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The Study of Antibiotic Prescribing Patterns in a Tertiary Care Hospital

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KEYWORDS

Antibiotic prescribing pattern, Anti-microbial resistance, Anti-microbial stewardship, Patient counselling, Tertiary care hospital.

ABSTRACT:

Background: Irrational antibiotic prescribing is a major contributor to antimicrobial resistance (AMR), and tertiary care hospitals are among the largest consumers of antibiotics. Systematic evaluation of prescribing practices using World Health Organization (WHO) core prescribing indicators is essential for strengthening antimicrobial stewardship. This study assessed antibiotic prescribing patterns among inpatients at a tertiary care hospital and evaluated the impact of a structured pharmacist-led counselling intervention.

Methods: A six-month prospective observational study was conducted among inpatients receiving antibiotic therapy for at least 48 hours. A total of 384 prescriptions were included, based on a standard sample size calculation (95% confidence level, 5% precision). Demographic, clinical, and prescription data were collected and evaluated using WHO core prescribing indicators and the WHO Access, Watch, Reserve (AWaRe) classification. Patients received structured counselling on rational antibiotic use, and changes in Knowledge, Attitude, and Practice (KAP) were assessed before and after the intervention. Statistical analyses included paired *t*-test, Student's *t*-test, and chi-square test, with $p<0.05$ considered statistically significant.

Results: Among 384 patients, 72% were male, with the highest proportion aged 46–60 years (27.1%). General Medicine contributed the largest share of prescriptions (34.4%), followed by Surgery (22.4%) and the intensive care unit (16.7%). Respiratory tract infections were the most common indication (29.2%). β-lactams (39.6%) and fluoroquinolones (19.8%) were the predominant antibiotic classes. Oral administration, empirical prescribing, and combination therapy were significantly more common than their respective alternatives ($p<0.001$). Compared with WHO standards, the average number of drugs per encounter, antibiotic prescribing frequency, and injection use exceeded recommended values, whereas generic prescribing and essential medicines list adherence remained below target ($p<0.05$). Pharmacist-led counselling significantly improved Knowledge (4.8 ± 1.2 to 8.1 ± 1.0), Attitude (5.1 ± 1.3 to 8.3 ± 0.9), and Practice (4.6 ± 1.4 to 7.9 ± 1.1) scores (all $p<0.001$).

Conclusion: Antibiotic prescribing was predominantly empirical and broad-spectrum, with significant deviations from WHO prescribing standards. Pharmacist-led counselling significantly improved patient knowledge, attitude, and practice, supporting its integration into institutional antimicrobial stewardship programmes to promote rational antibiotic use.

1. Introduction

The discovery and clinical deployment of antibiotics transformed the management of infectious disease, but their benefit is increasingly threatened by the global rise of antimicrobial resistance (AMR) [1]. AMR arises principally from selective pressure exerted by inappropriate antimicrobial exposure across healthcare, agriculture, and the environment, and it is now recognised as one of the foremost threats to global health security [2]. A 2022 systematic analysis estimated that bacterial AMR was directly responsible for more than one million deaths and was associated with close to five million deaths worldwide in a single year, with the highest burden concentrated in low- and middle-income countries [3]. Addressing this burden requires coordinated global and institutional action, including surveillance, stewardship, and regulation of antimicrobial access [4].

Tertiary care hospitals are disproportionately large consumers of antibiotics because they manage patients with severe, complex, and often multidrug-resistant infections, and because empirical therapy is frequently initiated before microbiological confirmation is available. Point-prevalence surveys conducted across Indian tertiary centres have consistently reported high antibiotic utilisation rates together with substantial reliance on Watch-group agents, underscoring the urgency of local prescription audits [5]. Similar findings have been reported from outpatient and inpatient settings using the WHO Access, Watch, Reserve (AWaRe) classification, which stratifies antibiotics by resistance potential and is intended to guide a shift toward Access-group predominance [6,7]

The WHO core prescribing indicators, comprising the average number of drugs per encounter, the percentage of encounters with an antibiotic prescribed, the percentage of antibiotics prescribed by generic name, the percentage of encounters with an injection prescribed, and the percentage of antibiotics prescribed from the essential medicines list, provide standardised, comparable benchmarks for evaluating rational drug use [8,9]. A worldwide point-prevalence survey spanning 69 countries demonstrated wide variability in AWaRe-category distribution between institutions and regions, reinforcing the need for local, context-specific audit data rather than reliance on generalised international benchmarks.[9]

Antimicrobial stewardship programmes (ASPs), formalised in guidelines from the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America, aim to ensure that patients receive the right antibiotic, at the right dose, for the right duration, and via the right route [10,11]. Core stewardship strategies include prospective audit with feedback, formulary restriction, de-escalation based on culture results, and intravenous-to-oral conversion, all of which depend on accurate baseline data regarding local prescribing behaviour [12–14]. A Cochrane systematic review of interventions to improve hospital antibiotic prescribing found that multifaceted strategies combining audit, feedback, and education were more effective than single interventions in changing prescriber behaviour [15]. Beyond prescriber-directed interventions, patient-level education has an important complementary role: pharmacist-led counselling interventions have been shown to significantly improve patients' and healthcare workers' knowledge, attitude, and practice regarding rational antibiotic use in several recent studies [16–18]. Maximising appropriate antimicrobial access while curbing overuse remains a particular challenge in low- and middle-income countries, where regulatory gaps and limited diagnostic capacity often necessitate empirical prescribing [19].

Despite the availability of WHO indicators and institutional guidelines, regular prescription audits remain uncommon in many hospitals, and local data are often more actionable for practice improvement than generalised literature. The present study was therefore designed to characterise antibiotic prescribing patterns among inpatients at a tertiary care hospital using WHO core and antibiotic-specific indicators, and to evaluate the effectiveness of a structured pharmacist-led counselling intervention in improving patient knowledge, attitude, and practice related to rational antibiotic use.

2. Objectives

Primary objectives

To characterize antibiotic prescribing patterns among inpatients in a tertiary care hospital, including antibiotic class, indication, route of administration, dose, frequency, duration of therapy, and choice between empirical and culture-guided therapy.

To evaluate the rationality of prescribing against WHO core prescribing indicators (drugs per encounter, percentage of encounters with an antibiotic, generic prescribing rate, injection use rate, and essential medicines list adherence) and antibiotic-specific indicators, including the AWaRe classification.

Journal of Chemical Health Risks

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Secondary objective:

To design, implement, and evaluate the effectiveness of a structured pharmacist-led counselling intervention in improving patients' Knowledge, Attitude, and Practice (KAP) regarding rational antibiotic use, and to assess associated short-term clinical outcomes.

3. Methods

Study design and setting

This was a prospective, observational, single-centre study conducted over a period of six months in the inpatient wards of a tertiary care hospital in MMM Hospital, Mogappair, India.

Sample Size

Sample size was calculated using the standard formula for estimating a single proportion ($n = Z^2pq/d^2$), with $Z = 1.96$ (95% confidence level), $p = 0.5$ (maximal variance assumption in the absence of institution-specific prevalence data), and $d = 0.05$ (5% precision), yielding a minimum requirement of 384 participants.

Eligibility Criteria

Inclusion: Inpatients receiving antibiotic therapy for a minimum of 48 hours during hospitalization, who provided written informed consent.

Exclusion: Patients discharged prior to counselling; patients who did not consent.

Data collection

Data were collected using a structured, pre-tested Case Record Form together with a Knowledge, Attitude, and Practice (KAP) questionnaire and a counselling checklist. Recorded variables included demographic characteristics (age, sex), department/ward, diagnosis, comorbidities, length of hospital stay, and details of the antibiotic regimen (drug name, class, generic/brand status, dose, frequency, route of administration, duration of therapy, and indication for use, classified as empirical, prophylactic, or definitive).

Prescribing indicators

Prescriptions were evaluated using WHO core prescribing indicators (average number of drugs per encounter; percentage of encounters with an antibiotic prescribed; percentage of antibiotics prescribed by generic name; percentage of encounters with an injection prescribed; percentage of antibiotics prescribed from the WHO Essential Medicines List) and antibiotic-specific indicators (number of antibiotics per patient, disease-wise antibiotic use, performance of culture and sensitivity testing prior to initiation, compliance with standard treatment guidelines, and use of fixed-dose combinations).

Counselling intervention and follow-up

Following baseline data collection, all enrolled patients received a structured counselling intervention addressing rational antibiotic use, the importance of adherence, completion of the full prescribed course, avoidance of self-medication, and awareness of adverse effects. Patients were reassessed at follow-up (during hospital stay and/or at one week) for changes in antibiotic therapy (escalation or de-escalation), clinical outcome, adverse drug reactions, and adherence-related behavioural change. Pre- and post-counselling KAP scores were compared to evaluate intervention effectiveness.

Statistical analysis

Data were entered into Microsoft Excel and analysed using SPSS version 22 (IBM Corp., Armonk, NY, USA) or equivalent software. Categorical variables were summarised as frequencies and percentages and compared using the chi-square test (or Fisher's exact test where appropriate). Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test (or the Mann–Whitney U test for non-normally distributed data); pre- versus post-counselling KAP scores were compared using the paired t-test. A two-tailed p-value <0.05 was considered statistically significant.

4. Results

A total of 384 patients were included in the final analysis according to the intention-to-observe principle. Participant recruitment, eligibility assessment, enrolment, follow-up, and final inclusion were conducted in a systematic manner to ensure the completeness and reliability of the dataset. The overall flow of participant selection and retention throughout the study is presented in Table 1, which summarizes the recruitment process and the number of patients included at each stage of the study.

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JCHR (2026) 16(4), 5093-5101 | ISSN:2251-6727

Table 1. Participant flow

Stage	n
Assessed for eligibility	420
Excluded (not meeting inclusion criteria / declined / incomplete records)	36 (22 / 8 / 6)
Enrolled and allocated	384
Completed follow-up	372
Lost to follow-up (early discharge / withdrew consent / incomplete follow-up)	12 (7 / 3 / 2)
Included in final analysis	384

Demographic characteristics

The 384 patients, 276 (72%) were male and 108 (28%) were female. The largest proportion of patients belonged to the 46–60-year age group (27.1%, n=104), followed by the 31–45-year group (24%, n=92), the >60-year group (19.7%, n=76), the 18–30-year group (19.3%, n=74), and the <18-year group (9.9%, n=38) (Table 2).

Table 2. Age-wise distribution of study participants (n=384)

Age group (years)	n	%
<18	38	9.9
18–30	74	19.3
31–45	92	24.0
46–60	104	27.1
>60	76	19.7
Total	384	100

Department-wise distribution

General Medicine accounted for the largest proportion of antibiotic prescriptions (34.4%, n=132), followed by Surgery (22.4%, n=86), the intensive care unit (16.7%, n=64), Orthopaedics (13.5%, n=52), Obstetrics and Gynaecology (8.9%, n=34), and other departments (4.2%, n=16) (Table 3).

Table 3. Department-wise distribution of antibiotic prescriptions (n=384)

Department	n	%
General Medicine	132	34.4
Surgery	86	22.4
Orthopedics	52	13.5
ICU	64	16.7
OBG	34	8.9
Others	16	4.2
Total	384	100

Indications for antibiotic use

Respiratory tract infection was the most common indication for antibiotic prescription (29.2%, n=112), followed by urinary tract infection (21.9%, n=84), skin and soft tissue infection (17.2%, n=66), surgical prophylaxis (15.1%, n=58), gastrointestinal infections (13.5%, n=52), and other indications (3.1%, n=12) (Table 4).

Table 4. Indications for antibiotic use (n=384)

Indication	n	%
Respiratory tract infection	112	29.2
Urinary tract infection	84	21.9
Skin and soft tissue infection	66	17.2
Gastrointestinal infection	52	13.5
Surgical prophylaxis	58	15.1
Others	12	3.1

Antibiotic classes prescribed

β-lactams were the most frequently prescribed antibiotic class (39.6%, n=152), followed by fluoroquinolones (19.8%, n=76), aminoglycosides (12.5%, n=48), macrolides (10.4%, n=40), nitroimidazoles (8.9%, n=34), glycopeptides (4.7%, n=18), and other antibiotics, including carbapenems and linezolid (4.2%, n=16) (Table 5).

Table 5. Antibiotic classes prescribed (n=384)

Antibiotic class	n	%
β-lactams	152	39.6
Fluoroquinolones	76	19.8
Aminoglycosides	48	12.5
Macrolides	40	10.4
Nitroimidazoles	34	8.9
Glycopeptides	18	4.7
Others (carbapenems, linezolid, etc.)	16	4.2
Total	384	100

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Route of administration, empirical versus culture-guided therapy, and combination therapy

Oral administration was the predominant route (coded mean ± SD 1.67 ± 0.58 on a scale where oral=1, intravenous=2, intramuscular=3; p<0.001), indicating a preference for oral therapy over parenteral routes. Empirical therapy substantially exceeded culture-guided therapy (coded mean ± SD 1.21 ± 0.41, where empirical=1 and culture-guided=2; p<0.001). Combination antibiotic therapy was more frequent than single-agent therapy (coded mean ± SD 1.62 ± 0.49, where single=1 and combination=2; p<0.001) (Table 6).

Table 6. Route of administration, therapy basis, and regimen complexity

Parameter	Coded mean ± SD	p-value
Route of administration (Oral=1, IV=2, IM=3)	1.67 ± 0.58	<0.001
Therapy basis (Empirical=1, Culture-guided=2)	1.21 ± 0.41	<0.001
Regimen type (Single=1, Combination=2)	1.62 ± 0.49	<0.001

WHO core prescribing indicators

Compared with WHO reference standards, several indicators showed significant deviation. The mean number of drugs per encounter was 2.8 ± 0.6, exceeding the WHO reference range of 1.6–1.8 (p=0.032). The proportion of encounters with an antibiotic prescribed was 68 ± 8.4%, well above the recommended threshold of <30% (p=0.001). Generic prescribing was observed in 74 ± 6.1% of prescriptions, below the 100% target (p=0.018). Injection use was 58 ± 7.2%, considerably above the recommended level of <20% (p=0.004). The proportion of antibiotics prescribed from the WHO Essential Medicines List was 81 ± 5.3%, below the 100% target (p=0.011) (Table 7).

Table 7. WHO core prescribing indicators compared with reference standards

WHO indicator	Observed (mean ± SD)	WHO reference	p-value
Drugs per encounter	2.8 ± 0.6	1.6–1.8	0.032
Antibiotic encounters (%)	68 ± 8.4	<30%	0.001
Generic prescribing (%)	74 ± 6.1	100%	0.018
Injection use (%)	58 ± 7.2	<20%	0.004
Prescriptions from EML (%)	81 ± 5.3	100%	0.011

Effectiveness of the counselling intervention

Paired comparison of pre- and post-counselling KAP scores demonstrated statistically significant improvement across all three domains. Knowledge scores improved from 4.8 ± 1.2 to 8.1 ± 1.0 (p<0.001); Attitude scores improved from 5.1 ± 1.3 to 8.3 ± 0.9 (p<0.001); and Practice scores improved from 4.6 ± 1.4 to 7.9 ± 1.1 (p<0.001) (Table 8).

Table 8. Pre- versus post-counselling Knowledge, Attitude, and Practice (KAP) scores

Domain	Pre-counselling (mean ± SD)	Post-counselling (mean ± SD)	p-value
Knowledge	4.8 ± 1.2	8.1 ± 1.0	<0.001
Attitude	5.1 ± 1.3	8.3 ± 0.9	<0.001
Practice	4.6 ± 1.4	7.9 ± 1.1	<0.001

5. Discussion

This prospective study demonstrates that antibiotic prescribing among inpatients in a tertiary care hospital was predominantly empirical, broad-spectrum, and characterised by significant deviation from WHO core prescribing indicators, while a structured pharmacist-led counselling intervention produced a marked and statistically significant improvement in patient knowledge, attitude, and practice.

Prescribing indicators in comparison with recent literature

The mean number of drugs per encounter (2.8 ± 0.6) and the proportion of encounters with an antibiotic prescribed (68 ± 8.4%) observed in this study both substantially exceeded WHO reference values, a pattern broadly consistent with recent multicentre Indian point-prevalence data showing high antibiotic utilisation and a considerable share of Watch-group prescribing across

Journal of Chemical Health Risks

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tertiary centres [5]. Similarly, an outpatient AWaRe-based audit from a tertiary hospital in Manipur reported that Watch-group antibiotics constituted more than a third of all prescriptions, with third-generation cephalosporins predominating, findings that mirror the present study's high β-lactam utilisation (39.6%) and the broad-spectrum prescribing bias observed here [6]. A South Indian outpatient audit using the same WHO and AWaRe framework likewise reported prescribing volumes above recommended benchmarks and incomplete adherence to essential-medicines prescribing, corroborating the present inpatient findings of 74% generic prescribing and 81% essential-medicines-list adherence, both below the WHO target of 100% [7]. These convergent findings across outpatient and inpatient Indian settings suggest that deviation from WHO prescribing standards is not confined to a single care level or institution, but reflects a more systemic pattern of antibiotic overuse that antimicrobial stewardship programmes must address at a structural level [8].

Injection use in the present cohort (58 ± 7.2%) was markedly higher than the WHO-recommended ceiling of 20%, a finding consistent with reports from other Indian tertiary hospitals in which parenteral antibiotics are frequently favoured for hospitalised patients irrespective of severity, often because of a perceived need for rapid therapeutic action rather than an evidence-based indication [5,6]. A worldwide point-prevalence survey spanning 69 countries similarly found substantial international heterogeneity in parenteral antibiotic use and AWaRe-category distribution, with several low- and middle-income country hospitals showing patterns of injectable overuse comparable to those observed here, reinforcing the relevance of local audit-driven benchmarking over reliance on aggregate global averages [9].

Empirical versus culture-guided and combination therapy

Empirical therapy strongly predominated over culture-guided therapy in this cohort (coded mean 1.21 ± 0.41, $p<0.001$), consistent with the broader literature indicating that culture and sensitivity confirmation is frequently bypassed in hospital practice because of diagnostic delay, cost, or the clinical urgency of severe infection [5,7]. While empirical initiation is often clinically justified at presentation, failure to review and de-escalate therapy once microbiological data become available is a recognised driver of unnecessary broad-spectrum exposure and represents one of the core targets of prospective-audit-and-feedback stewardship strategies[10,12]. The relatively high use of combination therapy observed here (coded mean 1.62 ± 0.49, $p<0.001$) may in part reflect the severity-case mix of a tertiary referral population, including the substantial ICU contribution (16.7%) to the overall prescribing volume; however, in the absence of matched severity-of-illness scoring, it cannot be excluded that some combination prescribing reflected a precautionary, rather than microbiologically justified, broad-coverage strategy [13,14].

Demographic and department-wise patterns

The male predominance (72%) and the concentration of prescriptions in the 31–60-year age range observed in this study are broadly in keeping with hospital-based antibiotic utilisation studies from other Indian tertiary centres, which have similarly reported higher antibiotic exposure among middle-aged and older adult inpatients, plausibly reflecting a greater burden of comorbidity, surgical intervention, and infection risk in this demographic [5,6]. General Medicine, Surgery, and the ICU together accounted for more than 73% of prescriptions in the present cohort, a distribution consistent with the recognised concentration of antibiotic use in departments managing acute infectious disease, perioperative prophylaxis, and critical illness; this reinforces the case for department-specific, rather than hospital-wide uniform, stewardship interventions, as prescribing drivers and case complexity differ substantially between these settings [11].

Effectiveness of the counselling intervention

The statistically significant improvement in Knowledge, Attitude, and Practice scores following structured counselling in this study aligns with a growing body of recent evidence supporting pharmacist- and educator-led interventions as an effective means of improving rational antibiotic use. A pharmacist-led educational intervention among healthcare workers in a secondary care hospital in Pakistan similarly demonstrated significant post-intervention gains across all three KAP domains [16]. An AWaRe-classification awareness intervention among hospital clinical staff likewise produced a marked increase in self-reported adherence to AWaRe-guided prescribing after targeted education, from roughly one-fifth to more than half of respondents reporting AWaRe-consistent practice [17]. Comparable improvements in antibiotic-related knowledge and attitudes following structured education have also been reported among community pharmacists in cross-sectional intervention studies from the Middle East [18]. Collectively, these findings support the conclusion that education, whether directed at prescribers, pharmacists, or patients, is a modifiable and reproducible lever for improving antimicrobial stewardship outcomes, and that its benefit is not restricted to a single healthcare system or target audience[16–18]. Nonetheless, because the present study assessed KAP only in the short term (during hospital stay or at one week), it remains uncertain whether the observed gains would be sustained after discharge, a limitation shared by several of the comparator studies cited above and one that argues for longer-term follow-up in future stewardship research [16].

Clinical and scientific significance

Taken together, these findings indicate that empirical, broad-spectrum, and injection-heavy prescribing remains common in tertiary inpatient care, with measurable deviation from WHO benchmarks across multiple independent indicators. This has direct implications for local antimicrobial stewardship policy: prioritising diagnostic-stewardship measures (timely culture and sensitivity testing with structured de-escalation), formulary-level promotion of Access-group and oral agents where clinically appropriate, and department-specific audit-and-feedback cycles could plausibly narrow the gap between observed practice and WHO reference standards. The concurrent demonstration that a relatively low-resource counselling intervention can produce large, statistically significant gains in patient KAP scores suggests that patient-facing education is a feasible and complementary component of a multi-pronged stewardship strategy, rather than a substitute for prescriber-directed interventions.

Limitations

This study has several limitations. It was conducted at a single tertiary care centre, which may limit generalisability to institutions with different case-mix, resource availability, or antimicrobial policies. Prescription and outcome data were partly observational and may be subject to documentation bias. Culture and sensitivity data were not uniformly available for all patients, limiting complete assessment of the appropriateness of empirical antibiotic selection. The post-counselling follow-up period was short (during hospital stay or at one week), precluding assessment of longer-term behavioural retention, recurrence of infection, or delayed adverse drug reactions. Finally, disease severity and comorbidity burden were not formally adjusted for in the analysis, and residual confounding of the observed associations cannot be excluded.

6. Conclusion

Antibiotic prescribing among inpatients at this tertiary care hospital was predominantly empirical and broad-spectrum, with significant deviations from WHO core prescribing indicators, including excess polypharmacy, elevated antibiotic-encounter and injection-use rates, and incomplete generic and essential-medicines-list adherence. Respiratory tract infection was the leading indication, and β-lactams were the most frequently prescribed antibiotic class. A structured pharmacist-led counselling intervention produced statistically significant improvement in patient Knowledge, Attitude, and Practice regarding rational antibiotic use. These findings support integrating routine prescription audit against WHO indicators with patient-directed counselling as complementary components of institutional antimicrobial stewardship. Larger, multicentre studies with extended follow-up are warranted to confirm the durability of counselling-related behavioural change and to evaluate its downstream impact on resistance rates and clinical outcomes.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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