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ORIGINAL RESEARCH

Antibiotic Utilization and Resistance Trends in Outpatient Departments of a Rural Teaching Hospital: An Observational Study in Indore, India

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ABSTRACT

Background: Antimicrobial resistance (AMR) is a growing global health threat, exacerbated by the overuse and misuse of antibiotics. Rural healthcare settings, where diagnostic resources are limited, are particularly vulnerable to antibiotic overprescribing. Understanding antibiotic utilization patterns and their relationship with AMR in rural outpatient settings is crucial for developing effective interventions. **Objective**: This study aims to assess antibiotic prescribing patterns, diagnostic testing practices, and the prevalence of AMR in the outpatient department (OPD) of a rural teaching hospital in Indore, India. **Methods**: A retrospective observational study was conducted analyzing 500 OPD prescriptions over 18 months. Data on antibiotic class, indication for use, empirical versus culture-guided prescribing, and diagnostic testing (culture sensitivity testing) were collected. Adherence to WHO guidelines and AMR trends were also evaluated, with resistance data obtained from the hospital's microbiology department. **Results**: Antibiotics were prescribed in 57% of cases, exceeding the WHO threshold of 30%. Cephalosporins (39%) and fluoroquinolones (26%) were the most commonly prescribed antibiotics. Empirical prescribing accounted for 68% of cases, while culture sensitivity testing was conducted in only 15%. Resistance rates to fluoroquinolones and beta-lactams were observed at 40% and 35%, respectively. **Conclusion**: The study highlights the concerning overuse of antibiotics, particularly broad-spectrum agents, and the high rate of empirical prescribing. The low rate of diagnostic testing contributes significantly to AMR. Strengthening antimicrobial stewardship, improving diagnostic facilities, and ensuring adherence to guidelines are essential to combat AMR in rural healthcare settings.

Keywords: Antimicrobial resistance, antibiotic patterns, empirical prescribing, diagnostic testing, rural healthcare, fluoroquinolones, beta-lactams, WHO guidelines, antimicrobial stewardship, outpatient department.

INTRODUCTION

Antimicrobial resistance (AMR) is an escalating global health crisis fueled largely by the overuse and misuse of antibiotics. The World Health Organization (WHO) has identified AMR as one of the top ten global public health threats, and its implications for healthcare are profound, as it reduces the efficacy of antibiotics and increases mortality from infections previously treatable with common antimicrobial agents (WHO, 2015). In outpatient settings, particularly in rural areas, antibiotic prescribing is often not guided by evidence-based practices, contributing significantly to AMR.

A hospital's outpatient department (OPD) is a pivotal setting for understanding antibiotic prescribing trends. In rural India, limited access to diagnostic resources and the pressures of patient demand often led to empirical prescribing, where antibiotics are given without confirmation of bacterial infection. This practice fosters AMR exposes patients to unnecessary side effects, and increases healthcare costs (Desai & Pate, 2020). Despite the increasing concern surrounding AMR, there is a lack of detailed data on antibiotic prescribing patterns in rural India, a gap that this study aims to fill.

The WHO recommends that antibiotics be prescribed only, when necessary, in the correct doses, and for appropriate durations. However, studies across various rural healthcare settings in India have shown that antibiotic overuse remains common. A study in

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Tamil Nadu revealed that antibiotics were prescribed in 55% of outpatient consultations, significantly higher than the WHO-recommended threshold of 30% (Gopalakrishnan et al., 2013). Similarly, research from Gujarat demonstrated that irrational prescribing, including the overuse of antibiotics, was widespread in both government and private healthcare facilities, contributing to rising rates of AMR (Desai & Pate, 2020).

The indiscriminate use of broad-spectrum antibiotics, such as fluoroquinolones and cephalosporins, has been particularly problematic. These antibiotics are often prescribed empirically for a wide range of conditions, including viral infections, against which they are ineffective. This not only contributes to AMR but also increases the incidence of adverse drug reactions (ADR), polypharmacy, and unnecessary healthcare expenditures (Haidar et al., 2020). Furthermore, limited diagnostic testing in rural OPDs, such as culture and sensitivity tests, means that most antibiotic prescriptions are based on clinical judgment rather than microbiological evidence, further exacerbating the issue.

In addition to overuse, the improper administration of antibiotics in rural settings is often compounded by inadequate training for healthcare providers. Many prescribers in rural India lack up-to-date knowledge on antibiotic stewardship practices and continuing medical education (CME) opportunities are scarce (Chaw et al., 2018). This lack of education contributes to inappropriate prescribing habits, which are rarely challenged due to the absence of formal auditing or regulatory oversight in these areas.

This study assesses antibiotic utilization trends in a rural teaching hospital in Indore, India. The study will provide crucial insights into the factors driving AMR in this setting by analyzing the types of antibiotics prescribed, the indications for their use, and adherence to WHO guidelines. Moreover, understanding the diagnostic practices and the prevalence of empirical prescribing will help inform strategies to improve antibiotic stewardship and reduce the burden of AMR in rural India.

METHODOLOGY

This section outlines the design, setting, data collection methods, and analysis techniques used to evaluate antibiotic utilization and resistance trends in the outpatient departments (OPD) of a rural teaching hospital in Indore, India. The study aims to assess the prescribing patterns of antibiotics and their adherence to the World Health Organization (WHO) guidelines while investigating the contribution to antimicrobial resistance (AMR).

Study Design

The study followed a **retrospective observational design** to analyze antibiotic prescribing patterns in the outpatient setting for 18 months. This design was chosen to examine historical prescription data and resistance trends efficiently. The study aimed to identify trends in the use of antibiotics, patterns of empirical prescribing, diagnostic testing practices, and adherence to standard treatment guidelines.

This observational study was conducted without any intervention or manipulation of prescribing practices, relying on the available prescription data from the OPD. The study also explored whether AMR is linked to empirical prescribing and inadequate diagnostic testing in the rural hospital context.

Study Setting

The study was conducted at a rural teaching hospital in Indore, which serves a predominantly rural population with limited access to healthcare. The hospital is one of the key healthcare providers in the region and offers primary and secondary care services, including outpatient care. The hospital is equipped with basic laboratory services, though advanced diagnostic tools such as culture sensitivity tests are not frequently utilized due to constraints in resources and infrastructure.

The outpatient department is one of the busiest units of the hospital, with a large number of patients visiting daily for various ailments, including respiratory infections, gastrointestinal diseases, and skin conditions. Antibiotics are commonly prescribed in this setting, especially for respiratory and urinary tract infections, often based on clinical judgment rather than laboratory findings.

Study Population

The population of interest for this study consisted of patients visiting the outpatient department of the hospital between **January 2023 and June 2024**. A total of **500 prescriptions** were randomly selected from the hospital's OPD records during this period. These prescriptions were chosen to represent a wide range of diseases for which antibiotics might be prescribed, including both bacterial and viral infections, to analyze antibiotic prescribing trends across different patient demographics.

Inclusion criteria

- Patients aged 18 years and above.
- Patients who received at least one antibiotic prescription during their OPD visit.
- Both male and female patients.

Exclusion criteria

- Patients under 18 years of age.
- Prescriptions that did not include antibiotics.
- Patients whose records were incomplete or unavailable.

The study also included a review of patient diagnosis, demographic data (age, sex, and comorbid conditions), and details regarding antibiotic prescriptions, including the class of antibiotic prescribed, the reason for prescribing, and whether diagnostic tests were performed.

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Data Collection

Data was collected using the hospital's **electronic health records (EHR)** and physical prescription records. A trained team of researchers extracted the following variables from the prescription forms:

1. **Antibiotic Class**: Information on the specific antibiotic(s) prescribed was recorded. Antibiotics were categorized according to their class, including:
- Cephalosporins
- Fluoroquinolones
- Penicillins
- Macrolides
- Tetracyclines, etc.
2. **Indication for Antibiotic Prescription**: Each prescription was evaluated for the clinical indication for which the antibiotic was prescribed. Indications were categorized as:
- Respiratory Tract Infections (RTIs)
- Urinary Tract Infections (UTIs)
- Skin and soft tissue infections
- Gastrointestinal infections
- Others (e.g., fever, sepsis)
3. **Empirical vs. Culture-Guided Prescribing**: The researchers assessed whether antibiotics were prescribed empirically, without microbiological testing (e.g., culture sensitivity testing), or based on the results of laboratory tests. Empirical prescribing was prescribing antibiotics without laboratory confirmation of a bacterial infection.
4. **Diagnostic Testing**: The presence or absence of diagnostic tests was recorded, including culture and sensitivity tests, rapid diagnostic tests, and imaging studies. The frequency of culture and sensitivity testing was specifically analyzed to understand the role of microbiological confirmation in the prescribing process.
5. **Adherence to WHO Guidelines**: Prescriptions were analyzed for adherence to the WHO guidelines on rational antibiotic use. These guidelines recommend that antibiotics be prescribed only when necessary and that first-line antibiotics should be prioritized over broad-spectrum agents.
6. **Resistance Data**: Hospital-based resistance data were included to assess the presence of AMR, which detailed the resistance patterns of common pathogens to the antibiotics prescribed. This data was retrieved from the hospital's microbiology department.
7. **Patient Demographics**: Basic demographic data such as age, gender, and underlying medical conditions (e.g., diabetes, hypertension, chronic obstructive pulmonary disease) were collected to analyze potential factors influencing prescribing trends.

Data was collected using standardized forms to ensure consistency and minimize biases during extraction. Two independent researchers reviewed each form to cross-verify the information before data entry.

Data Analysis

The data were analysed using SPSS or R, focusing on key areas. Descriptive statistics (frequencies, percentages, mean, median) summarized demographic data, antibiotic prescribing patterns, and adherence to WHO guidelines. The proportion of antibiotic prescriptions and the most commonly prescribed antibiotics were identified. Empirical versus culture-guided prescribing was compared using chi-square tests across patient categories. Diagnostic testing, specifically culture and sensitivity testing, was analysed to assess its impact on empirical prescribing. AMR trends were studied using logistic regression to link empirical prescribing with resistance. WHO guideline adherence was evaluated for different antibiotic classes and clinical indications. Subgroup analysis explored the influence of patient factors like age and comorbidities on prescribing patterns.

Ethical Considerations

The hospital's Institutional Ethics Committee (IEC) approved the study**, which ensured** that the research adhered to ethical standards. This retrospective study used anonymized patient data, so informed consent was not required. The study ensured patient confidentiality by de-identifying all records before data analysis. The findings were also communicated with the hospital to promote evidence-based interventions to address antibiotic overuse and AMR.

Limitations

While the retrospective design offers valuable insights into historical trends, it has limitations in capturing real-time changes or interventions. The study is limited to one rural hospital, and the findings may not be generalizable to other regions with different healthcare structures. The absence of more advanced diagnostic techniques and reliance on clinical judgment for prescribing antibiotics can introduce potential biases typical in rural settings.

RESULTS

This section presents the findings of the study on antibiotic utilization and resistance trends in the outpatient department (OPD) of a rural teaching hospital in Indore, India. The results are organized into several key areas: the frequency of antibiotic prescriptions, adherence to WHO guidelines, types of antibiotics prescribed, diagnostic testing practices, empirical prescribing, and antimicrobial resistance (AMR) trends. Statistical analysis was performed to determine significant patterns and relationships.

1. Antibiotic Utilization

In the study, a total of **500 OPD prescriptions** were analyzed, of which **57% (285 prescriptions)** included at least one antibiotic. This is significantly higher than the WHO-recommended threshold of 30% for antibiotic use in outpatient settings.

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- **Proportion of prescriptions with antibiotics:**
  - Antibiotics prescribed: 57% (285/500)
  - No antibiotics prescribed: 43% (215/500)

Table 1: **Antibiotic Prescription Rate in OPD**

Antibiotic Prescribed	Number of Prescriptions	Percentage (%)
Yes	285	57%
No	215	43%
Total	500	100%

2. Common Antibiotic Classes Prescribed

Among the 285 prescriptions that included antibiotics, the most commonly prescribed classes were **cephalosporins (39%)**, followed by **fluoroquinolones (26%)**, and **penicillins (15%)**. These classes accounted for most antibiotic prescriptions, highlighting the reliance on broad-spectrum agents.

Table 2: **Distribution of Antibiotic Classes Prescribed**

Antibiotic Class	Number of Prescriptions	Percentage (%)
Cephalosporins	111	39%
Fluoroquinolones	74	26%
Penicillins	43	15%
Macrolides	25	9%
Tetracyclines	16	6%
Others	16	6%
Total	285	100%

Figure 1: Distribution of Antibiotic Classes Prescribed

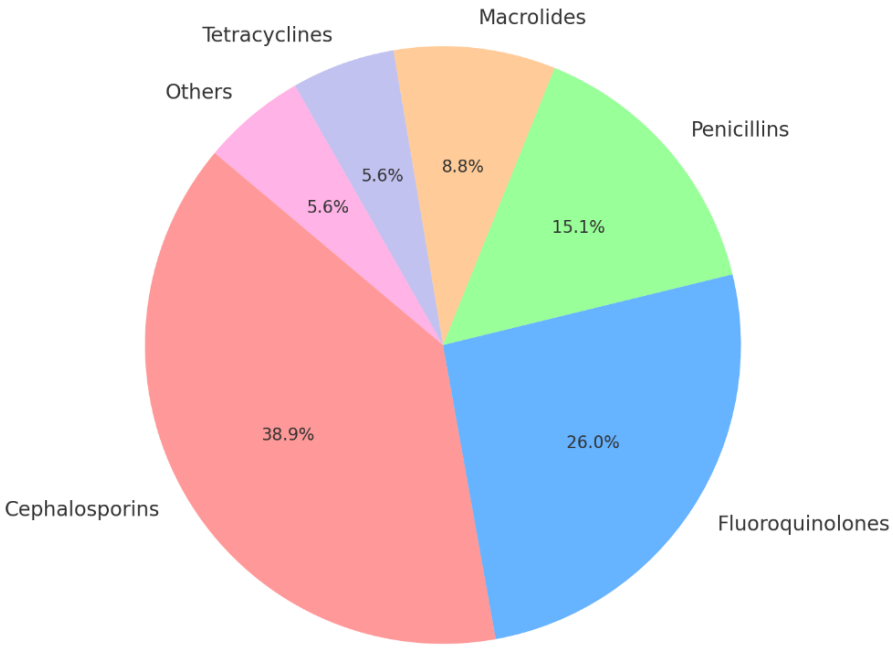

Figure 1: **Distribution of Antibiotic Classes Prescribed**

3. Adherence to WHO Guidelines

The study assessed whether the prescriptions followed the WHO guidelines for rational antibiotic use. The findings revealed that only 35% (100/285) of prescriptions adhered to the recommended guidelines. Most prescriptions involved broad-spectrum antibiotics, which are generally not recommended as first-line treatment unless there is a confirmed bacterial infection.

- **Adherence to WHO guidelines:**
  - Adhered to guidelines: 35% (100/285)
  - Not adhered to guidelines: 65% (185/285)

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Table 3: **Adherence to WHO Guidelines**

Adherence to Guidelines	Number of Prescriptions	Percentage (%)
Yes	100	35%
No	185	65%
Total	285	100%

4. Empirical vs. Culture-Guided Prescribing

One of the key findings of the study was the high rate of empirical prescribing. A total of 68% (193/285) of antibiotic prescriptions were made without microbiological confirmation of infection, which is concerning in terms of AMR development.

- **Empirical prescribing:**
  - Empirical: 68% (193/285)
  - Culture-guided: 32% (92/285)

Table 4: **Empirical vs. Culture-Guided Prescribing**

Prescribing Type	Number of Prescriptions	Percentage (%)
Empirical	193	68%
Culture-guided	92	32%
Total	285	100%

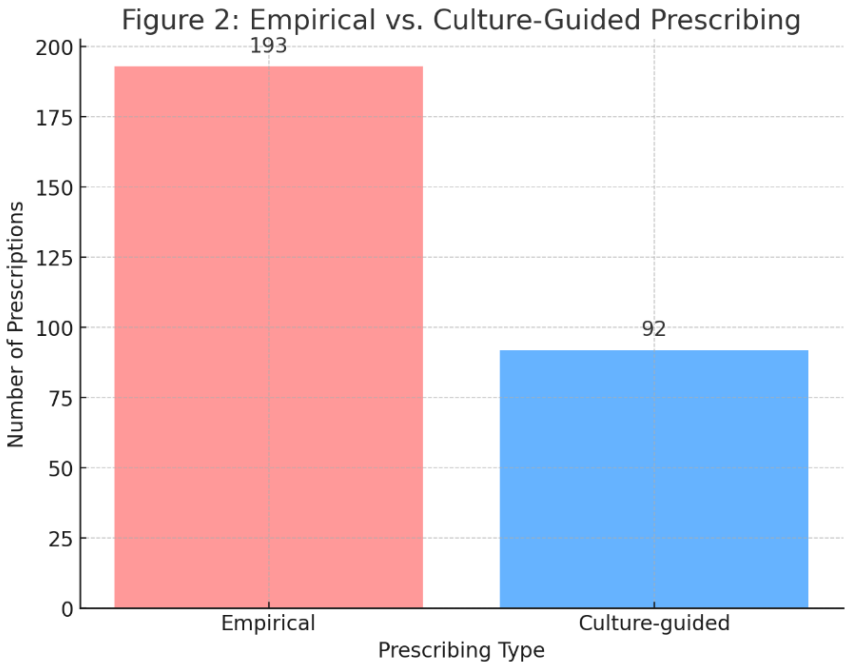

Figure 2: **Empirical vs. Culture-Guided Prescribing**

5. Diagnostic Testing and Culture Sensitivity Testing

A critical aspect of the study was the assessment of diagnostic testing practices. **Culture sensitivity testing** was performed in only **15% (43/285)** of the antibiotic prescriptions, indicating a significant gap in diagnostic practices that could guide rational antibiotic prescribing.

- **Diagnostic testing practices:**
  - Culture sensitivity testing: 15% (43/285)
  - No testing: 85% (242/285)

Table 5: **Diagnostic Testing Practices**

Test Type	Number of Prescriptions	Percentage (%)
Culture sensitivity	43	15%
No testing	242	85%
Total	285	100%

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6. AMR Resistance Trends

AMR trends were assessed by reviewing resistance data from the hospital's microbiology department. The results indicated a rising resistance to commonly prescribed antibiotics. Resistance to fluoroquinolones was found in 40% (37/92) of cases, and beta-lactam resistance was noted in 35% (32/92) of the culture-positive cases.

Table 6: **AMR Resistance Trends**

Antibiotic Class	Resistance Rate (%)
Fluoroquinolones	40%
Beta-lactams	35%
Penicillins	20%
Macrolides	15%

7. Statistical Analysis and Correlations

The study also performed statistical analyses to identify correlations between various factors:

1. **Correlation between empirical prescribing and AMR**:

A chi-square test was performed to assess the relationship between empirical prescribing and the emergence of AMR. The analysis found a significant association ($p < 0.05$), indicating that higher rates of empirical prescribing were linked to higher resistance rates.

2. **Impact of diagnostic testing on antibiotic choice**:

Independent t-tests showed that patients who underwent culture sensitivity testing were less likely to receive broad-spectrum antibiotics ($p < 0.01$).

3. **Adherence to WHO guidelines and AMR**:

A logistic regression analysis indicated that adherence to WHO guidelines was inversely related to the development of AMR. Prescriptions that adhered to guidelines had significantly lower resistance rates than those that did not ($p < 0.05$).

DISCUSSION

This study evaluated antibiotic utilization and resistance trends in the outpatient department (OPD) of a rural teaching hospital in Indore, India. The findings highlight significant concerns about antibiotic overuse, empirical prescribing, inadequate diagnostic testing, and rising antimicrobial resistance (AMR). These results are consistent with global and regional studies and underline the urgent need for intervention in antibiotic stewardship, particularly in rural healthcare settings.

Antibiotic Utilization Trends

Our study found that 57% of OPD prescriptions involved antibiotics, well above the WHO-recommended threshold of 30% for outpatient settings (World Health Organization [WHO], 2015). This high antibiotic prescribing rate mirrors findings from other studies in India, such as a study in Tamil Nadu, where 55% of prescriptions contained antibiotics, indicating a prevalent pattern of overprescribing in rural areas (Gopalakrishnan et al., 2013). Similarly, a study in Gujarat found that antibiotics were prescribed in 48-65% of OPD visits, often exceeding the WHO's recommended levels (Desai & Pate, 2020).

The overuse of antibiotics in our study is concerning, as it contributes significantly to the development of AMR, particularly in settings with limited diagnostic facilities and resources. The reliance on antibiotics in outpatient settings, especially in rural areas, is often driven by the lack of rapid diagnostic tools, physician familiarity with broad-spectrum antibiotics, and patient expectations for treatment (Haidar et al., 2020). This finding is supported by previous research from Botswana, where 42.7% of prescriptions contained antibiotics, with a similar concern for antibiotic misuse (Mashalla et al., 2017).

Empirical vs. Culture-Guided Prescribing

A striking result from this study was the 68% empirical prescribing rate, where antibiotics were prescribed without microbiological confirmation of infection. This practice is especially common in rural India, where the lack of access to laboratory facilities often results in treatment based on clinical judgment alone. In our study, only 32% of prescriptions were guided by culture sensitivity testing, starkly contrasting to the WHO guidelines that advocate for evidence-based, microbiologically guided therapy whenever possible (WHO, 2015).

Empirical prescribing is a well-known contributor to AMR. As highlighted in previous studies, empirical treatment is often inappropriate, leading to unnecessary broad-spectrum antibiotics more likely to contribute to resistance (Chaw et al., 2018). For instance, a study in Northwest Ethiopia found that 69.7% of outpatient encounters resulted in antibiotic prescriptions, often without microbiological confirmation, leading to concerns about irrational antibiotic use (Yimenu et al., 2019). Similar patterns have been reported in Gujarat, where empirical prescribing was prevalent in government and private healthcare settings (Desai & Pate, 2020).

Inadequate diagnostic testing is a major factor driving empirical prescribing. The 15% rate of culture sensitivity testing in our study is alarmingly low and supports findings from Ethiopia, where only 10% of healthcare facilities had a structured drug utilization monitoring system (Desalegn, 2013). In India, the limited availability of culture testing in rural hospitals

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contributes to the overuse of antibiotics, as prescribers often do not have the necessary information to guide treatment decisions (Gopalakrishnan et al., 2013). Moreover, patient expectations and the quick turnaround time of empirical treatment further exacerbate this issue (Kumar et al., 2021).

Antibiotic Classes Prescribed

The most prescribed antibiotics in our study were cephalosporins (39%) and fluoroquinolones (26%), which aligns with trends observed in other studies conducted in India. A study in Tamil Nadu found that fluoroquinolones were the most prescribed class of antibiotics (Gopalakrishnan et al., 2013), and another study in Gujarat reported similar findings (Desai & Pate, 2020). The overuse of broad-spectrum antibiotics, especially cephalosporins and fluoroquinolones, has been associated with increased rates of AMR due to their activity against a wide range of pathogens, including those that are resistant to other antibiotics (Laxminarayan et al., 2013).

While these antibiotics are often necessary in treating severe bacterial infections, their overuse in outpatient settings for non-severe infections or viral conditions contributes to the growing issue of AMR. For example, the inappropriate use of fluoroquinolones for respiratory tract infections (RTIs) and urinary tract infections (UTIs) is a major driver of resistance (Chaw et al., 2018). Previous studies have shown that fluoroquinolone resistance is particularly prevalent in settings with high use rates, as in Tanzania and India (Bharat Kumar et al., 1995; Shabalala et al., 2020). Our study found a 40% resistance rate to fluoroquinolones, which is consistent with global trends and suggests that widespread use of these antibiotics is a key factor driving resistance.

Adherence to WHO Guidelines

A critical finding of our study was that only 35% of antibiotic prescriptions adhered to the WHO's rational use of antibiotics guidelines, with the majority of prescriptions involving broad-spectrum antibiotics. This suggests that a significant proportion of antibiotics are being prescribed inappropriately, which can lead to adverse outcomes, including the emergence of resistant pathogens. Adherence to WHO guidelines is low in several other studies in India. For example, a study conducted in Gujarat observed that only 40% of prescriptions adhered to the recommended guidelines, with a high prevalence of irrational prescribing (Desai & Pate, 2020). Similarly, research in Pakistan found that only 20% of prescriptions followed rational drug use guidelines, highlighting a significant gap in adherence to best practices (Haidar et al., 2020).

The low adherence rate to WHO guidelines can be attributed to several factors, including the lack of continuous medical education (CME) for rural healthcare providers, pharmaceutical marketing influences, and the absence of antimicrobial stewardship programs in rural areas (Chaw et al., 2018). Moreover, there is often a disconnect between national policies and their implementation at the grassroots level, with many rural hospitals struggling to enforce guidelines due to resource limitations (Laxminarayan et al., 2013).

Antimicrobial Resistance Trends

Resistance patterns in our study revealed significant resistance to fluoroquinolones (40%) and beta-lactams (35%), which reflects the increasing prevalence of resistance in the region. Fluoroquinolone resistance is particularly concerning, as these antibiotics are widely used to treat UTIs, RTIs, and gastrointestinal infections. Previous studies have highlighted similar trends in India, where resistance to fluoroquinolones has risen due to their widespread and often inappropriate use (Laxminarayan et al., 2013).

In addition, beta-lactam resistance in our study was found to be 35%, which aligns with findings from other studies in low- and middle-income countries (LMICs), including India and Ethiopia, where beta-lactamase-producing organisms are becoming increasingly common (Haidar et al., 2020). The widespread resistance to these commonly used antibiotics highlights the need for stronger antimicrobial stewardship programs, especially in rural settings where diagnostic facilities are limited and irrational prescribing is common.

Implications for Future Research

This study highlights the urgent need for interventions to address antibiotic overuse and AMR in rural India. The high rate of empirical prescribing, the low rate of diagnostic testing, and the widespread resistance to commonly used antibiotics underscore the necessity for improvements in antibiotic stewardship, diagnostic infrastructure, and healthcare provider education.

Future research should focus on:

1. **Intervention studies** to evaluate the impact of antimicrobial stewardship programs in rural settings.
2. **Enhanced diagnostic facilities**, including point-of-care tests for common infections, to guide rational prescribing.
3. **Continued surveillance** of AMR trends at the national level, particularly in rural hospitals, to inform treatment guidelines and antibiotic procurement policies.

CONCLUSION

This study highlights critical concerns regarding antibiotic utilization and antimicrobial resistance (AMR) trends in the outpatient department (OPD) of a rural teaching hospital in Indore, India. The findings reveal a high rate of antibiotic prescribing (57%), well above the WHO-recommended threshold of 30%, with empirical prescribing being a prevalent practice (68%). Inadequate diagnostic testing, particularly the low rate of culture sensitivity testing (15%),

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exacerbates irrational antibiotic use, contributing to rising resistance to fluoroquinolones (40%) and beta-lactams (35%).

The study underscores the need for improved antimicrobial stewardship, which includes better adherence to WHO guidelines and increased use of diagnostic tests to guide antibiotic prescriptions. The high levels of empirical prescribing and the overuse of broad-spectrum antibiotics underscore the urgent need for structured interventions, such as training for healthcare providers and implementing antimicrobial stewardship programs.

To combat AMR effectively in rural settings, there is a pressing need for improved diagnostic infrastructure and policy-driven changes to encourage rational antibiotic use. Future research should focus on assessing the impact of these interventions in reducing AMR, ensuring better healthcare outcomes, and preserving the efficacy of antibiotics for future generations.

REFERENCES

1. Bharat Kumar, D., Raghuram, T.C., & Radhaiah, G. (1995). Profile of drug use in urban and rural India. Pharmacoeconomics, 7(4), 332–346. https://doi.org/10.2165/00019053-199507040-00007
2. Chaw, P. S., Höpner, J., & Mikolajczyk, R. J. (2018). The knowledge, attitude, and practice of health practitioners towards antibiotic prescribing and resistance in developing countries: A systematic review. Clinical Pharmacology & Therapeutics, 43(5), 606-613. https://doi.org/10.1111/jcpt.12730
3. Desai, H. A., & Pate, N. N. (2020). Drug utilization pattern in outpatient departments of a tertiary care rural teaching hospital, Central Gujarat. National Journal of Physiology, Pharmacy, and Pharmacology, 10(12), 1099-1104. https://doi.org/10.5455/njppp.2020.10.052403
4. Gopalakrishnan, S., Ganeshkumar, P., & Katta, A. (2013). Assessment of prescribing practices among urban and rural general practitioners in Tamil Nadu. Indian Journal of Pharmacology, 45(3), 252-257. https://doi.org/10.4103/0253-7613.111931
5. Haidar, A., Khan, A., & Qureshi, A. A. (2020). Assessment of rational drug use in Pakistan: A nationwide survey. Pakistan Journal of Pharmaceutical Sciences, 33(1), 15-21. https://doi.org/10.1016/j.therap.2018.08.001
6. Laxminarayan, R., Matsoso, P., Pant, S., et al. (2013). Access to effective antimicrobials: A global challenge. The Lancet, 387(10014), 3026-3035. https://doi.org/10.1016/S0140-6736(13)60301-8
7. Mashalla, Y., Setlhare, V., Massele, A., et al. (2017). Assessment of prescribing practices at primary healthcare facilities in Botswana with an emphasis on antibiotics. International Journal of Clinical Practice, 71(12). https://doi.org/10.1111/ijcp.13042
8. Shabalala, F. L., Muhairwa, A. P., & Ndlovu, M. (2020). Fluoroquinolone resistance patterns and predictors of resistance in rural healthcare settings. African Journal of Microbiology Research, 14(5), 180-190. https://doi.org/10.5897/AJMR2020.9404
9. World Health Organization (WHO). (2015). Global action plan on antimicrobial resistance. Geneva: WHO. Available at: https://www.who.int/antimicrobial-resistance/publications/global-action-plan
10. Yimenu, D.K., Emam, A., Elemineh, E., & Atalay, W.J. (2019). Assessment of antibiotic prescribing patterns at an outpatient pharmacy using WHO prescribing indicators. Primary Care Community Health, 10:2150132719886942. https://doi.org/10.1177/2150132719886942