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Medical Science

To Cite:
Iqbal MZ, Shahzad S, Latif SMU, Mubarik A, Fatima N, Arshad S, Aamir R, Shoukat MA, Ilyas MA, Sher F. Prescription pattern of antibiotics and infection control among outpatients presented at the different community pharmacies in Lahore, Pakistan. *Medical Science* 2024; 28: e29ms3327
doi: https://doi.org/10.54905/disssi.v28i146.e29ms3327

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Peer-Review History
Received: 26 January 2024
Reviewed & Revised: 30/January/2024 to 06/April/2024
Accepted: 10 April 2024
Published: 16 April 2024

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

DISCOVERY SCIENTIFIC SOCIETY

Prescription pattern of antibiotics and infection control among outpatients presented at the different community pharmacies in Lahore, Pakistan

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ABSTRACT

Background: Infection is a public health issue all over the world. There are specific demographics that influence infection rates, and prescription patterns vary between countries. *Objective:* This study aimed to determine the prescription pattern of physicians working in Lahore city and the factors affecting infection cure rate. *Methods:* This cross-sectional study was conducted in a different community pharmacy in Lahore city, and the prescriptions belonging to different physicians were evaluated. An infection control rate was also checked in a patient by a validated data collection form. Statistical Package for Social Science (SPSS) ver. 25.0 was used to analyze the data. *Results:* There was a statistically significant association ($p<0.001$) observed between infection control and patients' gender. Post-hoc pairwise comparison of the chi-square test reveals that culture and sensitivity test is having a positive effect on an infection cure rate in patients visiting different community pharmacies in Lahore city where the P value was 0.008 and effect size was determined to be 0.187, indicating a weak positive association in a culture sensitivity test and infection rate cure. In the current study, it was found that unmarried patients (75.5%) had better infection control compared to married patients (51.1%). *Conclusion:* In conclusion, the study participants showed that better control of infection could be achieved by conducting timely culture sensitivity tests, avoiding smoking in patients, and making timely and proper diagnoses of diseases.

Keywords: Infection control, prescription pattern, demographic variables, adherence of patients, antibiotics, community pharmacies

1. INTRODUCTION

In the present day, a wide variety of antibiotics are used to treat different types of diseases and assist in controlling infections. They are the most commonly prescribed drugs worldwide, offering hope to patients with various bacterial and fungal diseases. In 1980, the term 'antibiosis', the opposite of symbiosis, was first used by Paul Vuillemin to describe the interactions among various microorganisms (Nicolaou and Rigol, 2018). However, the term "antibiotics" later came to refer to naturally occurring products of microorganisms, such as bacteria or fungi, that help kill other microorganisms by inhibiting their growth. Previously, infectious diseases were the leading cause of high morbidity and mortality worldwide, with the average life expectancy at birth being below 50.

In 1928, Alexander Fleming discovered the first antibiotic, penicillin, marking the beginning of the antibiotic era. In the US, non-communicable diseases such as cardiovascular diseases, cancer, and stroke became the major causes of death, and the average life expectancy at birth rose to 78.8 years. However, individuals with chronic kidney and liver diseases still face significant risks (Adedeji, 2016). Antibiotics have been playing a role in various diseases. For Example, in respiratory disorders, aerosols prepared with antibiotics drastically reduced inflammation and infective exacerbations (Babu et al., 2013). Similarly, in Inflammatory Bowel Disease (IBD), an idiopathic intestinal condition, many antibiotics successfully cure it by reducing the abnormal gut microbiota (Nitzan et al., 2016).

The prescribing pattern and appropriate use of antibiotics are essential factors in reducing antibiotic resistance. It is also helpful in monitoring, evaluating, and making modifications to the physician's prescription practices, prioritizing patient care, and making it more effective. Drug utilization evaluation (DUE) is also necessary to reduce cases of antibiotic resistance caused by the use of multiple drugs at the same time (Remesh et al., 2013). In rational prescribing, physicians should aim for enhanced clinical effectiveness, minimize adverse events, avoid wasting sacred healthcare resources, and respect patient choice (Maxwell, 2016). The strategies for promoting rational prescribing include educational, managerial, and regulatory approaches. A study showed that infectious diseases killed more than 30 million young people in 2019. Meanwhile, the majority of communicable disease cases were found in children under five years old, with a growing trend in children older than five and adolescents.

Tuberculosis and Human Immunodeficiency Virus (HIV) are increasingly prevalent in adolescents. On the other hand, diarrhea, pneumonia, and malaria account for 59.8% of infections in young people. Most infection-related deaths occur in developing countries such as Nigeria, Pakistan, and India. Antimicrobial resistance is one of the major issues, especially in the developing world, causing a significant rise in health costs and mortality. This is mainly due to the rising use of antibiotics in the developing world, self-medication, low-quality drugs, extensive use of antibiotics in animals, and low vaccination rates (Godman et al., 2021). A previous study suggests that less than 40 percent of patients receive treatment in line with guidelines, even in the developing world.

Therefore, there is a need for national and international policies to educate ordinary people and healthcare professionals about the judicious use of antibiotics, regulatory control over the availability of antibiotics without prescription, and surveillance of antimicrobial use and resistance (Uchil et al., 2014). Streptococcus pneumoniae continues to be the primary cause of pneumonia in hospital-acquired and community-acquired pneumonia. Patients in outpatient settings with no co-morbidities are usually treated with amoxicillin in contrast to a combination of Co-amoxiclav and macrolide in patients having co-morbidities and admitted to hospitals (Modi and Kovacs, 2020). Mycobacterium tuberculosis (MTB) has appeared as one of the top 10 causes of death worldwide (Xi et al., 2022). Drug-sensitive tuberculosis is treated in two phases.

The first phase, also known as the intensive phase, involves the use of Rifampicin, Isoniazid, Pyrazinamide, and Ethambutol for eight weeks. This is followed by the continuation phase, where treatment consists of Isoniazid, Rifampicin, and Ethambutol for 16 weeks (Natarajan et al., 2020). Multidrug-resistant tuberculosis is caused by Mycobacterium tuberculosis strains that are resistant to Isoniazid and Rifampicin. The resistance to antibiotics is influenced by factors such as socioeconomic status, race, lifestyle, and detection techniques (Xi et al., 2022). Research on the use of antibiotics and infection control in the outpatient setting in Pakistan is limited. This study aims to assess the use of antibiotics among different demographic populations in Lahore, Pakistan, and examine the role of compliance in prescription patterns.

2. MATERIALS AND MATERIALS

The current study is multicentered and was conducted at various community pharmacies in Lahore, one of the biggest and most significant cities in Pakistan. In this cross-sectional observational study, we utilized a pre-validated data collection tool to gather

feedback and responses from patients at various community pharmacies. This study lasted seven months, from December 12, 2022, to June 22, 2023. The purpose of this study was to assess the prescription patterns of antibiotics and infection control among outpatients who have been taking these prescribed antibiotics continuously for an extended period from various community pharmacies in Lahore. The study aimed to explore the association between different demographic factors, and infection control among outpatients. Additionally, the study aimed to analyze the type of therapy, its frequency, patient compliance with the treatment, and the specific antibiotics that have been prescribed. This information was gathered from community pharmacies where patients purchased medications as prescribed by their physicians.

The study originally aimed for a sample size of approximately 96 patients and used a stratified convenience sampling approach. Patient age is mainly divided into six groups: Less than five years, 5-14 years, 15-30 years, 31-44 years, 45-64 years, and more than 65 years. Pregnant women and those unwilling to participate were excluded from the study. Information was collected using a detailed form that included patients' demographics, family and mental health history, symptoms, type of therapy, and the duration of treatment. Registered pharmacists in Pakistan conducted the data collection. Pharmacies were randomly selected, and each eligible pharmacy received a mandatory consent form. Clear explanations were provided for each query. After obtaining ethical approval, we communicated the significance and implications of the study to every eligible participant.

Subsequently, consent was obtained from the selected study participants, and the study's ethical considerations were emphasized. A minimum of five prescriptions were gathered from each community pharmacy, and all necessary data was documented on a data collection form during patient interviews. All patients with infections and a complete medication record, including their age, race, gender, family history, marital status, and medical history (past and current), were requested to provide consent. This study received ethical approval from Lahore Pharmacy College, Lahore, Pakistan, with the ethical approval number (ref: ZI/43/22).

Statistical analysis

The experiment data is presented in both descriptive and analytical formats. The data underwent statistical analysis using the Statistical Package for the Social Sciences (SPSS) version 24.0. A significance level of $P < 0.05$ was set to determine statistical significance. Non-parametric statistical analysis, which examines the relationship between a dependent variable and infection control, was employed. The analysis of data for the control of infection involved using a chi-square test to determine the p-values of different variables. A p-value of less than 0.05 was considered to be statistically significant in this model. Additionally, the effect size was calculated using Phi and Cramer's V in the non-parametric analysis. These measures adjust the chi-square significance to factor out the sample size.

3. RESULTS

In a study involving 96 patients with diverse infections recruited from various community pharmacies, male patients had a higher participation rate than females. Approximately 75% of the sample did not undergo cultural and sensitivity testing. The socio-demographic details of the respondents are presented in (Table 1). The study evaluates the impact of different variables on infection control in patients with various diseases. Approximately 95% of the total patients were on monotherapy to treat infections in various community pharmacies. Only 16.7% of the total sample size reported daily exercise. Furthermore, around 55.2% of the sample had a proper diagnosis written on their prescription. More detailed information can be obtained from Table 1.

Table 1 Represents the demographic information of the patients. (N=96)

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	
Mono therapy	91 (94.8)
Dual therapy	5 (5.2)
Triple therapy	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)

Female patients who participated in the present study got more infection control (80.6%) as compared to males. Similarly, children with ages less than five years had more controlled infection (100%) as compared to the other age groups of the current study (*P = 0.097*). Similarly, patients with a proper diagnosis written on a prescription also have a better infection control 53 (100%) as compared to the patients who do not have a diagnosis on their prescription. On the other hand, there is no significant association between the education of a patient and infection control (P = 0.968). More details can be found in Table 2.

Various types of antibiotics were used by patients visiting community pharmacies. The most commonly prescribed antibiotic was penicillin, followed by macrolides. On the other hand, the least prescribed antibiotic was sulfonamides. Detailed information can be found in Figure 1 below. A range of patient compliance was observed as patients visited pharmacies to collect their medication. The majority of the patients, accounting for 54%, adhered to the prescribed therapy. Further details about compliance can be found in (Figure 2).

Table 2 Post-hoc pairwise comparison of chi-squared tests for different variables with control of infection in 96 patients.

Variables	Infection Control (N %)		*P*-value*	Effect size#
	Yes	No		
Gender				
Male	36 (55.4)	29 (44.6)	*0.016*	0.245
Female	25 (80.6)	6 (19.4)		
Age				
Less than five years	2 (100)	0 (0)	0.097	-
5-14 years	7 (100)	0 (0)		
15-30 years	9 (75)	3 (25)		
31-44 years	22 (55)	18 (45)		
45-64 years	10 (50)	10 (50)		
More than 65 years	11 (73.3)	4 (26.7)		
Culture Sensitivity				
Yes	19 (79.2)	5 (20.8)	0.008	0.187
No	42 (58.3)	30 (41.7)		
Marital Status				
Yes	24 (51.1)	23 (48.9)	0.013	0.254
No	37 (75.5)	12 (24.5)		
Daily Exercise				
Yes	11 (68.8)	5 (31.3)	0.635	-
No	50 (62.5)	30 (37.5)		
Smoking				
Yes	9 (40.9)	13 (59.1)	0.022	0.256
No	52 (70.3)	22 (29.7)		
Number of antibiotics				
One drug	59 (64.8)	32 (35.2)	0.261	-
Two drugs	2 (40)	3 (60)		
Three drugs	0 (0)	0 (0)		
Patients Education				
No formal	16 (69.6)	7 (30.4)	0.968	-
Primary	7 (58.3)	5 (41.7)		
Secondary	10 (62.5)	6 (37.5)		
College	11 (61.1)	7 (38.9)		
University	17 (63)	10 (37)		
Employment status				
Yes	42 (79.2)	11 (20.8)	<0.001	0.362
No	19 (44.2)	24 (55.8)		
Diagnosis				
Yes	53 (100)	0(0)	<0.001	0.841
No	8 (18.6)	35 (81.4)		
Route of Drug Administration				
Oral	46 (59.7)	31 (40.3)	0.096	-
Parenteral	15 (78.9)	4 (21.1)		

*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.

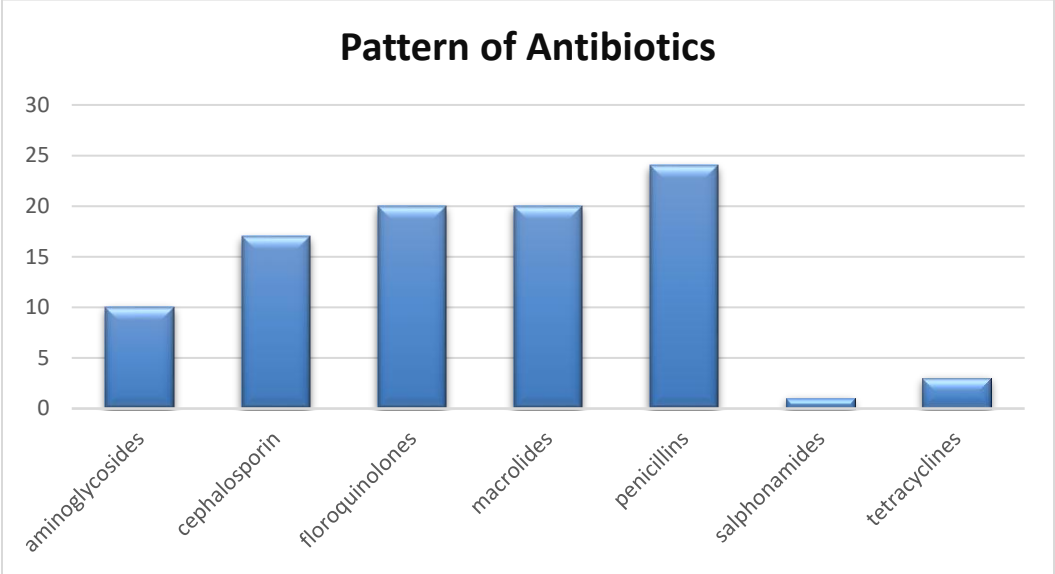

Figure 1 Pattern of antibiotics in patients.

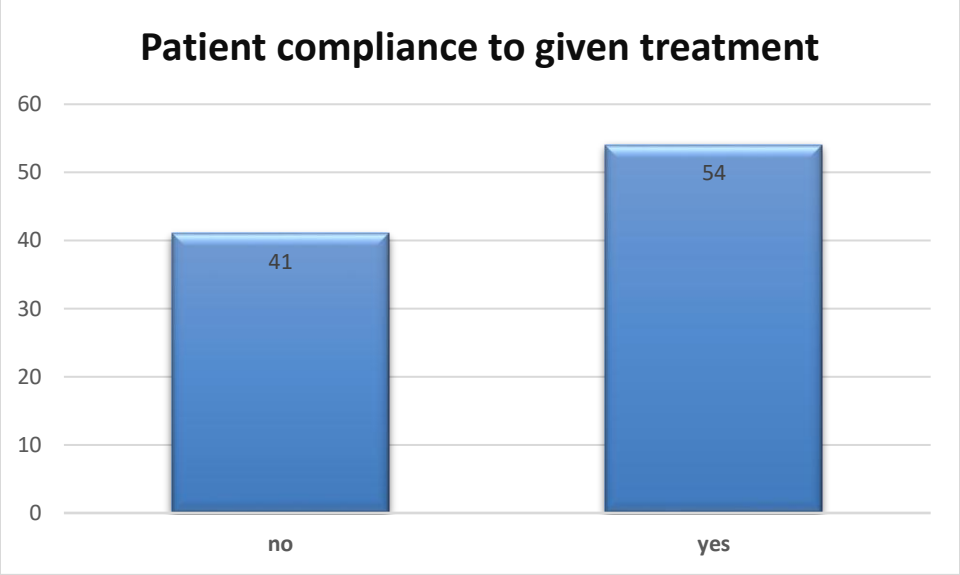

Figure 2 Pattern of antibiotics prescribed in the patients.

4. DISCUSSION

Successfully treating an infection relies on the patient's commitment to following the prescribed medication schedule, including both dosage and frequency. Additionally, the prescription pattern of antibiotics is crucial for effectively controlling patient infections. By addressing relevant contributing factors, the control of infection can be significantly enhanced. This study meticulously analyzed the diverse confounding variables associated with infection control. Females constituted the majority of patients diagnosed with infection, making up 80.6% of the population. There was a statistically significant association of $p<0.001$ observed between infection control and patients' gender. The current research suggests that female patients exhibited superior infection control compared to male patients,

with a p-value of 0.016 and an effect size of 0.245. This finding indicates a moderate positive association between gender and infection control.

The enhanced infection control observed in females could be attributed to their healthier dietary habits and heightened focus on health. Additionally, women seek medical assistance earlier and more frequently than men. Moreover, research has indicated that women generally consume less alcohol, follow a nutritious diet, engage in regular exercise, and are more likely to adhere to a healthy meal plan. Our current study findings align with a 2014 study conducted in Malaysia, which reported similar results among patients with diabetes mellitus. However, most of the patients enrolled in the study were male, i.e., 51.3%. However, the control was more effective in females (Iqbal et al., 2014). Similarly, the research findings are also consistent with a study conducted in Pakistan, which indicates that gender has a positive impact on controlling infections.

Post-hoc pairwise comparison of the chi-square test reveals that culture and sensitivity test is having a positive effect on an infection cure rate in patients visiting different community pharmacies in Lahore city where the P value was 0.008 and effect size was found to be 0.187, indicating a weak positive association in a culture sensitivity test and infection rate cure. The current research findings align with a study conducted in Pakistan in 2023. The study showed that patients who underwent culture and sensitivity tests had better-controlled infection rates and received proper medication compared to those who did not undergo the tests (Altaf et al., 2023). The study findings indicated that unmarried patients (75.5%) had better control compared to married patients (51.1%). The study found a statistically significant difference with a p-value of 0.013 and an effect size of 0.254. It observed that marital status had an impact on controlling infections in patients visiting community pharmacies.

These findings align with a 2010 study on sepsis by Seymour et al., (2010) and his team, which reported that sepsis was significantly more controlled in single and widowed individuals compared to married persons. This could be due to the busier schedules of married patients compared to single individuals (Seymour et al., 2010). A moderate positive association was observed between the smoking status of patients and the control of infections. The analysis showed a positive impact with a P value of 0.022 and Phi and Cramer's values of 0.256 when comparing these two variables. The likely reason for this is the negative impact of smoking and nicotine on the body, which could worsen the situation of infection (Arcavi and Benowitz, 2004). According to a 2020 narrative review, the risk of infection is two to three times higher when a patient smokes, and vice versa (Jiang et al., 2020).

On the other hand, the number of antibiotics does not relate to the control of infections in patients coming to a community pharmacy with a P value of 0.261 when the chi-square test was used to find the association. In the current survey, patient education was found to have no relationship with infection control in patients visiting community pharmacies, as indicated by a P value of 0.968 when the chi-square test was applied to assess the association between these two variables. These findings contrast with a study conducted in Turkey, which suggested that improving patient education or providing training to patients or their family members leads to better infection control in patients (Erdek et al., 2017). The findings of a recent study show that the employment status of patients has a positive impact on the control of infection in patients. The association was moderately positive with a P value of < 0.001 and an effect size of 0.362.

Similarly, the proper diagnosis of an underlying condition of disease has a positive impact on the control of infections in a patient, and the patients with a correct diagnosis were 100% cured at the end of the current study and the association was found to be a strongly positive association with an effect size of 0.841. A hospital-based cross-sectional survey on infectious patients in 2023 by Fabre and colleagues reported that a proper diagnosis has a direct relation with the cure of infection in a patient (Fabre et al., 2023). The current study reveals that the most important and frequently used antibiotics in a prescription pattern were penicillin and macrolides.

The higher use of penicillin (24%) and macrolides (20%) in prescriptions may be due to recommendations from infection control guidelines (Leekha et al., 2011; Quek et al., 2022). Patient compliance also directly relates to infection control, with a rate of 54%. The likely reason for this could be that patients are following the treatment guidelines or receiving better counseling during the prescription or follow-up with their physicians. By taking medication on time as prescribed, the infection can be better controlled. These findings align with a study conducted by Iqbal et al., (2024) in Malaysia, which found that patients who were more compliant with their treatment had better outcomes in a randomized control trial evaluating patients with diabetes mellitus.

5. CONCLUSION

Physicians working in Lahore, Pakistan, demonstrate adequate prescription patterns in line with the recommendations of different guidelines on infections. The most frequently prescribed antibiotics were penicillin and macrolides. The study participants indicated that better infection control can be achieved by timely culture sensitivity testing, avoiding smoking in patients, and ensuring timely and accurate disease diagnosis, all of which play a significant role in timely disease cure and infection management

Limitations of the study

This study was conducted exclusively in selected pharmacies, which are frequented by a few clinics and hospital patients for prescription refills. A comprehensive follow-up study could be carried out to assess the influence of demographics and prescription patterns of antibiotics used by patients in Pakistan.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Acknowledgement

We want to thank, all the participants of this study especially the pharmacists available and helped during the data collection stage of this study.

Ethical Approval

This study received ethical approval from Lahore Pharmacy College, Lahore, Pakistan, with the ethical approval number (ref: ZI/43/22).

Funding

This study has not received any external funding.

Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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