

Original Article

# Use of Antibiotics in Tertiary Care Hospitals of Metropolitan City Islamabad

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## ABSTRACT

**Background:** The global threat of antimicrobial resistance (AMR) necessitates a deeper understanding of antibiotic use patterns within healthcare settings. Previous studies have indicated variable prevalence rates of antibiotic use across different regions, underscoring the need for localized data to inform antimicrobial stewardship initiatives.

**Objective:** This study aimed to determine the prevalence and patterns of antibiotic use in two tertiary care hospitals in Islamabad, Pakistan, to identify opportunities for improving antibiotic prescribing practices and inform the development of targeted antimicrobial stewardship programs.

**Methods:** A descriptive cross-sectional study was conducted through a point prevalence survey in two tertiary care hospitals over three months, from January to March 2022. Data on antibiotic use were collected from patient files, employing a two-stage random sampling method for both hospital and ward selection. The survey assessed the prevalence of antibiotic use, categorized according to the WHO Aware classification (Access, Watch, Reserve, Not Recommended), and analysed the indications, dosages, routes of administration, and compliance with prescribing guidelines. Statistical analysis was performed using SPSS version 25.

**Results:** The prevalence of antibiotic use among the surveyed population (n=255) was 78%, with a higher prevalence observed in neonatal (100%) and paediatric (100%) departments compared to the adult department (74.66%). Ceftriaxone (27.06%), meropenem (10.98%), and moxifloxacin (9.41%) were the most frequently used antibiotics. Most antibiotics prescribed belonged to the 'Watch' group (70%), with 17.6% in the 'Access' group, and 11.6% in the 'Reserve' group. Prophylactic use accounted for 62.9% of all antibiotics prescribed. The study also noted a lack of compliance with prescribing guidelines and a scarcity of culture sensitivity testing.

**Conclusion:** The study reveals a high prevalence of antibiotic use in tertiary care hospitals in Islamabad, with a significant reliance on 'Watch' and 'Reserve' group antibiotics. These findings highlight the critical need for the implementation of antimicrobial stewardship programs and national action plans to promote rational antibiotic use and combat AMR.

**Keywords:** Antimicrobial Resistance, Antibiotic Use, Tertiary Care Hospitals, Antimicrobial Stewardship, WHO Aware Classification, Point Prevalence Survey, Islamabad, Ceftriaxone, Meropenem, Moxifloxacin.

## INTRODUCTION

The emergence and utilization of antibiotics since the advent of the first "magic bullet" in the early 20th century have dramatically transformed the landscape of medical treatment, notably reducing mortality rates associated with communicable diseases. However, the therapeutic boon of antibiotics is shadowed by the menace of antimicrobial resistance (AMR), a burgeoning global threat that undermines the efficacy of these drugs, leading to increased mortality, morbidity, healthcare costs, and prolonged hospital stays. The phenomenon of AMR is particularly alarming in tertiary care hospitals, where the nexus of prolonged patient stays and the post-discharge period significantly contributes to the spread of resistant bacterial strains (1, 2). This concern is not limited to high-income regions; the impact is even more profound in low-to-middle-income countries (LMICs), where inadequate surveillance systems and limited access to newer antibiotics exacerbate the prevalence of AMR infections, posing a grave public health challenge (3).

Notably, the disparity in antibiotic prescription patterns across various regions highlights the magnitude of irrational antibiotic use. For instance, studies have shown that children in Italy receive antibiotics at rates significantly higher than their counterparts in the UK and the Netherlands, with over half of Italian infants being prescribed antibiotics, and this figure rising to 84% by the age of two (4). Such indiscriminate use of antibiotics is a contributing factor to the rising tide of AMR, especially in areas like Southeast Asia, identified as hotspots for AMR emergence due to factors like rapid economic growth, high infectious disease burden, and inappropriate antimicrobial use in both healthcare and agriculture (5). The last two decades have witnessed a 35% increase in antibiotic consumption in LMICs, with certain countries experiencing a surge as high as 76% alongside a notable rise in the use of broad-spectrum antibiotics, including carbapenems, by up to 45% (6-9).

Pakistan, grappling with escalating AMR, exemplifies the challenges faced by LMICs. Studies indicate a dramatic increase in resistance among clinical isolates of *Escherichia coli* to 3rd generation cephalosporins, and a rising prevalence of Methicillin-resistant *Staphylococcus aureus* (MRSA) among hospitalized patients, necessitating the use of more expensive second-line drugs (Plan 2017). This surge in multidrug-resistant infections is attributed to the irrational use of broad-spectrum antibiotics compounded by subpar infection control practices (11).

In response to this dire situation, the World Health Organization (WHO) and the United Nations have spearheaded initiatives such as the Global Action Plan and Antimicrobial Stewardship Programs (ASPs) to combat AMR through strategic antibiotic use and the promotion of appropriate prescribing practices (9, 12-14). Despite these efforts, the implementation of ASPs remains sporadic, with only a handful of hospitals adopting measures like disease-specific guidelines, consultation services, and regular audits of antibiotic prescribing (11).

The challenge of AMR is exacerbated by the absence of comprehensive data on antibiotic use, particularly in settings like Islamabad, Pakistan's capital, where no point prevalence surveys have been conducted to date. This lack of data hampers the effective implementation of ASPs at both local and national levels, underscoring the urgent need for research to elucidate the patterns of antibiotic use, especially among paediatric populations. Such research is critical for informing and refining ASPs, thereby enhancing the judicious use of antibiotics, and mitigating the threat of AMR. This study aims to bridge this knowledge gap by determining the point prevalence of antibiotic use in Islamabad's hospitals and analysing the prescription patterns of WHO-aware group antibiotics in paediatric patients, with the goal of leveraging this data to bolster ASP development and improve antibiotic stewardship across Pakistan.

## MATERIAL AND METHODS

The study employed a descriptive cross-sectional design, incorporating a point prevalence survey conducted across two tertiary care hospitals in Islamabad. This survey, aimed at gauging the point prevalence of antibiotic use, was carried out at a single instance in time, specifically targeting the wards of the selected hospitals. To minimize disruptions to the hospitals' daily routines, the survey was scheduled for 8 am on alternate days across different wards, spanning a three-month period from January to March 2022. Data pertinent to the study's objectives were meticulously gathered from patient files, ensuring the integrity and relevance of the information collected.

The sampling methodology adopted a two-stage random sampling approach, distinctively applied to both the selection of hospitals and the wards within them. Public sector hospitals in Islamabad were initially listed, with their respective bed sizes, as provided by the Ministry of Health. The participating hospitals were then randomly selected, adhering to the WHO's recommended point prevalence survey methodology for sample size calculation. The sample size, determined using the Open-Epi tool, amounted to 257 patients, calculated to achieve a 95% confidence interval.

Inclusion criteria for sample recruitment encompassed all inpatients present in the public sector tertiary care hospitals at the survey's 8 am commencement, regardless of their antimicrobial treatment status. However, patients in emergency and outpatient departments were excluded from the study. The Global Point Prevalence Survey standardized form, derived from WHO methodology, served as the primary data collection instrument, comprising both ward and patient-level questionnaires. The latter detailed the indications for antibiotic use and the specific antibiotics administered.

Data were initially recorded in raw form and inputted into Microsoft Excel, where the point prevalence numerator was calculated. Subsequent coding and filtering of each variable facilitated the transfer of data to SPSS statistical software (version 25), where descriptive frequencies were analysed. Calculations included the total number of beds, the number of admitted patients, and bed occupancy rates, culminating in the point prevalence computation via an Excel-formulated algorithm.

Ethical considerations were scrupulously observed, with approval granted by the Internal Review Board of the Health Services Academy (IRB-HSA), aligning with the ethical guidelines outlined in the WHO Point Prevalence Survey Methodology. Although patient interaction was minimal, verbal informed consent was obtained, supplemented by written consent from hospital administration and,

for hospitalized children, from their caregivers. All data, anonymized to protect patient confidentiality, was securely stored, adhering to stringent privacy standards.

The study did not receive any external or internal funding, and no conflicts of interest were declared. Despite the study's limitations, such as the potential inaccuracy of medical notes within patient files and the constraints in assessing appropriate antibiotic therapy, its findings offer valuable insights into the prevalence and patterns of antibiotic use within the capital city. The limited participation, with only two hospitals agreeing to partake, may affect the generalizability of the results across the entire city.

## RESULTS

The results provided a multifaceted overview of the demographic characteristics and antibiotic usage patterns within the study population. The first chart, illustrating the gender distribution, shows a slight predominance of females over males, with females constituting 51% of the population and males comprising 49%. This balance underscores the nearly equal representation of genders in the study.



Figure 1 Demographic and Study Characteristics

The age-wise distribution of the population is detailed in the second chart, which reveals a significant portion of the population falls within the old age adult category, numbering 128 individuals. This is followed by middle-aged adults and young adults, with counts of 56 and 35, respectively. The counts progressively decrease through the younger age groups, with children at 15, infants at 11, and neonates at 10, indicating a skewed distribution towards the older population.

In the third graph, focusing on WHO aware group antibiotics, the 'Watch' category is the most represented with 179 instances, followed by the 'Access' group at 45, and the 'Reserve group at 30. A solitary instance falls under the 'Not recommended' category, highlighting the critical focus on monitoring and potentially restricting the use of 'Watch' group antibiotics due to their importance in antimicrobial resistance.

The indications for antibiotic use, as shown in the fourth chart, are predominantly for Mp (82 instances), closely followed by Cai (79 instances), and Sp (76 instances). There are fewer instances of antibiotic use for Hcai (11) and Oth/unk (7), suggesting a targeted approach to antibiotic prescription based on specific medical indications.

Finally, the analysis of the type of antibiotic therapy, depicted in a separate figure, overwhelmingly shows a preference for Empirical Therapy, with 249 instances compared to just 6 for Direct Therapy. This significant disparity underscores a reliance on empirical approaches to antibiotic therapy within the studied population, possibly reflecting a

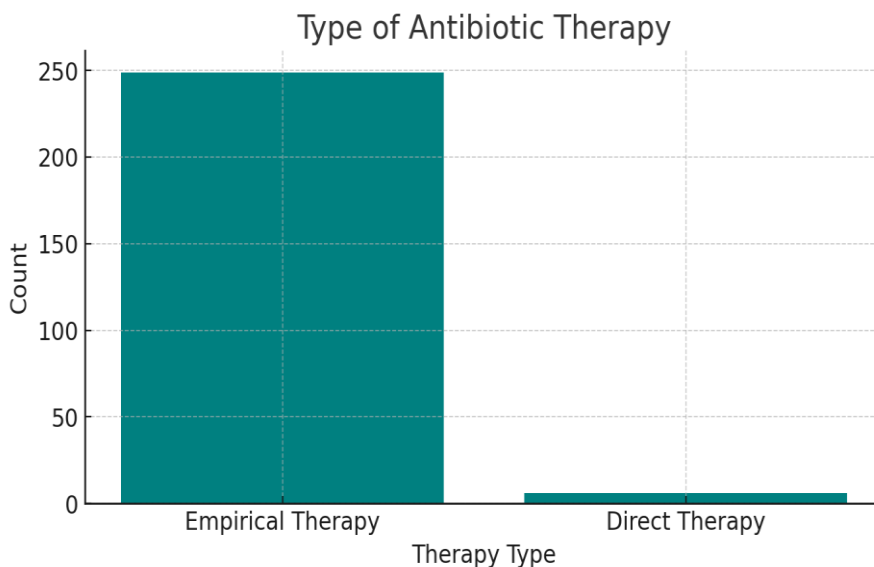


Figure 2 Type of Antibiotic Therapy

broader trend in antibiotic prescription practices in the healthcare settings under investigation.

Table 1: Departmental Distribution and Prevalence of Antibiotic Use

Department	Total (n=255)	Patients on Antibiotics (n=199)	Prevalence (%)
Adult Department	219	165	74.66
Neonatal Department	10	10	100.00
Paediatric Department	24	24	100.00
Overall	255	199	78.00

In the conducted study, the distribution of antibiotic use across different departments revealed a total of 255 patients, with a notable prevalence of antibiotic prescription in both the neonatal and pediatric departments, where 100% of patients received antibiotics, contrasting with the adult department, which saw a prevalence of 74.66% (Table 1). This indicates a particularly high reliance on antibiotics for younger patients within the surveyed hospitals.

The examination of WHO aware group antibiotics showed a dominant usage of the 'Watch' group, constituting 70% of all antibiotics prescribed, followed by the 'Access' group at 17.6%, and the 'Reserve' group at 11.6%. Notably, there was only a single instance (0.39%) of a 'Not recommended' antibiotic being prescribed, underscoring a general adherence to recommended practices in antibiotic selection (Table 2).

The detailed analysis of indications for antibiotic use illustrated a varied landscape of infectious diseases being treated. Respiratory tract infections were the most common, accounting for 27.45% of antibiotic usage, followed by other non-infectious diseases at 26.27%, and gastrointestinal infections at 13.73%. This diversity in antibiotic application underscores the wide range of conditions for which antibiotics are deemed necessary within these healthcare settings (Table 2).

Regarding the administration of antibiotics, the study highlighted a predominant preference for twice-daily (BD) dosing, which accounted for 57.2% of prescriptions, followed by once daily (OD) at 29.01%, and thrice daily (TDS) at 13.7%. Intravenous (IV) administration was the route of choice for 91.3% of the doses, emphasizing the severity of conditions treated and the need for rapid antibiotic action. The study also found that the majority of patients (73.4%) were prescribed only one antibiotic, with a smaller proportion receiving two or more, indicating a cautious approach to antibiotic therapy among the clinicians involved (Table 3).

The types of antibiotics used varied, with Ceftriaxone being the most frequently prescribed, representing 27.06% of all antibiotic prescriptions. Other commonly used antibiotics included Meropenam (10.98%), Moxifloxacin (9.41%), and Augmentin plus Clavulanic Acid (9.02%), reflecting a preference for broad-spectrum antibiotics to address a wide range of infections (Table 4).

Table 2: Antibiotic Awareness and Usage

WHO Aware Group	Frequency	%age	Indications of Use	Frequency	%age
Access	45	17.6	GI Infection	35	13.73
Watch	179	70	RT Infection	70	27.45
Reserve	30	11.6	UTI	29	11.37
Not Recommended	1	0.39	Other Non-infectious Disease	67	26.27
Total	255	100	Hepatic Infection	20	7.84
			Skin Infection	13	5.10
			Appendicitis	10	3.92
			Not Confirmed Diagnosis	11	4.31

Table 3: Antibiotic Administration and Compliance

Aspect	Frequency	%age
Dosages/Day (OD, BD, TDS)	74, 146, 35	29.01, 57.2, 13.7
Route of Administration (IM, IV, PO)	1, 233, 21	0.39, 91.3, 8.23
Number of Antibiotics per Patient (1 to 4)	146, 49, 3, 1	73.4, 24.6, 1.5, 0.5
Guideline Compliance (NA)	255	100
Stop/Review Date Documented (Yes, No)	25, 230	9.8, 90

Table 4: Most Frequently Used Antibiotics and Dosage

Antibiotic	Frequency	%age
Ceftriaxone	69	27.06
Meropenam	28	10.98
Moxifloxacin	24	9.41
Augmentin + Clavulanic Acid	23	9.02
Cefoperazone + Sulbactam Sodium	14	5.49
Ciprofloxacin	14	5.49
Other (less frequent antibiotics)	Varied	<=3.92

Lastly, the prevalence of antibiotic use across the departments underscored a significant reliance on these medications, with an overall prevalence rate of 78.00% among the patients surveyed. This high rate of antibiotic prescription, especially in the neonatal and pediatric departments, highlights the critical role of antibiotics in managing infections in these vulnerable populations. Moreover, the patterns of WHO aware group antibiotic use, as well as the specific antibiotics selected for treatment, suggest a nuanced understanding and application of antibiotic stewardship principles among healthcare providers in the studied settings (Tables 1 and 4).

## DISCUSSION

In the point prevalence survey conducted within two tertiary care hospitals in Pakistan, a significant finding was the high prevalence of antibiotic use at 78%, surpassing global averages reported in similar studies. This prevalence notably exceeded figures from the African region at 50% and Europe at 30%, as outlined in a recent Global Point Prevalence Survey (16, 17). Interestingly, our findings were somewhat aligned with those from Mexico, where antibiotic use prevalence was documented at 68% (18), suggesting a regional variance in antibiotic prescribing practices. This variance becomes even more apparent when comparing our results to lower prevalence rates in neighboring countries, such as China and India, with 52% and 62.6% respectively, whereas Iraq presented a higher rate at 92% (13, 15).

The observed prevalence in our study closely mirrors that of a similar investigation in the Punjab province, where antibiotic usage was reported at 77%, highlighting consistency within national trends yet diverging significantly from a subsequent study in the same region reporting a higher prevalence of 89.1% (12). These discrepancies underscore the heterogeneity of antibiotic use across different settings, further complicating efforts to generalize findings across broader regions.

Ceftriaxone emerged as the most frequently utilized antibiotic in our survey, followed by meropenem and moxifloxacin, mirroring global prescribing patterns where ceftriaxone also dominates, especially in Asia, Latin America, and parts of Europe. This consistency

in antibiotic choice, particularly with ceftriaxone, reflects its broad application across varying healthcare contexts, despite regional differences in antibiotic resistance and prescribing guidelines (9, 19). However, the notable utilization of moxifloxacin in our setting diverges from global trends, possibly attributed to its increased use during the COVID-19 pandemic, marking a shift from traditional choices like azithromycin.

Prophylactic antibiotic use in our study was primarily divided between medical (32.1%) and surgical (29.8%) prophylaxis, with community-acquired infections accounting for 30.98% of antibiotic applications. This distribution is somewhat aligned with global patterns, where medical and surgical prophylaxes are prevalent, especially in Asia and Latin America, whereas Europe tends to favor surgical prophylaxis (21). Our findings resonate with studies from Tanzania and regional investigations from Iraq, China, and India, suggesting a consistent emphasis on prophylaxis across different healthcare settings (13, 15, 23).

The study's analysis revealed that a substantial 70% of prescribed antibiotics belonged to the 'watch' group, followed by 17.6% in the 'access' group and 11.6% in the 'reserve' group, with a negligible 1% falling into the 'not recommended' category. This pattern indicates a potentially alarming reliance on antibiotics associated with higher resistance rates, mirroring observations in Iran and China, and suggesting a widespread challenge in antibiotic stewardship (16).

A distinct observation was the predominant use of 'watch' group antibiotics across various age groups, especially in older adults, which could be attributed to the prevalence of comorbid conditions requiring more aggressive treatment approaches. In contrast, neonates, infants, and children demonstrated a more balanced use of 'access', 'watch', and 'reserve' group antibiotics, highlighting the nuanced approach to antibiotic prescribing in pediatric populations.

The study's findings underscore the urgent need for enhanced antibiotic stewardship and the implementation of national action plans to address antimicrobial resistance. The high prevalence of intravenous antibiotic administration and prophylactic use, particularly from the 'watch' and 'reserve' groups, points to a pressing need for rationalizing antibiotic use and improving documentation practices within healthcare settings. By providing baseline data on antibiotic usage patterns, this study contributes valuable insights for the development of targeted antimicrobial stewardship programs, aiming to curb the rise of antibiotic resistance and ensure the sustainable use of these critical medications. Future efforts should adopt a multisectoral approach, extending prevalence studies to a national scale to gain a comprehensive understanding of antibiotic use and resistance trends across Pakistan and inform comparisons with other lower-middle-income countries.

## CONCLUSION

The conducted study highlights a notably high prevalence of antibiotic use within two tertiary care hospitals in Pakistan, emphasizing a critical need for the establishment and rigorous implementation of antimicrobial stewardship programs. The predominant reliance on 'watch' and 'reserve' group antibiotics, especially through intravenous administration for prophylactic purposes, underscores the urgent requirement to rationalize antibiotic prescribing practices. This study not only sheds light on the pressing issue of antibiotic resistance but also provides foundational data essential for developing effective interventions aimed at promoting judicious antibiotic use. Addressing these challenges is imperative for safeguarding the efficacy of antibiotics, thereby ensuring their continued viability as a cornerstone of human healthcare.

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