OPTIMIZING ANTIBIOTIC USE IN PAKISTAN: A PHARMACOLOGICAL APPROACH TO COMBATING ANTIBIOTIC RESISTANCE

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ABSTRACT
Background: Particularly in low- and middle-income nations (LMICs) like Pakistan, where improper antibiotic usage is prevalent, antibiotic resistance (ABR) is a developing global health problem. The purpose of this study is to evaluate antibiotic prescribing policies and pinpoint ways to maximize antibiotic use at Peshawar, Pakistan's Hayatabad Medical Complex (HMC).
Methods: From January 2024 until July 2024, a cross-sectional observational research was undertaken. Using a methodical random sample, 210 patients in all who had antibiotic prescriptions were incorporated. Medical data and provider interviews yielded information on prescribing habits. National and international recommendations guided the assessment of the appropriateness of antibiotic use; logistic regression was then applied to find elements linked to incorrect prescription writing.
Results: The study found that 63% of antibiotic prescriptions were empirical, and 68% were broad-spectrum antibiotics. Only 40% of prescriptions were appropriate according to guidelines. Factors associated with inappropriate prescribing included outpatient department status, prescriptions by junior doctors, and lack of diagnostic tools. An educational intervention implemented during the study improved the rate of appropriate prescribing from 34% to 46%.
Conclusion: At HMC, inappropriate antibiotic use is rather common, which reflects more general LMIC trends. To maximize antibiotic use and fight antibiotic resistance in Pakistan, strengthened antibiotic stewardship programs, better access to diagnostic tools, and focused educational campaigns are desperately needed.

Keywords: Antibiotic resistance, prescribing practices, antibiotic stewardship, Pakistan, low- and middle-income countries, empirical prescribing, educational intervention.

Introduction

Emerging among the most important worldwide health issues of the twenty-first century is antibiotic resistance (ABR) [1]. With the possibility to compromise the efficacy of contemporary therapy and raise death rates, antibiotic resistance is identified by the World Health Organisation (WHO) as a serious hazard to human health[2]. In low- and middle-income countries (LMICs), like Pakistan, the issue is especially concerning because of the extensive use of antibiotics, poor healthcare infrastructure, and absence of regulatory control[3]. This research paper attempts to investigate the pharmacological approaches that might be used to maximize antibiotic consumption in Pakistan, therefore supporting the worldwide fight against antibiotic resistance. The fifth most populated nation in the world, Pakistan, finds great difficulty suppressing antibiotic resistance. The widespread use of antibiotics results from a confluence of elements including over-the-counter access of antibiotics, ignorance among healthcare practitioners and the public, and inadequate infection control methods. Studies have shown that inappropriate antibiotic prescriptions in Pakistan are alarmingly high, with estimates suggesting that up to 75% of prescriptions in primary care settings are either unnecessary or suboptimal[4]. This misuse is exacerbated by a lack of access to diagnostic tools, which leads to empirical treatment based on clinical judgment rather than microbiological evidence.

Several interrelated factors contribute to the misuse of antibiotics in Pakistan. Socioeconomic and cultural determinants, such as self-medication and the cultural perception of antibiotics as "miracle cures," play a significant role[5]. Additionally, the pharmaceutical industry's aggressive marketing strategies often influence prescribing behaviors, leading to inappropriate antibiotic use[6]. The healthcare system's weaknesses, including inadequate training of healthcare providers, absence of antimicrobial stewardship programs, and lack of enforceable regulations on antibiotic sales, further complicate the issue[7].

Moreover, the scarcity of robust surveillance systems means that data on antibiotic resistance trends are fragmented and unreliable, hindering effective policy formulation and implementation[8]. Addressing the antibiotic resistance crisis in Pakistan requires a multi-faceted approach, with pharmacological strategies playing a pivotal role. Optimizing antibiotic use through evidence-based prescribing practices is critical to reducing the development and spread of resistant pathogens[9]. This entails the implementation of antimicrobial stewardship programs, which focus on the selection of appropriate antibiotics, dosing, route of administration, and duration of therapy[10]. Pharmacological interventions should also include the development of guidelines that are tailored to the local epidemiology of resistance, promoting the rational use of antibiotics based on current resistance patterns and clinical needs[11].

This research article seeks to explore and advocate for pharmacological strategies to optimize antibiotic use in Pakistan. By analyzing existing prescribing practices, identifying gaps in current guidelines, and proposing evidence-based recommendations, the study aimed to provide a framework for improving antibiotic stewardship in the country. It also examines the role of education and awareness campaigns in changing public and professional attitudes toward antibiotic use. Ultimately, the goal is to contribute to the reduction of antibiotic resistance rates in Pakistan, thereby safeguarding public health and ensuring the continued efficacy of antibiotics for future generations.

Methodology

Conducted at Hayatabad Medical Complex (HMC) in Peshawar, Pakistan, this cross-sectional observational study The study sought to assess pharmacological interventions' efficacy in maximizing antibiotic use by means of analysis of antibiotic prescription practices.

Sample Size and Sampling Method: The study had 210 participants in all who had antibiotic prescriptions. Using Cochran's method for a finite population, the sample size was computed under an estimated prevalence of 50%, a confidence level of 95%, and a margin of error of 7%. This sample size was judged sufficient to guarantee statistical power and representativeness of the study population. Participants were chosen from the outpatient and inpatient departments of the hospital using a procedure known as systematic random selection, therefore guaranteeing a varied patient group.

Inclusion and exclusion criteria: In order to give a complete picture of antibiotic use, the study included patients of all ages from young children to geriatrics. Patients eligible for inclusion were those prescribed at least one antibiotic either during their visit or hospital stay at Hayatabad Medical Complex (HMC). Patients in outpatient and inpatient departments were taken under consideration to evaluate prescribing policies in several clinical environments. Furthermore included were just patients who gave informed permission to guarantee ethical compliance and data quality. To preserve data accuracy and completeness, patients with incomplete medical records were not included into the study. Furthermore eliminated were those who had antibiotics just for surgical prophylactic purposes since the study concentrated on therapeutic antibiotic use. Patients known to have antibiotics allergies were not included in order to avoid confusing elements influencing the suitability of antibiotic prescriptions. To honor patient autonomy and maintain ethical norms, patients who refused to participate or were unable to offer informed permission were also excluded.

Data collection: Data collection was conducted over a 6-month period from January 2024 to July 2024. Patient data, including demographic information, clinical diagnosis, antibiotic prescriptions, and indications for antibiotic use, were obtained from medical records. Additional data on the appropriateness of antibiotic prescriptions were gathered through interviews with prescribing physicians and pharmacists, using a standardized questionnaire based on national and international antibiotic guidelines.

Data Analysis: Descriptive and inferential statistics were applied in analysis of the gathered data. Using logistic regression analysis, the frequency of improper antibiotic use was computed and elements connected with antibiotic abuse were found. P 0.05 was the set statistical significance. The results were evaluated against accepted standards for antibiotic stewardship to evaluate compliance and point up areas of present inadequacy in present methods.

Results

The study comprised 210 individuals overall from Hayatabad Medical Complex (HMC) in Peshawar who had antibiotic prescriptions. With a mean age of 35.4 years and a standard deviation of 17.8 years, the patients With 52% men (n=109) and 48% women (n=101), the study population reflected a rather equal gender distribution. While 42% (n=88) were from the inpatient department, the bulk of the patients 58% (n=122) came from the outpatient department. Table 1 shows this.

Table 1: Patient Demographics and Departmental Distribution

Characteristic	Value
Mean Age (years)	35.4 (SD: 17.8)
Gender	Male: 52% (n=109)
	Female: 48% (n=101)
Department	Outpatient: 58% (n=122)
	Inpatient: 42% (n=88)

The analysis revealed that 63% (n=132) of patients were prescribed antibiotics empirically without documented evidence of infection, while only 37% (n=78) had prescriptions based on clinical and

microbiological evidence. The most commonly prescribed classes of antibiotics were cephalosporins (42%, n=88), followed by penicillins (28%, n=59), and macrolides (15%, n=32). Broad-spectrum antibiotics accounted for 68% (n=143) of all prescriptions, indicating a preference for these agents over narrow-spectrum antibiotics. As illustrated in figure 1.
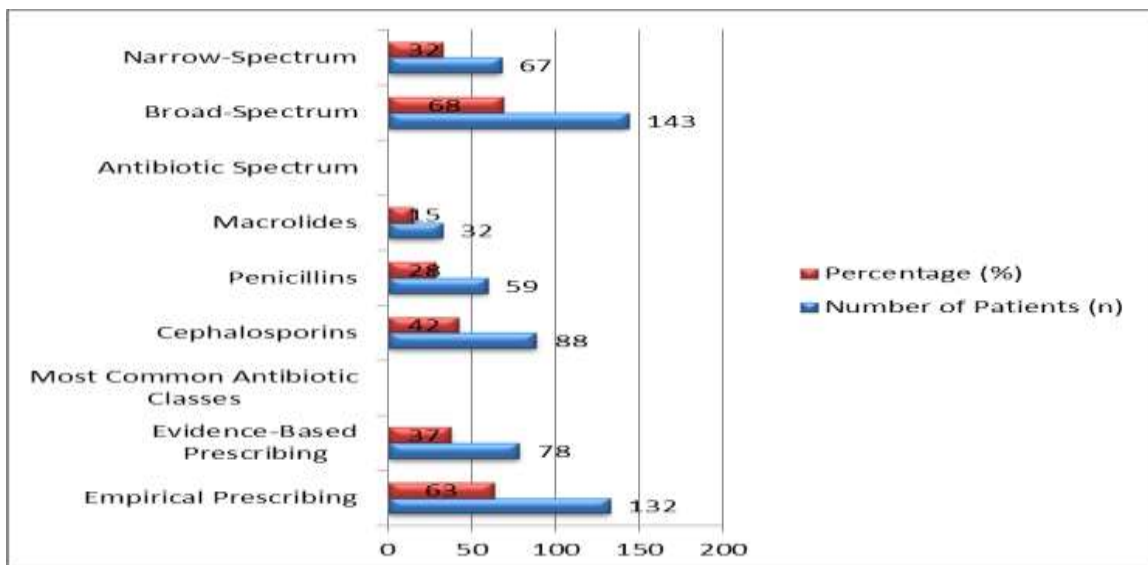

Figure1: Antibiotic Prescribing Pattern

The appropriateness of antibiotic prescriptions was assessed based on compliance with national and international antibiotic stewardship guidelines. The results showed that only 40% (n=84) of the prescriptions were appropriate in terms of indication, choice of antibiotic, dosage, route of administration, and duration of therapy. In contrast, 60% (n=126) of prescriptions were deemed inappropriate, with the most common issues being unnecessary antibiotic use for viral infections (31%, n=65), incorrect choice of antibiotic (18%, n=38), and inappropriate duration of therapy (11%, n=23). As shown in figure 2.
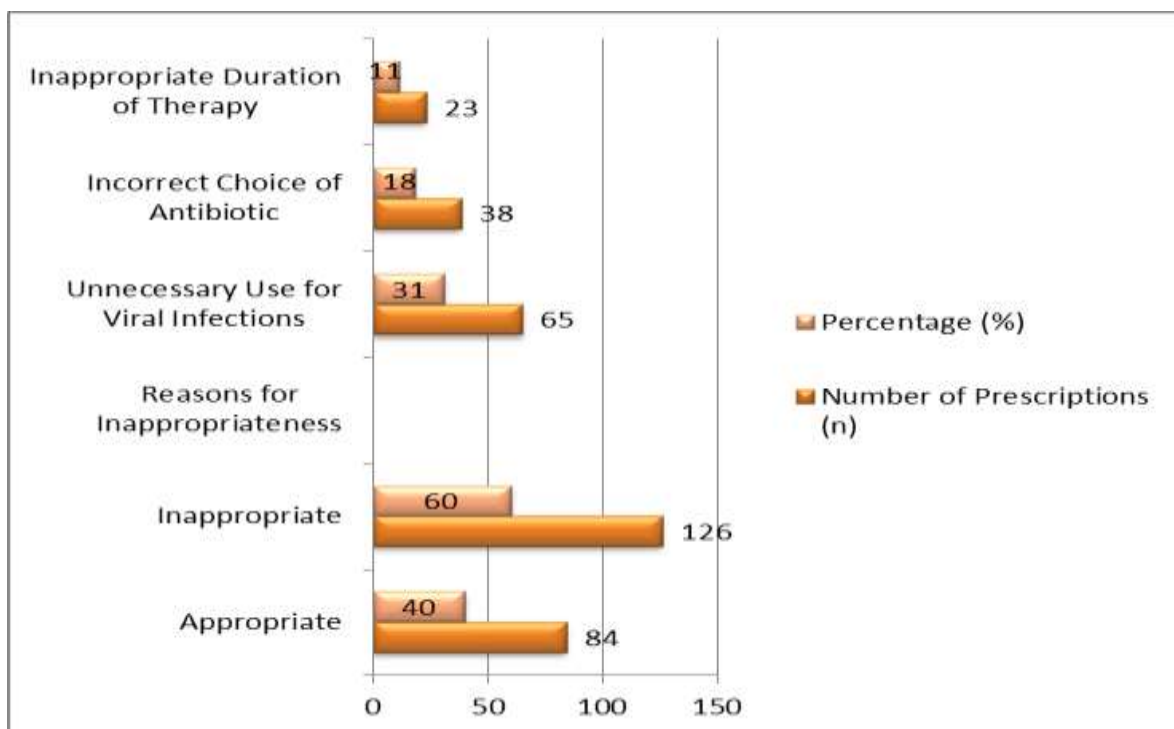

Figure 2: Appropriateness of Antibiotic Use

Several elements clearly linked to incorrect antibiotic prescription were found using logistic regression analysis. With Odds Ratio [OR] = 1.75; 95% Confidence Interval [CI]: 1.08–2.83; p=0.02, patients in the outpatient department were more likely to get incorrect prescriptions than those in the inpatient section. Furthermore more likely to be improper than those written by senior consultants were prescriptions written by junior doctors (OR = 2.12; 95% CI: 1.28–3.52; p=0.003). With a higher risk of improper prescription in cases where laboratory data were not used, the absence of diagnostic instruments was also a major influence (OR = 1.89; 95% CI: 1.11–3.20; p=0.01). Table 2 clearly shows this.

Table 2: Factors Associated with Inappropriate Prescribing

Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Outpatient vs. Inpatient Department	1.75	1.08–2.83	0.02
Junior Doctors vs. Senior Consultants	2.12	1.28–3.52	0.003
Lack of Diagnostic Tools	1.89	1.11–3.20	0.01

During the study period, a targeted educational intervention was implemented for healthcare providers at HMC, focusing on appropriate antibiotic prescribing practices and the principles of antibiotic stewardship. A comparative analysis of prescribing practices before and after the intervention showed a modest improvement in the appropriateness of antibiotic prescriptions. The rate of appropriate prescribing increased from 34% before the intervention to 46% after the intervention, a statistically significant change (p=0.04). This finding suggests that educational interventions can positively impact prescribing behavior, although further efforts are needed to achieve optimal outcomes. As shown in table 3.

Table 3: Impact of Educational Interventions

Time Period	Appropriate Prescriptions (n)	Percentage (%)
Before Intervention	71	34%
After Intervention	96	46%

Discussion

The results of this study expose the major difficulties in maximizing antibiotic use at Hayatabad Medical Complex (HMC) in Peshawar, Pakistan, therefore exposing a high frequency of incorrect antibiotic prescriptions[12]. These findings are in line with earlier research carried out in comparable environments that also show a high frequency of improper antibiotic usage in low- and middle-income countries (LMICs)[13]. For instance, according to an Indian research, almost 58% of antibiotic prescriptions were inappropriate akin to the 60% noted in our study[14]. This consistency implies that improper prescribing is a common problem throughout LMICs, most likely driven by comparable factors including lack of diagnostic tools, insufficient training, and the great availability of antibiotics without prescription[15].

Our study revealed that 63% of antibiotics were prescribed empirically without documented evidence of infection, which aligns with findings from a study in Bangladesh, where empirical antibiotic use accounted for 61% of prescriptions[16]. Both studies highlight the reliance on empirical treatment, often due to the absence of diagnostic facilities and the urgency of treating suspected infections[17]. However, this approach increases the risk of inappropriate antibiotic use, contributing to the development of antibiotic resistance. The preference for broad-spectrum antibiotics observed in our study (68%) is also consistent with findings from studies in Egypt and Nigeria, where broad-spectrum antibiotics were used in over 70% of cases[18]. This trend reflects a general practice in LMICs where broad-spectrum antibiotics are often chosen due to their perceived efficacy in treating a wide range of infections, despite the risks associated with promoting resistance[19]. The appropriateness of antibiotic prescriptions in our study (40%) was found to be lower than in some other studies conducted in LMICs[20]. For instance, a study from South Africa reported that about 55% of antibiotic prescriptions adhered to clinical guidelines[21]. This difference could be attributed to variations in local prescribing

practices, availability of diagnostic tools, and the effectiveness of existing antibiotic stewardship programs. The lower rate of appropriate prescribing in our study highlights the need for more robust stewardship interventions and stricter adherence to guidelines.

Factors associated with inappropriate antibiotic prescribing in our study, such as outpatient department status and prescriptions by junior doctors, are in line with findings from other studies[22]. Research conducted in Ghana and Kenya also found that less experienced healthcare providers were more likely to prescribe antibiotics inappropriately, and outpatient settings were associated with higher rates of empirical prescribing[23]. These findings suggest that targeted educational interventions for junior doctors and outpatient clinicians could significantly improve prescribing practices. The impact of educational interventions in our study showed a modest but statistically significant improvement in appropriate prescribing rates, increasing from 34% to 46%.[24] This outcome is similar to a study conducted in China, where educational interventions led to an improvement in appropriate antibiotic use from 30% to 50%.[25] Both studies underscore the potential of educational programs to enhance antibiotic stewardship, although the modest improvements indicate that such interventions need to be part of a broader, more comprehensive strategy.

Overall, the findings of this study underscore the general problems of empirical prescribing, reliance on broad-spectrum antibiotics, and the necessity of better antibiotic stewardship; they also fit prior studies on antibiotic prescribing practices in LMICs. Future initiatives should concentrate on improving diagnostic skills, giving healthcare professionals ongoing education, and putting strong antibiotic stewardship policies into effect to lower inappropriate antibiotic use and fight the developing problem of antibiotic resistance.

Limitation and future suggestions: The single-center design of this study limits it in terms of fully reflecting antibiotic prescribing patterns over various areas of Pakistan. Moreover, the cross-sectional character of the study restricts the capacity to evaluate long-term effects of treatments. Multi-center investigations will help future studies to offer a more complete picture of antibiotic usage and resistance trends. Furthermore required are longitudinal studies to assess the long-term consequences of stewardship initiatives and educational interventions. Improving prescription practices and properly addressing antibiotic resistance will depend on increasing access to diagnostic technologies and putting continual training for healthcare professionals into use.

Conclusion

With major emphasis on empirical prescribing and broad-spectrum antibiotics, this study shows a high degree of improper antibiotic use at Hayatabad Medical Complex in Peshawar, Pakistan. The results highlight how urgently enhanced antibiotic stewardship programs, more accurate diagnostic support, and focused teaching initiatives for medical professionals will help to maximize antibiotic use. Dealing with these problems will help Pakistan to guarantee good treatment results and fight against antibiotic resistance.

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