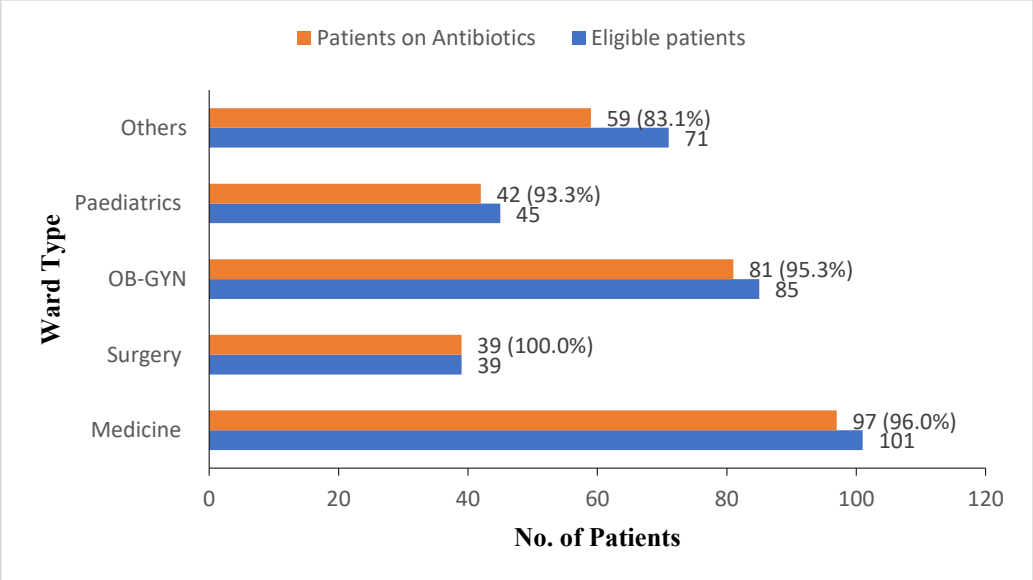

Figure 1: Prevalence of antibiotic use in different wards.

Table 2: Antibiotics prescribed by injectable route

Wards		Injectable AB n (%)
Medicine	(n=167)	140 (84.3)
Surgery	(n=72)	70 (97.2)
OB-GYN *	(n=126)	108 (85.6)
Paediatrics	(n=62)	62 (100)
Others**	(n=159)	148 (93.1)

Total	**(N=586)**	**528 (90.1)**

* OB-GYN: Obstetrics and Gynaecology, **Others: ENT, Orthopaedics

the medicine department (84.3%) (Table 2). The overall prescriptions with a stop /review date mentioned were only 11.9%, ranging from 7.1% in obstetrics/gynaecology to 19.5% in ENT/ Ortho departments (Table 3).

Overall, surgical prophylaxis (43%) was the most frequent reason for prescribing antibiotics, followed by community-acquired infections (28%), others (14%), medical prophylaxis (13%), and HAIs (2%) (Figure 2). In others (14%), the reason (e.g., CAI, HAI, prophylaxis) was not documented in the medical record. However, data from individual wards showed variation in the indications for use (Figure 3). Among patients who received surgical prophylaxis, 4 received a single dose of antibiotics, 21 were prescribed antibiotics for one day, and 113 received antibiotics for more than one day.

Third-generation cephalosporins (42%) were the most commonly prescribed antimicrobials, followed by aminoglycosides (11.28%) and Imidazoles (9.40%) (Figure 4). There was a difference in the choice of antimicrobials used in various specialty wards, with ceftriaxone being the most commonly used antimicrobial in all the wards (Figure 5). Antibiotic prescriptions for definitive use were observed in 0.3% (1 case). Double anaerobic coverage was noted in 14.1% (45/318) of total prescriptions, with rates ranging from 2.4% in Paediatrics to 17.2% in Obstetrics/Gynaecology wards. Additionally, 28.3% (90/318) of antimicrobial prescriptions included dual coverage for Gram-negative organisms, varying from 7.4% in Obstetrics/Gynaecology to 81.3% in ENT/Orthopaedics wards (Table 4).

The AWaRe classifies antibiotics into three stewardship groups: access, watch, and reserve to emphasize the importance of their optimal uses and potential for antimicrobial resistance. Our survey of antimicrobial use revealed that the percentage distribution, according to the WHO AWaRe classification (2021), was as follows: access (31.79%), watch (62.91%), reserve (1.88%), and not recommended (3.42%) (Figure 6).

Overall, Access-class antibiotics were highly used in other specialties, such as orthopedics and ENT (48.43%), followed by surgery (38.89%) and Obstetrics and Gynaecology (33.33%) wards. At the same time, watch-class of antibiotics were highly used in paediatric wards (82.26%), followed by medicine wards (76.05%). Reserve-class antibiotics were maximally prescribed in paediatrics, whereas no reserve-class antibiotics were used in the surgery ward (Figure 7).

Table 3: Prescriptions with stop /review date mentioned

Wards		**Prescriptions with stop /review date mentioned n (%)**
Medicine	(n=167)	16 (9.6)
Surgery	(n=72)	7 (9.7)
OB-GYN *	(n=126)	9 (7.1)
Paediatrics	(n=62)	7 (11.3)
Others**	(n=159)	31 (19.5)
Total	**(N=586)**	**70 (11.9)**

* OB-GYN: Obstetrics and Gynaecology, **Others: ENT, Orthopaedics

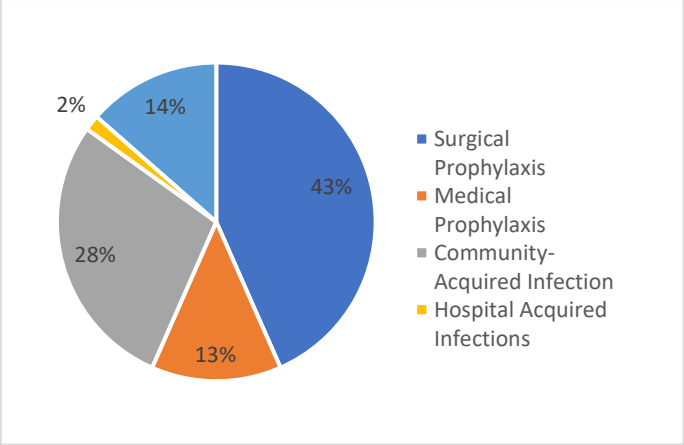

Figure 2: Distribution of antibiotic use by type of indication

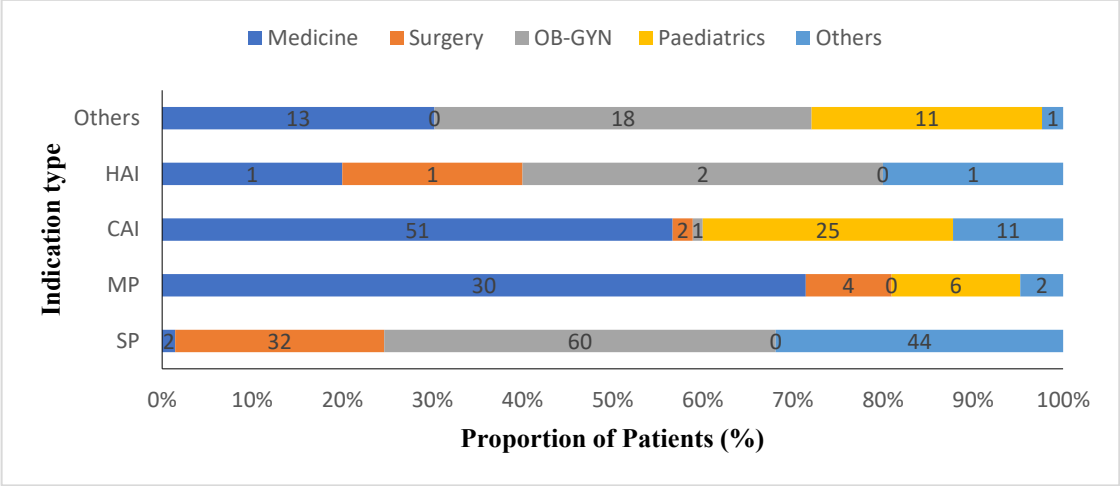

Figure 3: Different antibiotic indications categorized by ward type

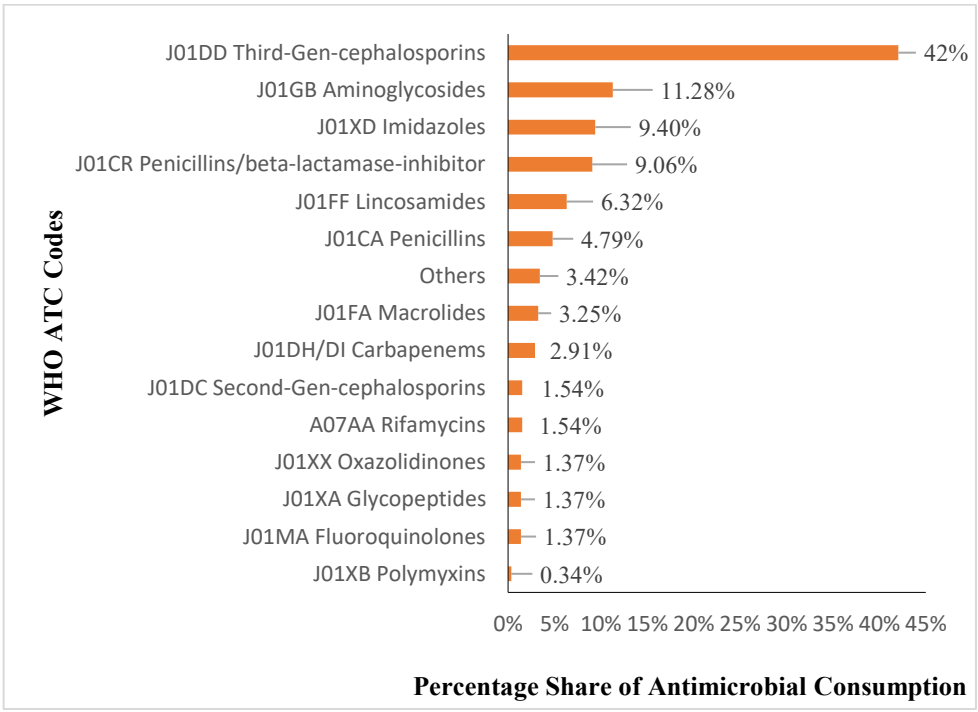

Figure 4: Overall antimicrobial utilization according to WHO-ATC (Anatomical Therapeutic Chemical) class. Others include: Cefoperazone and Sulbactam*, Ceftriaxone and Sulbactam*, Cefuroxime and Sulbactam* (* Not Recommended)

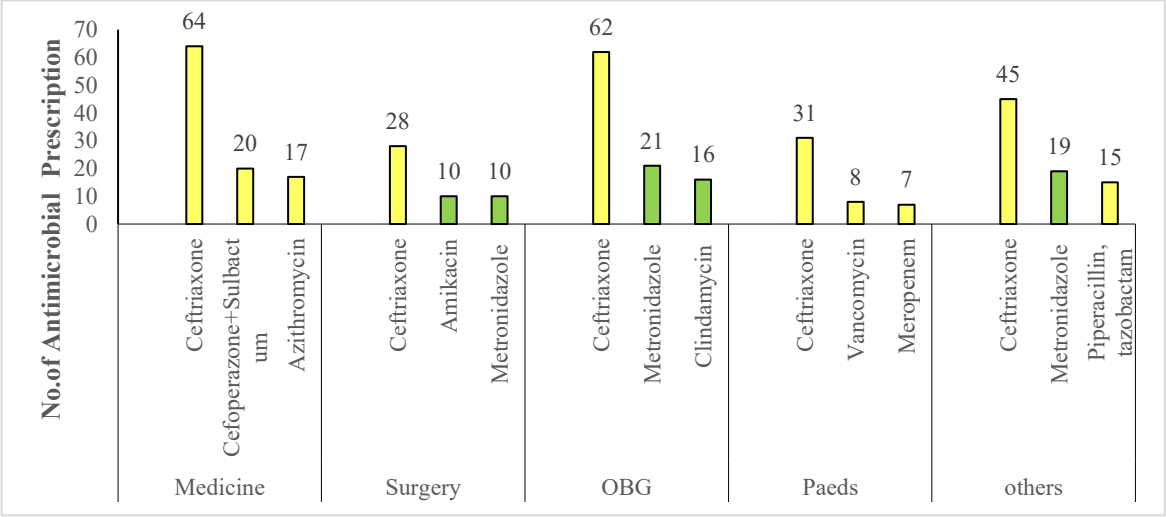

Figure 5: Distribution of the top three most common antimicrobial prescriptions in various wards

Table 4: Patients on definitive therapy, double anaerobic cover and double cover for gram-negative organisms

Wards		Definitive therapy n (%)	Double Anaerobic cover n (%)	Double cover for Gram-negative n (%)
Medicine	(n=97)	0	15 (15.5)	17 (17.5)
Surgery	(n=39)	1(2.6)	5 (12.8)	14 (35.9)
OB-GYN *	(n=81)	0	14 (17.2)	6 (7.4)
Paediatrics	(n=42)	0	1 (2.4)	5 (11.9)
Others**	(n=59)	0	10 (16.9)	48 (81.3)
Total	**(N=318)**	**1 (0.3)**	**45 (14.1)**	**90 (28.3)**

* OB-GYN: Obstetrics and Gynaecology, **Others: ENT, Orthopaedics

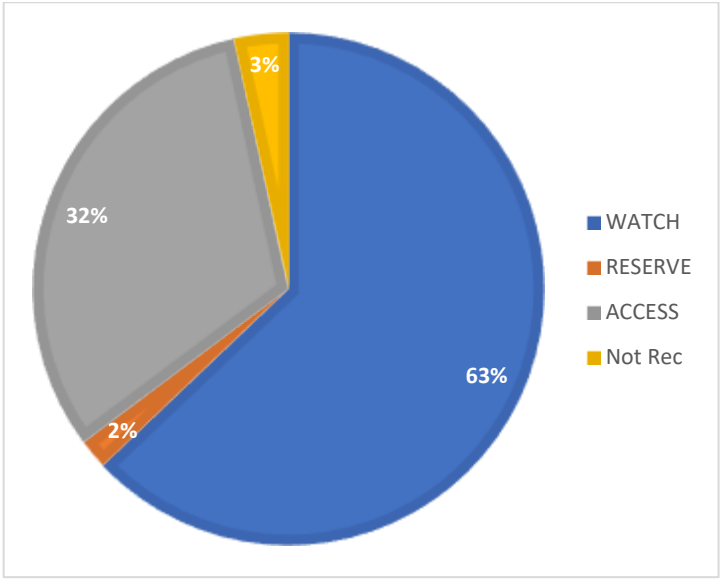

Figure 6: Percentage of antibiotic prescriptions as per AWaRe category

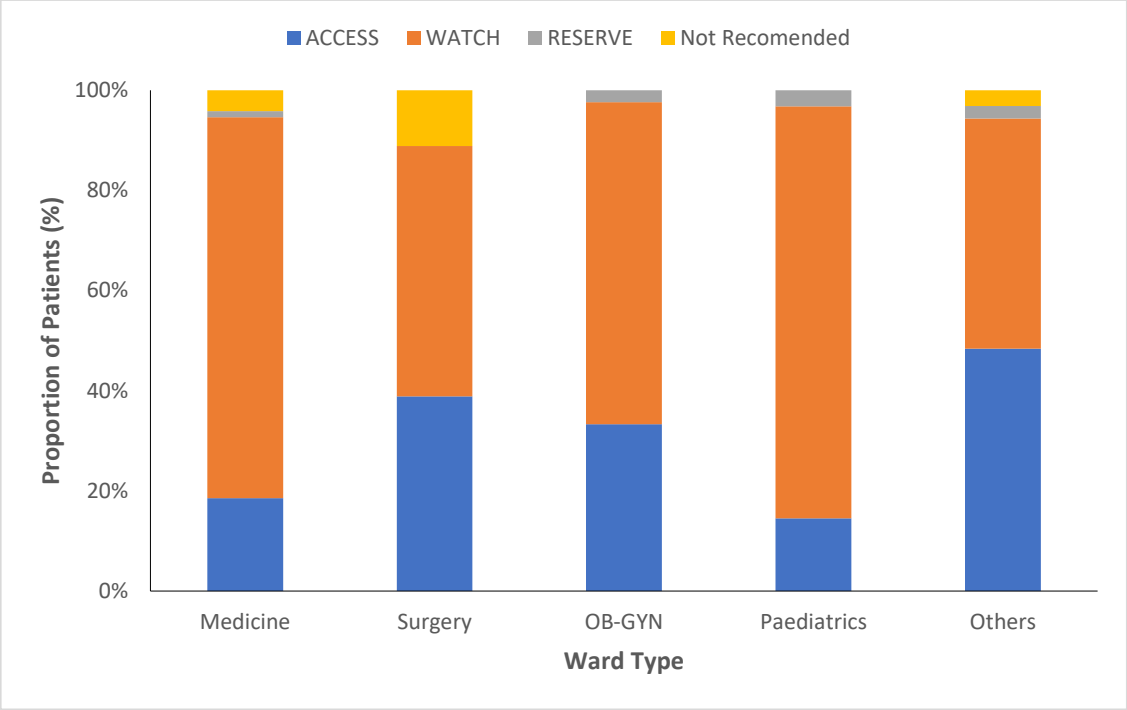

Figure 7: Antibiotics usage by ward type as per WHO AWaRe classification

DISCUSSION

AMR has been strongly linked to antibiotic consumption.[3] The present study evaluated antimicrobial prescribing practices for inpatients in a tertiary hospital in North India.

This PPS brought forth several important findings. Foremost, the site's antimicrobial use was reasonably high among hospitalised patients. The results revealed an overall high prevalence of 93.3% of antimicrobial use in hospital inpatients, which is comparable with antimicrobial use found at a tertiary hospital in South East Nigeria of 78.2% and RDGMC, Ujjain of 71.4%.[11,12] However, relatively low use of antimicrobials was reported in other surveys conducted at tertiary care hospitals in West Bengal (22.71%) and in PGIMS, Rohtak (37.3%).[13,14] The high rate of antimicrobial use at our centre might be because, being a tertiary care government hospital, more critically ill patients are referred here. Also, a proper antibiotic policy was absent at our center.

The high use of injectable antibiotics (90.1%) in inpatients is likely due to severe illness, oral intake limitations, and the injectable nature of commonly used drugs like 3rd-generation cephalosporins and aminoglycosides. However, parenteral use increases risks such as longer hospital stays, catheter-related issues, and higher costs. Promoting oral antibiotics when appropriate can mitigate these risks and is a key goal of antibiotic stewardship. Injectable-to-oral switch rates are useful for monitoring program success, supported by clear documentation of prescribing reasons, review dates, and stop dates.

The most common indication for antibiotic prescribing was surgical prophylaxis (43%), while community-acquired infections (28%) followed. This is comparable to other surveys in Rohtak, India (42.5%; 32.8%, respectively) and Karachi, Pakistan (40%; 27%, respectively).[14,15] Over half of the patients surveyed (195/341; 57.2%) were admitted to surgical specialty wards, including those for surgery, obstetrics/gynaecology, ENT, and orthopaedics, which accounts for the higher number of patients on antibiotic surgical prophylaxis. In over 80% of cases, surgical prophylaxis was extended beyond 24 hours. This practice does not align with most international guidelines, which recommend administering preoperative doses of antimicrobials within 60 minutes before the surgical incision, with no postoperative doses. If postoperative antimicrobials are used, they should be limited to a single dose after wound closure or continued for less than 24 hours.[16]

Third-generation cephalosporins (42%) were the most commonly prescribed antimicrobials, followed by Aminoglycosides (11.28%) and Imidazole derivatives (9.4%). These findings are similar to data

from tertiary care hospitals in Bangladesh, where third-generation cephalosporins (43.9%) were followed by Imidazole derivatives (12.1%) and penicillin (11.8%).[17]

Our observations revealed that definitive treatment accounted for only 0.3% of antimicrobial prescriptions, a concerning finding that highlights the underutilization of microbiological diagnostics and underscores the urgent need for a robust antibiotic stewardship program. These indicators should be adopted as key targets to reduce hospital-acquired infections and combat antimicrobial resistance.

Our study also revealed that the use of double anaerobic antibiotic coverage (14.1%) and dual antibiotic coverage for Gram-negative organisms (28.3%) was relatively high compared to another multicentre study conducted in tertiary care centres in India, which reported rates of 2.7% and 7.1%, respectively.[12] The high use of such overlapping antibiotic regimens raises concerns regarding unnecessary antibiotic exposure, increased risk of antimicrobial resistance, higher treatment costs, and potential for adverse drug reactions.

The AWaRe classification of antibiotics was developed in 2017 by the WHO Expert Committee on Selection and Use of Essential Medicines as a tool to support antibiotic stewardship efforts at local, national, and global levels, Antibiotics are classified into three groups, Access, Watch, and Reserve, taking into account the impact of different antibiotics and antibiotic classes on antimicrobial resistance, to emphasize the importance of their appropriate use. It is updated every 2 years. The WHO 13th General Programme of Work 2019–2023 includes a country-level target of at least 60% of total antibiotic consumption being Access group antibiotics.[18]

In our survey, only a small proportion of patients were prescribed antimicrobials from the Reserve category (1.88%) of the WHO AWaRe classification. In contrast, a large majority received antimicrobials from the Watch group (62.91%). The use of Access group antibiotics (31.79%) was significantly lower than the WHO-recommended global target of over 60% of total antibiotic consumption.[10] A survey on antimicrobial use in Pakistan reported a similar pattern, with 67% of antibiotics in the Watch group, 30% in the Access group, and 3% in the Reserve category.[19] However, a study conducted in Rohtak, India, showed comparatively better outcomes, with 44% of antibiotics falling under the Access group, 41% in the Watch group, and 2.7% in the Reserve category.[14] Higher use of antimicrobials in the watch group can be challenging,[20] as it may contribute to the rising rates of antimicrobial resistance. Factors such as lack of awareness among prescribers, inadequate diagnostic support, or unavailability of Access group antibiotics in hospital formularies may be contributing to this pattern.

CONCLUSION

This point prevalence survey highlighted extensive antimicrobial use among hospitalized patients. The findings provided valuable baseline data to support the development of targeted strategies for optimizing antimicrobial use and assessing future initiatives aligned with the national action plan to combat antibiotic resistance, enhance surveillance of resistant infections, and strengthen infection prevention and control measures. Key areas identified for intervention included promoting a culture of routine microbiological testing, formulating and implementing hospital-specific antibiotic guidelines, and improving surgical prophylaxis practices. Additional targets included increasing awareness and detection of healthcare-associated infections (HAIs), encouraging the use of ‘Access’ group antibiotics as per WHO AWaRe classification, minimizing the use of double gram-negative and double anaerobic coverage, enhancing de-escalation through targeted therapy, promoting intravenous-to-oral switch when appropriate, and strengthening communication among healthcare workers through comprehensive documentation in medical records.

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Conflicts of Interest

The author(s) do not have any conflict of interest.

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