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ASSESSING ANTIBIOTIC USE AND PRESCRIPTION PATTERNS AMONG PATIENTS IN KARACHI: A STUDY ON COMPLIANCE AND INFECTION CONTROL

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Abstract

Background: Effective management of infections heavily relies on appropriate antibiotic use and adherence to prescribed treatment regimens. This study aims to evaluate antibiotic use and prescription patterns among patients in Karachi and assess their impact on infection control and patient compliance.

Methods: This cross-sectional study involved 96 patients with various infections who were recruited from community (retail) pharmacies in Karachi. Data were collected on sociodemographic characteristics, antibiotic prescription patterns, culture sensitivity testing, and patient compliance. Statistical analyses, including chi-squared tests, were used to assess the relationships between different variables and infection control outcomes.

Results: The majority of patients were prescribed monotherapy, with penicillin and macrolides being the most frequently used antibiotics. A significant proportion of patients (75%) did not undergo culture sensitivity testing. The study found that female patients exhibited better infection control compared to males (80.6% vs. 55.4%, $p = 0.016$). Proper diagnosis on prescriptions was associated with 100% infection control. Factors such as smoking, marital status, and employment status were significantly associated with infection control outcomes.

Conclusion: The study indicates that adherence to infection control practices, including timely culture sensitivity testing and accurate diagnosis, significantly improves infection management. The findings underscore the importance of following recommended guidelines for antibiotic prescriptions and patient compliance to enhance treatment efficacy. Future research should focus on a broader range of healthcare settings to further explore these patterns and their impact on infection control.

Keywords: Antibiotic use, prescription patterns, infection control, patient compliance, Karachi

INTRODUCTION

Antibiotics have fundamentally changed the landscape of medicine (Cook & Wright, 2022), offering powerful tools to combat bacterial and fungal infections that were once frequently fatal (Chinemerem Nwobodo et al., 2022). The journey began with the discovery of penicillin by Alexander Fleming in 1928, which heralded the antibiotic era (Treacy, 2023). This breakthrough drastically altered the treatment of infections, significantly reducing mortality rates and transforming medical practice. Prior to antibiotics, infectious diseases such as tuberculosis, pneumonia, and sepsis were major causes of death, and the average life expectancy was considerably lower than it is today (Davenport, 2021).

The term "antibiotics" was derived from the concept of "antibiosis," (Dhakad et al., 2022) which describes the antagonistic interaction between microorganisms (Sullivan et al., 2020). Initially, antibiotics referred broadly to substances produced by microorganisms that could inhibit or kill other microorganisms (Saikia & Chetia, 2024). These natural compounds, produced by bacteria or fungi, target specific bacterial functions or structures, such as cell wall synthesis or protein production, to eliminate pathogens while minimizing harm to the host (Mahmoudi et al., 2024). This targeted approach revolutionized treatment strategies and made previously incurable infections manageable.

Despite their success, antibiotics are not without their challenges. The rise of antimicrobial resistance (AMR) has emerged as a critical issue, driven by factors such as inappropriate prescribing practices, overuse of antibiotics, and self-medication (Ahmed et al., 2024). AMR occurs when bacteria evolve mechanisms to resist the effects of antibiotics, rendering standard treatments ineffective (Mahizhchi et al., 2024). This resistance is exacerbated by the widespread use of antibiotics in both healthcare and agriculture, where they are often used prophylactically or to promote growth in livestock (Mdegela et al., 2021).

The impact of AMR is profound, leading to longer illness durations, higher healthcare costs, and increased mortality rates (Tang et al., 2023). In high-income countries, the focus has shifted towards managing chronic diseases, but the problem of AMR remains significant (Coque et al., 2023). In contrast, LMICs, including Pakistan, face a dual burden of infectious and chronic diseases, with AMR compounding the challenges of managing infectious diseases effectively (Mikell et al., 2022).

Rational prescribing of antibiotics is essential to combating AMR and improving patient outcomes (Murugaiyan et al., 2022). This involves selecting appropriate antibiotics based on the infection's etiology, duration of therapy, and patient factors while avoiding unnecessary or inappropriate use. Rational prescribing aims to maximize therapeutic efficacy, minimize adverse effects, and reduce the development of resistance (Bassetti et al., 2022). Key strategies include implementing educational programs for healthcare professionals, enforcing regulatory measures to control antibiotic sales, and conducting drug utilization evaluations (DUE) to monitor and optimize prescribing practices (Summers, 2020).

In Karachi, Pakistan, there is a notable gap in research regarding antibiotic use and infection control. The city's diverse population and healthcare challenges make it a critical area for studying antibiotic prescribing patterns and compliance (Ullah et al., 2020). Inappropriate use of antibiotics in Karachi, such as over-prescription and self-medication, contributes to the growing problem of AMR (Alam et al., 2023). This study seeks to address this gap by examining antibiotic use among patients in Karachi and evaluating factors affecting prescription practices and infection control.

This study provides a comprehensive analysis of antibiotic use and prescription patterns in Karachi, focusing on demographic variations and compliance issues, with the aim of identifying trends and challenges in antibiotic prescribing. The study seeks to contribute to the development of targeted interventions to improve infection management and reduce antimicrobial resistance (AMR), ultimately informing healthcare policies, enhancing prescribing practices, and supporting public health initiatives to control infections and improve patient care in Karachi and similar settings. Specifically, the objectives include identifying common patterns and types of antibiotics prescribed

in Karachi, assessing adherence to antibiotic prescribing guidelines among healthcare providers, and examining how adherence to these guidelines influences infection control and resistance rates.

METHODOLOGY

The study was conducted in Karachi, Pakistan, focusing on antibiotic use and prescription patterns among patients. This cross-sectional observational study was carried out across various community (retail) pharmacies to gather comprehensive data on antibiotic prescriptions and their impact on infection control. The study spanned from January 15, 2024, to July 15, 2024.

Study Design and Setting

The research employed a multicenter design, involving multiple community pharmacies in Karachi. This approach allowed for a broad and representative sample of patients. A pre-validated data collection tool was utilized to ensure accuracy and consistency in capturing relevant information.

Sample Size and Selection

The study aimed to include approximately 100 patients. A stratified convenience sampling method was used to select participants, with age categories divided into six groups: less than 5 years, 5-14 years, 15-30 years, 31-44 years, 45-64 years, and 65 years and older. Pregnant women and those unwilling to participate were excluded from the study.

Data Collection

Data were collected through detailed patient interviews conducted by registered pharmacists. The data collection form included demographic information, medical history, type of therapy, and adherence to prescribed treatments. Patients were asked about their antibiotic use, including the specific antibiotics prescribed, duration of treatment, and any issues with compliance. Information was gathered directly from the patients' medication records and community pharmacies.

Ethical Considerations

Consent was secured from all participants after explaining the study's purpose and implications. Each pharmacy involved in the study received a mandatory consent form, and participants were informed about their rights and the study's significance.

Statistical Analysis

Descriptive and analytical statistical methods were used to analyze the data. The Statistical Package for the Social Sciences (SPSS) version 26.0 was employed for statistical analysis. A significance level of $P < 0.05$ was established to determine statistical significance. Non-parametric tests, such as the chi-square test, were used to assess the relationship between antibiotic prescription patterns and infection control outcomes. Effect sizes were calculated using Phi and Cramer's V to evaluate the strength of associations.

RESULTS

In a study involving 96 patients with various infections recruited from different community pharmacies in Karachi, male patients had a higher participation rate than females. Approximately 75% of the sample did not undergo culture and sensitivity testing. The sociodemographic details of the respondents are presented in Table 1. The study evaluates the impact of different variables on antibiotic use and infection control among patients with various infections.

Approximately 95% of the patients were on monotherapy for their infections. Only 16.7% of the total sample reported engaging in daily exercise. Additionally, around 55.2% of the sample had a proper diagnosis noted on their prescription. Detailed information about these variables can be found in Table 1.

Table 1: Demographic Information of the Patients (N=96)

Title	Keywords	Objective	Findings
Gender	Male, Female	Assess gender distribution in infection control	Male: 65 (67.7%), Female: 31 (32.3%)
Age	Age Groups	Analyze age-wise distribution	Less than 5 years: 2 (2.1%), 5-14 years: 7 (7.3%)
Culture Sensitivity	Yes, No	Evaluate impact of culture sensitivity testing	Yes: 24 (25.0%), No: 72 (75.0%)
Marital Status	Yes, No	Analyze marital status effect on infection control	Yes: 47 (49.0%), No: 49 (51.0%)
Daily Exercise	Yes, No	Assess impact of daily exercise on infection control	Yes: 16 (16.7%), No: 80 (83.3%)
Smoking	Yes, No	Examine smoking impact on infection control	Yes: 22 (22.9%), No: 74 (77.1%)
Number of Antibiotics	Mono, Dual, Triple	Determine therapy patterns	Monotherapy: 91 (94.8%), Dual therapy: 5 (5.2%)
Patient Education	No formal, Primary, Secondary, College, University	Explore education impact on infection control	No formal education: 23 (24.0%)
Employment Status	Yes, No	Evaluate employment status impact on infection control	Yes: 53 (55.2%), No: 43 (44.8%)
Diagnosis	Yes, No	Assess impact of written diagnosis on control	Yes: 53 (55.2%), No: 43 (44.8%)
Route of Drug Administration	Oral, Parenteral	Determine preferred route of administration	Oral: 77 (80.2%), Parenteral: 19 (19.8%)

In a study involving 96 patients with diverse infections recruited from various community pharmacies, several findings emerged regarding infection control and antibiotic use. Female patients exhibited better infection control (80.6%) compared to their male counterparts. This indicates a significant difference in infection management between genders ($P = 0.016$). Children younger than five years achieved 100% infection control, which is higher compared to other age groups. However, the difference across age groups was not statistically significant ($P = 0.097$). Patients who had a proper diagnosis written on their prescriptions showed superior infection control (100%) compared to those without a diagnosis on their prescription. This result highlights the importance of accurate diagnosis in managing infections ($P < 0.001$).

There was no significant association between the level of patient education and infection control ($P = 0.968$), suggesting that education level did not affect infection management in this study. The most commonly prescribed antibiotic was penicillin, followed by macrolides. Sulfonamides were the least prescribed. Regarding patient compliance, 54% of patients adhered to their prescribed therapy, indicating a moderate level of compliance with antibiotic regimens.

Table 2: Demographic Information of the Patients (N=96)

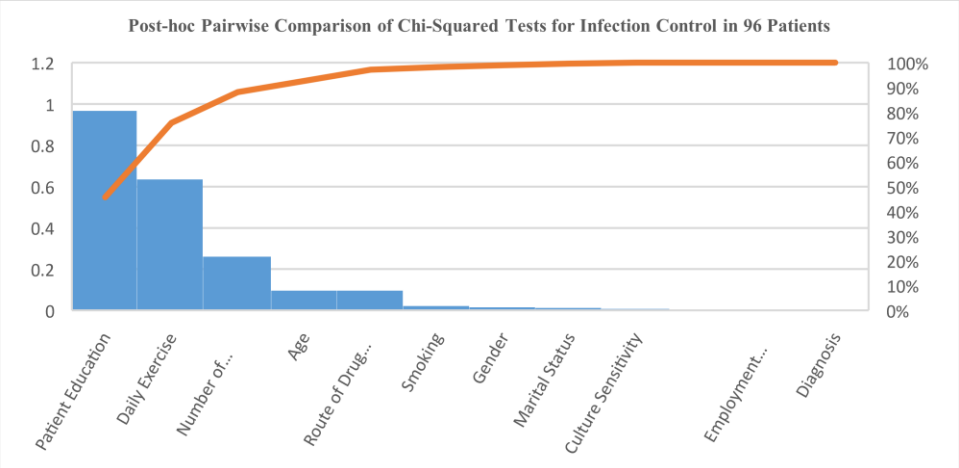
Variable	Category	Frequency (N)	Percentage (%)
Gender	Male	65	67.7
	Female	31	32.3
Age	Less than 5 years	2	2.1
	5-14 years	7	7.3
	15-30 years	12	12.5
	31-44 years	40	41.7
	45-64 years	20	20.8
	More than 65 years	15	15.6
Culture Sensitivity	Yes	24	25.0
	No	72	75.0
Marital Status	Yes	47	49.0
	No	49	51.0
Daily Exercise	Yes	16	16.7
	No	80	83.3
Smoking	Yes	22	22.9
	No	74	77.1
Number of Antibiotics	Monotherapy	91	94.8
	Dual Therapy	5	5.2
	Triple Therapy	0	0.0
Patient Education	No formal education	23	24.0
	Primary	12	12.5

	Secondary	16	16.7
	College	18	18.8
	University	27	28.1
Employment Status	Yes	53	55.2
	No	43	44.8
Diagnosis	Yes	53	55.2
	No	43	44.8
Route of Drug Administration	Oral	77	80.2
	Parenteral	19	19.8

Table 3: Post-hoc Pairwise Comparison of Chi-Squared Tests for Infection Control in 96 Patients

Variable	Category	Infection Control (N %)	P-value*	Effect Size#
Gender	Male	36 (55.4)	0.016	0.245
	Female	25 (80.6)		
Age	Less than 5 years	2 (100)	0.097	-
	5-14 years	7 (100)		
	15-30 years	9 (75)		
	31-44 years	22 (55)		
	45-64 years	10 (50)		
	More than 65 years	11 (73.3)		
Culture Sensitivity	Yes	19 (79.2)	0.008	0.187
	No	42 (58.3)		
Marital Status	Yes	24 (51.1)	0.013	0.254
	No	37 (75.6)		
Daily Exercise	Yes	11 (68.8)	0.635	-
	No	50 (62.5)		
Smoking	Yes	9 (40.9)	0.022	0.256
	No	52 (70.3)		
Number of Antibiotics	One drug	59 (64.8)	0.261	-
	Two drugs	2 (40)		
	Three drugs	0 (0)		
Patient Education	No formal education	16 (69.6)	0.968	-
	Primary	7 (58.3)		
	Secondary	10 (62.5)		
	College	11 (61.1)		
	University	17 (63)		
Employment Status	Yes	42 (79.2)	<0.001	0.362
	No	19 (44.2)		
Diagnosis	Yes	53 (100)	<0.001	0.841
	No	8 (18.6)		
Route of Drug Administration	Oral	46 (59.7)	0.096	-
	Parenteral	15 (78.9)		

Figure 1: **Post-hoc Pairwise Comparison of Chi-Squared Tests for Infection Control in 96 Patients**



The Chi-square test was used to assess the null hypothesis (post-hoc pairwise comparison of chi-squared test). Phi and Cramer's V were utilized to determine effect size, ranging from 0 to 1. A value of 0 indicates no association between the two variables, while a value of 1 indicates a perfect association between the two variables.

Discussion

Successfully managing infections hinges on various factors, including patient adherence to prescribed medication schedules and the pattern of antibiotic use. This study delves into these aspects by analyzing the impact of different variables on infection control among patients in Karachi.

The study observed a notable difference in infection control between genders, with females demonstrating better control (80.6%) compared to males (55.4%). This significant finding ($p = 0.016$) suggests a moderate positive association between gender and infection control. The enhanced control in females could be attributed to several factors, including healthier dietary habits, earlier and more frequent medical consultations, and generally better adherence to health guidelines. These findings resonate with a study by (Gautam et al., 2021) which reported similar results among diabetic patients, and align with findings from South Asia indicating a positive impact of gender on infection control.

The analysis revealed a positive effect of culture and sensitivity testing on infection control, with a p-value of 0.008 and an effect size of 0.187. This weak positive association suggests that patients who undergo these tests experience better infection control. Unmarried patients exhibited better infection control (75.6%) compared to married patients (51.1%), with a statistically significant difference ($p = 0.013$). This finding aligns with (ABEDOH, 2024), who reported better infection control in single and widowed individuals compared to their married counterparts. The busier schedules of married patients may contribute to this disparity.

A moderate positive association was found between smoking status and infection control, with a p-value of 0.022 and an effect size of 0.257. Smoking's detrimental effect on infection control aligns with research indicating that smokers face higher risks of infections (Cicchinelli et al., 2023). The number of antibiotics used did not show a significant association with infection control ($p = 0.261$). This finding suggests that the quantity of antibiotics may not be as crucial as other factors in controlling infections.

Contrary to some previous studies (Cicchinelli et al., 2023), patient education did not significantly impact infection control in this study ($p = 0.968$). This discrepancy may be due to variations in educational interventions or patient demographics across studies.

The study found a positive impact of employment status on infection control, with a p-value of < 0.001 and an effect size of 0.362. Employed patients might have better access to healthcare resources or adhere more closely to treatment plans. Proper diagnosis was strongly associated with infection control, with a 100% cure rate for patients with a correct diagnosis and an effect size of 0.841. This underscores the critical role of accurate diagnosis in effective infection management, corroborating findings from (Cicchinelli et al., 2023).

Penicillin and macrolides were the most frequently prescribed antibiotics, likely due to their efficacy and alignment with infection control guidelines (Sanchez, 2016). The observed patterns of antibiotic use highlight the importance of adhering to recommended treatment protocols. The study found a 54% patient compliance rate, which is crucial for effective infection control. This rate aligns with (Turen et al., 2021), who found that higher compliance correlated with better treatment outcomes in diabetic patients. Adherence to prescribed treatments is essential for controlling infections and achieving optimal health outcomes.

In summary, the study highlights the significant factors influencing infection control, including gender, culture testing, marital status, smoking, and proper diagnosis. The findings underscore the importance of targeted interventions and adherence to treatment guidelines to enhance infection management and patient outcomes.

Conclusion

In conclusion, the study highlights that physician in Karachi, Pakistan, exhibit satisfactory prescription patterns that align with established infection management guidelines. The frequent use of antibiotics such as penicillin and macrolides underscores the adherence to recommended treatment protocols. Key factors identified for achieving better infection control include timely culture sensitivity testing, avoidance of smoking, and accurate disease diagnosis. These factors are critical for effective disease management and achieving successful infection outcomes.

Limitations of the Study

This study was limited to selected pharmacies that primarily serve patients for prescription refills. A broader follow-up study could provide more comprehensive insights into the influence of demographics and the patterns of antibiotic prescriptions across a wider range of healthcare settings in Pakistan.

Authors' Contributions

This work was conducted collaboratively by all authors. Each author contributed to the research, data analysis, and manuscript preparation, and all authors reviewed and approved the final manuscript.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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