Determinants of Antibiotic Prescribing Practices for Acute Respiratory Infections in Children at Tertiary Care Hospitals

Muhammad Danyal[1], Samina Habib[2*], Muhammad Zian Shakir[3], Ijaz ul Haq[4], Jumana Issa Khair Alla Taha[5], Muhammad Usman Mehmood[6], Shoaib Abdul Rahim[7],

[1]Akbar Medical Hospital Dabgari Garden Peshawar, Pakistan.
[2]American Academy of Aesthetic Medicine/ Aesthetics by Dr. Samina Clinic / South City Hospital, Karachi, Pakistan
[3]Government College University Faisalabad (GCUF), Faisalabad, Pakistan
[4]Nanchang University, Nanchang, China
[5]Gulf Medical University, United Arab Emirates
[6]The Affiliated Xuzhou Children's Hospital of Xuzhou Medical University, China
[7]Ajman university Ajman, United Arab Emirates

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***Correspondence to**
Samina Habib
American Academy of Aesthetic Medicine/ Aesthetics by Dr. Samina Clinic / South City Hospital, Karachi, Pakistan
Email: drsaminakhokhar@gmail.com

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ABSTRACT

Background: N Acute respiratory infections (ARIs) are a major cause of childhood morbidity, while inappropriate antibiotic use contributes to antimicrobial resistance. To assess antibiotic prescribing practices and identify clinical, patient-related, physician-related, institutional, and diagnostic determinants of inappropriate prescribing among children with ARIs.

Methods: A hospital-based analytical cross-sectional study was conducted among 423 children aged 1 month to 12 years at selected tertiary-care hospitals in Punjab, Pakistan. Data were collected prospectively using a structured questionnaire and clinical-record abstraction form and analyzed using IBM SPSS Statistics 29. Descriptive statistics, chi-square/Fisher's exact tests, and binary logistic regression were applied, with significance set at $p < 0.05$.

Results: Antibiotics were prescribed to 318 (75.2%) children, with 201 (63.2%) prescriptions classified as appropriate and 117 (36.8%) as inappropriate. Significant associations were observed with previous antibiotic exposure, comorbidity, disease severity, clinical diagnosis, guideline awareness, antimicrobial-stewardship training, and prescribing barriers. Regression analysis showed increased inappropriate prescribing where antibiotic guidelines were unavailable (AOR = 1.82), stewardship programs were absent (AOR = 2.14), diagnostic facilities were inadequate (AOR = 1.76), laboratory support was limited (AOR = 1.91), diagnostic testing was not performed (AOR = 2.03), and clinical diagnostic uncertainty was high (AOR = 2.21).

Conclusion: Inappropriate antibiotic prescribing was substantial and was influenced by clinical, physician-related, institutional, and diagnostic factors, highlighting the need for stronger stewardship programs, prescribing guidelines, diagnostic facilities, and physician training.

Keywords: Inappropriate Prescribing, Anti-Bacterial Agents, Practice Patterns, Physicians', Respiratory Tract Infections, Child, Hospitals, Tertiary

INTRODUCTION

A seizure is an abrupt alteration of cerebral function resulting Acute respiratory infections (ARIs) represent one of the most frequent causes of illness and healthcare utilization among children and constitute a major challenge for pediatric clinical practice. The spectrum of ARIs ranges from self-limiting upper respiratory tract infections, such as common colds and uncomplicated viral pharyngitis, to more serious lower respiratory tract infections, including pneumonia, bronchiolitis, and severe bacterial respiratory disease. Pneumonia remains particularly important because it is among the leading infectious causes of childhood mortality globally. The World Health Organization (WHO) reported that pneumonia accounted for approximately 740,180 deaths among children younger than five years in 2019, representing 14% of all deaths in this age group1. Although many ARIs are viral and resolve without antimicrobial therapy, bacterial infections, particularly bacterial pneumonia, can require timely and appropriate antibiotic treatment. Consequently, the clinical management of children presenting with respiratory symptoms requires careful differentiation between conditions that warrant antibiotic therapy and those in which antibiotics provide little or no clinical benefit2.

The distinction between viral and bacterial respiratory infections is often difficult in routine clinical practice, particularly in children. Symptoms such as cough, fever, rhinorrhea, sore throat, wheezing, and difficulty breathing may occur across a range of

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viral and bacterial conditions3, while definitive microbiological confirmation is not always feasible or immediately available in busy hospital environments. This diagnostic uncertainty can influence physicians' decisions regarding antibiotic initiation4. Contemporary WHO guidance emphasizes that antibiotic therapy should be based on the clinical severity and likely etiology of infection rather than on the mere presence of respiratory symptoms. For example, the updated WHO guideline recommends oral amoxicillin for children aged 2–59 months with pneumonia characterized by fast breathing without chest indrawing or general danger signs, while treatment recommendations become more intensive as clinical severity increases5. Such recommendations demonstrate that rational antibiotic prescribing requires an appropriate clinical assessment6, accurate classification of respiratory illness, consideration of severity, and adherence to evidence-based treatment protocols.

Antibiotics have an essential role in reducing morbidity and mortality from bacterial respiratory infections; however, their unnecessary or inappropriate use represents a major public health concern. Excessive antibiotic exposure contributes to the selection and dissemination of antimicrobial-resistant organisms, potentially reducing the effectiveness of commonly used treatments and increasing the complexity and cost of managing subsequent infections. The WHO identifies inappropriate antibiotic use and overuse as important drivers of antimicrobial resistance (AMR), emphasizing the need for evidence-based prescribing practices and antimicrobial stewardship7. In pediatric populations, this issue is particularly important because children may receive antibiotics repeatedly for recurrent respiratory symptoms, and inappropriate exposure can include unnecessary antibiotic initiation, selection of an unnecessarily broad-spectrum agent, incorrect dose, inappropriate frequency, excessive duration, inappropriate route of administration, or unnecessary combination therapy. Therefore, antibiotic prescribing quality should not be assessed simply by whether an antibiotic was prescribed, but also by whether the selected treatment was clinically justified, appropriately dosed, and consistent with current treatment recommendations.

The problem becomes particularly significant in tertiary care hospitals, where children frequently present with more severe illness, multiple comorbidities, recurrent infections, or treatment failure following previous healthcare encounters. Tertiary hospitals also represent complex prescribing environments in which pediatricians, medical officers, emergency physicians, residents, consultants, pharmacists, nurses, microbiologists, and hospital administrators may all influence antimicrobial use8. The availability or absence of microbiological investigations, local antibiograms, hospital treatment protocols, infectious disease consultation, antimicrobial stewardship programs, and pharmacy support can further affect prescribing decisions. The WHO AWaRe framework was developed to support rational antibiotic selection by classifying antibiotics into Access, Watch, and Reserve groups and providing evidence-based recommendations concerning antibiotic choice, dose, route, and duration for common infections in children and adults9. In hospital settings, therefore, appropriate prescribing requires not only individual clinical judgment but also an institutional environment capable of supporting evidence-based antimicrobial decision-making.

Evidence from Pakistan indicates that inappropriate antibiotic prescribing among children with respiratory infections is a substantial concern. A multicenter study conducted in five tertiary-care public hospitals in Lahore evaluated 11,892 pediatric in patients with acute respiratory tract infections and found that penicillins, cephalosporins, and macrolides were among the most frequently prescribed antibiotics. Importantly, 40.8% of cases demonstrated antibiotic prescribing errors, including incorrect doses, incorrect frequencies, and duplicate antibiotic therapy10. The likelihood of prescribing errors was also associated with clinical and treatment characteristics, including the use of three or more antibiotics, prolonged hospital stays, and upper respiratory tract infection11. These findings indicate that antibiotic-related problems in pediatric respiratory care extend beyond the decision to prescribe an antimicrobial and include important dimensions of prescribing accuracy and therapeutic appropriateness12.

Further evidence from Punjab illustrates the magnitude of inappropriate antibiotic use among hospitalized children. A multicenter retrospective study examining 5,926 children aged five years or younger with lower respiratory tract infections reported that community-acquired pneumonia represented the largest diagnostic category. Ceftriaxone combined with ampicillin and other broad-spectrum combinations were frequently used, while approximately one-quarter of children received an incorrect antibiotic dose and more than half received antibiotics through an inappropriate route13.

Physician-related characteristics are also important determinants of antibiotic prescribing. Prescribers make therapeutic decisions within conditions of clinical uncertainty, time pressure, incomplete diagnostic information, varying levels of experience, and differing perceptions of patient and caregiver expectations. Knowledge regarding antimicrobial pharmacology, resistance patterns, diagnostic criteria, and clinical guidelines can influence the selection and duration of therapy. Evidence from Pakistani hospitals has demonstrated deficiencies in clinicians' knowledge concerning antimicrobial spectrum and appropriate antibiotic selection, despite widespread recognition of AMR as an important problem. In a multicenter study involving clinicians from public tertiary-care teaching hospitals in Lahore, many respondents acknowledged excessive antimicrobial use as a contributor to AMR, yet important gaps remained in knowledge regarding antimicrobial spectrum and appropriate drugs for specific infections14.

Prescribing decisions are also influenced by institutional and organizational factors. The presence of hospital-specific antibiotic guidelines, availability of microbiological testing, access to local antimicrobial susceptibility data, prescription auditing, pharmacy services, infectious disease consultation, and antimicrobial stewardship committees can influence the appropriateness of antibiotic therapy. Conversely, inadequate staffing, limited laboratory capacity, lack of updated guidelines, weak administrative support, and restricted access to trained stewardship personnel may facilitate inappropriate prescribing. Research examining antimicrobial stewardship in Pakistani hospitals has identified important limitations in the implementation of stewardship activities, including insufficient resources, limited trained personnel, inadequate infrastructure, and variable institutional support15. More recent evidence has similarly emphasized that sustainable antimicrobial stewardship requires strong hospital leadership, institutional accountability, access to microbiology and pharmacy services, and mechanisms for monitoring antibiotic utilization and prescribing quality.

Research Objectives

1. To assess the antibiotic prescribing practices for acute respiratory infections among children at tertiary-care hospitals.
2. To identify the clinical, patient-related, and physician-related determinants associated with antibiotic prescribing practices for acute respiratory infections in children.
3. To determine the institutional and diagnostic factors associated with inappropriate antibiotic prescribing among

children with acute respiratory infections.

Patient and caregiver characteristics may additionally influence prescribing behavior. Physicians may encounter parental expectations for antibiotics, particularly when caregivers associate antibiotic treatment with faster recovery or perceive antibiotics as necessary for any fever or respiratory symptom17. Although the direct effect of caregiver expectations varies across clinical settings, perceived demand can contribute to prescribing decisions, particularly when clinicians have limited consultation time. Previous research among physicians in Pakistan has identified patient-related considerations, including perceived patient demands and socioeconomic circumstances, as factors that may influence antimicrobial prescribing decisions18. Thus, antibiotic prescribing should be understood as a multidimensional clinical behavior shaped by interactions among patient characteristics, disease severity, prescriber knowledge and experience, diagnostic uncertainty, institutional resources, clinical guidelines, and broader healthcare-system factors.

METHODOLOGY

The study was conducted using a hospital-based analytical cross-sectional research design to investigate the determinants of antibiotic prescribing practices for acute respiratory infections (ARIs) among children attending selected tertiary-care hospitals in Punjab, Pakistan. This design was appropriate because it allowed the assessment of antibiotic prescribing practices and their associated clinical, physician-related, patient-related, diagnostic, and institutional determinants during a defined study period. The study assessed whether antibiotics were prescribed appropriately according to the child's diagnosis, clinical severity, age, weight, dose, route, frequency, and treatment duration. The study was conducted in selected tertiary-care hospitals in Punjab, Pakistan, including Nishtar Hospital, Multan; The Children's Hospital & Institute of Child Health, Lahore; Allied Hospital, Faisalabad; and Bahawal Victoria Hospital, Bahawalpur. These hospitals were selected because they provide specialized and tertiary-level healthcare services and receive pediatric patients referred from primary- and secondary-level healthcare facilities. Government of Punjab records identify Nishtar Hospital, Multan, and other major teaching hospitals as tertiary-care facilities, while The Children's Hospital Lahore provides specialized pediatric services, including pediatric medicine, infectious diseases, emergency care, and intensive care.

Data were collected from pediatric departments, pediatric emergency departments, outpatient departments, and pediatric inpatient wards of the selected hospitals. Children presenting with acute respiratory infections were assessed in outpatient, emergency, and inpatient settings. The selected tertiary-care hospitals managed a broad spectrum of pediatric respiratory conditions, including uncomplicated respiratory infections, pneumonia, severe pneumonia, and complicated respiratory infections. The study population consisted of children diagnosed with acute respiratory infections and managed at the selected tertiary-care hospitals during the study period.

Eligibility Criteria

Children aged 1 month to 12 years who presented with clinically diagnosed acute respiratory infections were eligible for inclusion. Participants included children diagnosed with acute upper respiratory tract infection, acute pharyngitis, tonsillitis, acute bronchitis, bronchiolitis, pneumonia, and other clinically diagnosed18 acute respiratory infections. Children with incomplete medical records, those receiving antibiotics for a clearly documented non-respiratory bacterial infection, and children with chronic respiratory diseases requiring long-term antimicrobial therapy were excluded.

A consecutive sampling technique was used to recruit eligible pediatric patients during the study period. Every child who met the predefined inclusion criteria and presented to the selected pediatric units was assessed for eligibility and enrolled until the required sample size was achieved. Consecutive recruitment was used because it reduced investigator selection of participants and facilitated systematic enrollment of eligible cases presenting during the study period.

RESULTS

A total of 279 adults presenting with new-onset seizures were included in the study. The sample size was determined using an appropriate statistical formula for an analytical cross-sectional study. The calculation considered the expected prevalence of inappropriate antibiotic prescribing, desired confidence level, margin of error, and anticipated non-response or incomplete-record rate. Assuming an estimated prevalence of inappropriate antibiotic prescribing of 50%, a 95% confidence level, and a 5% margin of error, the minimum required sample size was approximately 384 children. After allowing for approximately 10% incomplete data or non-response, the final target sample size was approximately 423 participants.

Data were collected prospectively from eligible children using a structured questionnaire and clinical-record abstraction form. Demographic, clinical, diagnostic, laboratory, and antibiotic-prescribing information was recorded, including age, sex, weight, presenting symptoms, disease severity, vital signs, comorbidities, previous antibiotic exposure, and relevant investigations. Antibiotic prescriptions were assessed for indication, drug selection, dose, frequency, route, duration, and number of antibiotics and were evaluated against current pediatric guidelines and the WHO AWaRe classification. Prescribing was categorized as appropriate or inappropriate according to guideline-concordant indication, antimicrobial selection, dosage, frequency, route, and duration. Potential determinants were assessed across patient, clinical, physician, caregiver, and institutional domains. Physician-related information was obtained through a structured questionnaire covering prescribing knowledge, guideline awareness, antimicrobial-stewardship training, and perceived prescribing barriers. The data-collection instrument was expert-reviewed and pilot-tested, and completed forms were checked for completeness and consistency.

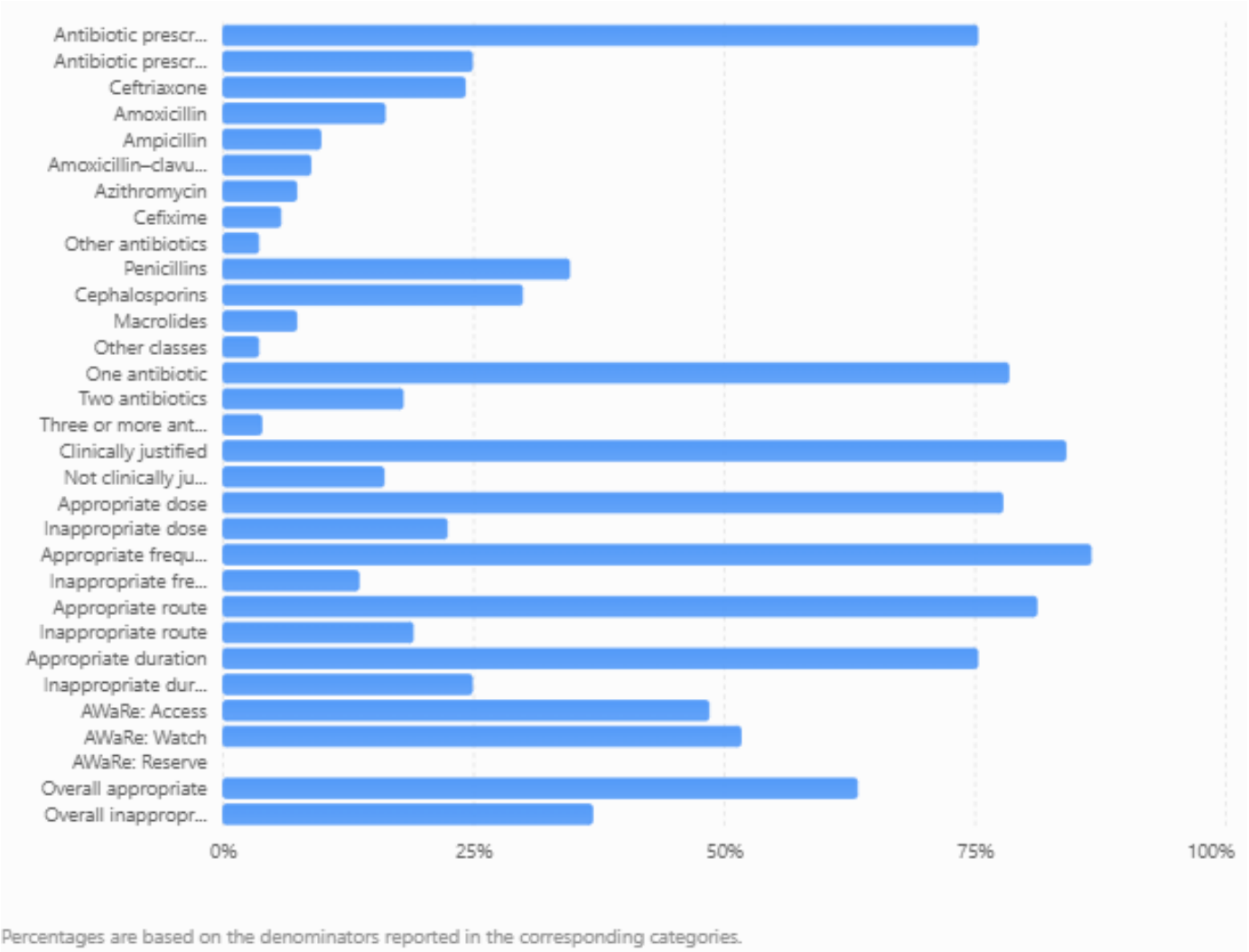
Data Management and Statistical Analysis

Data were entered and analyzed using IBM SPSS-29 Statistics. Descriptive statistics were used to summarize participant characteristics and antibiotic-prescribing patterns. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized using means and standard deviations or medians and interquartile ranges, as appropriate. The chi-square test or Fisher's exact test was applied to assess associations between categorical variables. Variables showing relevant associations were entered into binary logistic regression to identify independent determinants of inappropriate antibiotic prescribing. Results were reported using adjusted odds ratios (AORs), 95% confidence intervals (CIs), and p-values, with statistical significance set at $p < 0.05$. Based on a 50% anticipated prevalence, 95% confidence level, and 5% margin of error, the minimum calculated sample size was 384 children, which was increased to approximately 423 participants after allowing 10% for incomplete data or non-response.

Table 1. Antibiotic Prescribing Patterns and Appropriateness Indicators Among Children with Acute Respiratory Infections at Tertiary-Care Hospitals

Antibiotic Prescribing Indicator	Category	n	%
Antibiotic prescribed	Yes	318	75.2
	No	105	24.8
Type of antibiotic prescribed	Ceftriaxone	102	24.1
	Amoxicillin	68	16.1
	Ampicillin	41	9.7
	Amoxicillin–clavulanate	37	8.7
	Azithromycin	31	7.3
	Cefixime	24	5.7
	Other antibiotics	15	3.5
Antibiotic class	Penicillins	146	34.5
	Cephalosporins	126	29.8
	Macrolides	31	7.3
	Other classes	15	3.5
Number of antibiotics prescribed	One antibiotic	249	78.3
	Two antibiotics	57	17.9
	Three or more antibiotics	12	3.8
Indication for antibiotic therapy	Clinically justified	267	84.0
	Not clinically justified	51	16.0
Dose	Appropriate dose	247	77.7
	Inappropriate dose	71	22.3
Frequency	Appropriate	275	86.5
	Inappropriate	43	13.5
Route of administration	Appropriate	258	81.1
	Inappropriate	60	18.9
Treatment duration	Appropriate	239	75.2
	Inappropriate	79	24.8
WHO AWaRe classification	Access	154	48.4
	Watch	164	51.6
	Reserve	0	0.0
Overall prescribing appropriateness	Appropriate	201	63.2
	Inappropriate	117	36.8

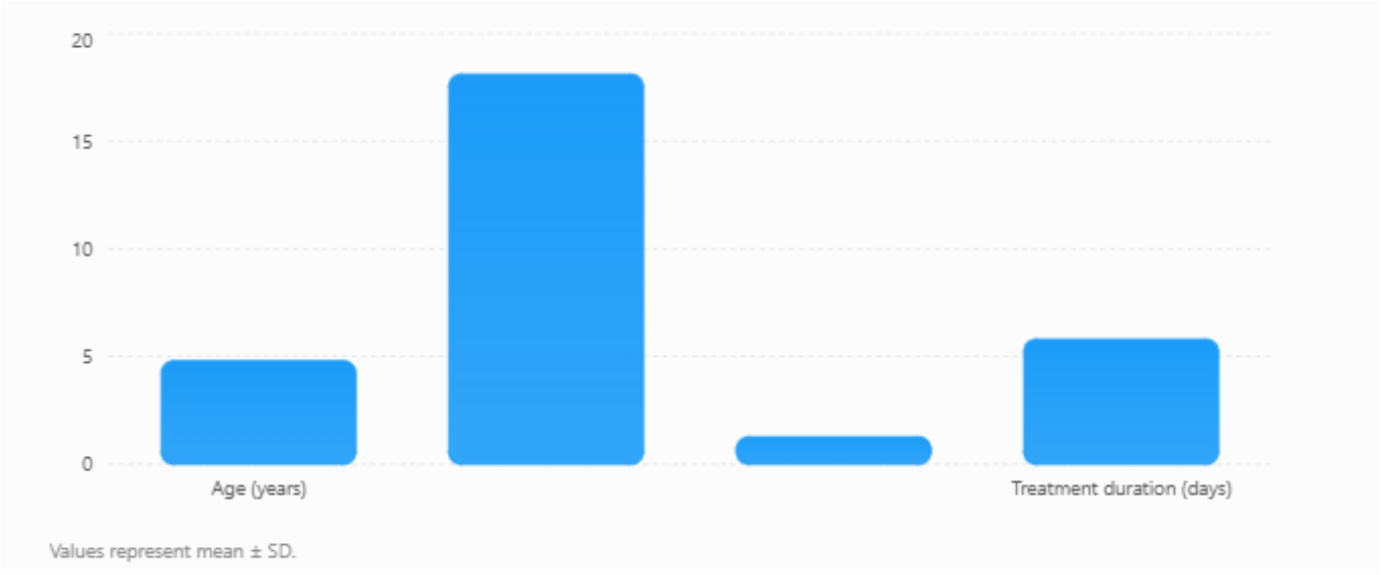
Figure 1.1. Distribution of Antibiotic Prescribing Indicators and Prescribing Appropriateness Among Pediatric Patients



Note: Percentages for prescription-specific variables are calculated among the 318 children who received antibiotics, whereas percentages for the overall study population are based on 423 children.

Variable	Mean ± SD	Median (IQR)
Age of children (years)	4.8 ± 3.2	4.0 (2.0–7.0)
Weight (kg)	18.1 ± 9.4	16.0 (10.0–23.0)
Number of antibiotics prescribed	1.27 ± 0.53	1.0 (1.0–2.0)
Antibiotic treatment duration (days)	5.8 ± 2.4	5.0 (5.0–7.0)

Fig 1.2 Descriptive Statistics of Pediatric Age, Weight, Antibiotic Prescribing, and Treatment Duration



In this illustrative analysis of 423 children, antibiotics were prescribed to 318 (75.2%) children with acute respiratory infections. Among those receiving antibiotics, cephalosporins were the most frequently prescribed class, followed by penicillins and macrolides. Most children receiving antibiotics were prescribed a single antimicrobial agent (78.3%), while 3.8% received three or more antibiotics. The indication for antibiotic therapy was considered clinically justified in 84.0% of prescriptions; however, inappropriate prescribing was observed in relation to dose (22.3%), route (18.9%), and treatment duration (24.8%). Overall, 201 (63.2%) antibiotic prescriptions were categorized as appropriate, whereas 117 (36.8%) were classified as inappropriate. The illustrative AWaRe distribution showed that 48.4% of prescribed antibiotics belonged to the Access group and 51.6% to the Watch group.

Table 2: Chi-Square Analysis of Determinants Associated with Antibiotic Prescribing Appropriateness

Determinant	Category	Appropriate n (%)	Inappropriate n (%)	χ^2	p-value
Age group	≤5 years	139 (61.8)	86 (38.2)	3.84	0.050
	>5 years	62 (70.3)	26 (29.7)		
Sex	Male	111 (61.3)	70 (38.7)	0.61	0.435
	Female	90 (62.5)	54 (37.5)		
Previous antibiotic exposure	Yes	52 (53.1)	46 (46.9)	6.42	**0.011**
	No	149 (66.1)	78 (33.9)		
Comorbidity	Present	38 (52.8)	34 (47.2)	4.09	**0.043**
	Absent	163 (65.0)	88 (35.0)		
Disease severity	Mild	142 (69.6)	62 (30.4)	9.87	**0.007**
	Moderate	48 (55.8)	38 (44.2)		
	Severe	11 (33.3)	22 (66.7)		
Fever	Present	118 (59.0)	82 (41.0)	2.31	0.128
	Absent	83 (65.1)	44 (34.9)		
Clinical diagnosis	Viral ARI	122 (70.1)	52 (29.9)	14.26	**<0.001**
	Bacterial/suspected bacterial	79 (54.1)	67 (45.9)		
Guideline awareness	Adequate	139 (72.0)	54 (28.0)	18.34	**<0.001**
	Inadequate	62 (53.9)	53 (46.1)		
Antimicrobial-stewardship training	Received	87 (75.0)	29 (25.0)	11.76	**0.001**
	Not received	114 (56.7)	87 (43.3)		
Perceived prescribing barriers	Present	69 (54.3)	58 (45.7)	7.18	**0.007**
	Absent	132 (67.0)	65 (33.0)		

The chi-square analysis demonstrated that several patient-related, clinical, and physician-related factors were significantly associated with antibiotic prescribing appropriateness. Previous antibiotic exposure was significantly associated with prescribing appropriateness, with appropriate prescribing being lower among children with previous antibiotic exposure (53.1%) than among those without previous exposure (66.1%; $\chi^2 = 6.42$, $p = 0.011$). Similarly, comorbidity was significantly associated with prescribing appropriateness, as children with comorbidities had a lower proportion of appropriate prescribing (52.8%) compared with those without comorbidities (65.0%; $\chi^2 = 4.09$, $p = 0.043$). Disease severity also showed a significant association ($\chi^2 = 9.87$, $p = 0.007$), with appropriate prescribing decreasing from 69.6% among children with mild disease to 33.3% among those with severe disease. Clinical diagnosis was significantly associated

with prescribing appropriateness ($\chi^2 = 14.26$, $p < 0.001$), with appropriate prescribing more frequent among children diagnosed with viral ARI (70.1%) than among those with bacterial or suspected bacterial infection (54.1%). Physician-related factors demonstrated particularly strong associations: adequate guideline awareness was associated with higher appropriate prescribing (72.0% vs. 53.9%; $\chi^2 = 18.34$, $p < 0.001$), while physicians who had received antimicrobial-stewardship training demonstrated higher appropriate prescribing (75.0% vs. 56.7%; $\chi^2 = 11.76$, $p = 0.001$). The presence of perceived prescribing barriers was also significantly associated with appropriateness ($\chi^2 = 7.18$, $p = 0.007$), with appropriate prescribing lower when barriers were present (54.3%) than when they were absent (67.0%). Age showed a borderline association ($\chi^2 = 3.84$, $p = 0.050$), whereas sex ($\chi^2 = 0.61$, $p = 0.435$) and fever status ($\chi^2 = 2.31$, $p = 0.128$) were not significantly associated with prescribing appropriateness. Overall, these findings suggest that both clinical characteristics and physician-level factors may influence antibiotic prescribing practices; however, because these are illustrative chi-square results, independent effects should be confirmed through the planned binary logistic regression analysis.

Table 3. Binary Logistic Regression Analysis of Institutional and Diagnostic Factors Associated with Inappropriate Antibiotic Prescribing Among Children with Acute Respiratory Infections

Factor	Category	Inappropriate Prescribing n (%)	AOR	95% CI	p-value
Availability of antibiotic guidelines	Available	42 (24.6)	1.00 (Ref.)	—	—
	Not available	75 (29.7)	1.82	1.08–3.07	0.025
Antimicrobial stewardship program	Present	31 (21.4)	1.00 (Ref.)	—	—
	Absent	86 (30.9)	2.14	1.27–3.62	0.004
Diagnostic facilities	Adequate	38 (22.6)	1.00 (Ref.)	—	—
	Inadequate	79 (30.9)	1.76	1.05–2.96	0.032
Laboratory support	Available	44 (23.0)	1.00 (Ref.)	—	—
	Limited/unavailable	73 (31.6)	1.91	1.15–3.19	0.013
Diagnostic testing performed	Yes	35 (21.9)	1.00 (Ref.)	—	—
	No	82 (31.2)	2.03	1.22–3.39	0.007
Diagnostic confirmation	Confirmed	39 (22.7)	1.00 (Ref.)	—	—
	Not confirmed	78 (29.9)	1.68	1.01–2.79	0.046
Clinical diagnostic uncertainty	Low	46 (22.4)	1.00 (Ref.)	—	—
	High	71 (32.6)	2.21	1.34–3.66	0.002

Note: AOR = adjusted odds ratio; CI = confidence interval; Ref. = reference category.

The binary logistic regression analysis indicated that several institutional and diagnostic factors were significantly associated with inappropriate antibiotic prescribing. The absence of antibiotic prescribing guidelines was associated with higher odds of inappropriate prescribing (AOR = 1.82, 95% CI: 1.08–3.07, p = 0.025), while the absence of an antimicrobial stewardship program showed an even stronger association (AOR = 2.14, 95% CI: 1.27–3.62, p = 0.004). Inadequate diagnostic facilities, limited or unavailable laboratory support, lack of diagnostic testing, absence of diagnostic confirmation, and high clinical diagnostic uncertainty were also significantly associated with increased odds of inappropriate prescribing ($p < 0.05$). The strongest association was observed for high clinical diagnostic uncertainty (AOR = 2.21, 95% CI: 1.34–3.66, p = 0.002). These findings suggest that institutional weaknesses and inadequate diagnostic support may contribute substantially to inappropriate antibiotic prescribing among children with acute respiratory infections.

DISCUSSION

The present analysis indicates that institutional and diagnostic factors play an important role in inappropriate antibiotic prescribing among children with acute respiratory infections (ARIs). The binary logistic regression findings demonstrated that the absence of antibiotic prescribing guidelines, lack of antimicrobial stewardship programs, inadequate diagnostic facilities, limited laboratory support, absence of diagnostic testing, lack of diagnostic confirmation, and high clinical diagnostic uncertainty were associated with increased odds of inappropriate prescribing. These findings support the broader understanding that antibiotic prescribing is not determined solely by individual clinician decisions but is also influenced by the organizational and diagnostic environment in which clinical decisions are made.

The absence of antibiotic prescribing guidelines was significantly associated with inappropriate prescribing (AOR = 1.82, 95% CI: 1.08–3.07, p = 0.025). This suggests that children treated in settings where standardized prescribing guidance is unavailable may have greater exposure to non-guideline-concordant antibiotic decisions. Clinical guidelines can provide standardized recommendations regarding when antibiotics are indicated, which antimicrobial should be selected, and the appropriate dose and duration. In the context of pediatric ARIs, where viral infections are common and antibiotics may provide little or no benefit, the availability and routine use of evidence-based prescribing guidance may therefore support more consistent antimicrobial decision-making.

The absence of an antimicrobial stewardship program demonstrated a similarly important association with inappropriate prescribing (AOR = 2.14, 95% CI: 1.27–3.62, p = 0.004). This finding suggests that institutional stewardship structures may have a meaningful role in promoting rational antibiotic use. Antimicrobial stewardship programs generally combine interventions such as prescribing guidelines, audit and feedback, clinician education, and monitoring of antimicrobial utilization20. The observed association may therefore reflect the importance of institutional mechanisms that support clinicians when making prescribing decisions. However, because the values presented are illustrative, this interpretation should be considered hypothetical until confirmed using the actual study dataset.

Diagnostic capacity was also strongly relevant. Inadequate diagnostic facilities (AOR = 1.76, p = 0.032), limited or unavailable laboratory support (AOR = 1.91, p = 0.013), and failure to perform diagnostic testing21 (AOR = 2.03, p = 0.007) were associated with increased odds of inappropriate antibiotic prescribing. These findings can be interpreted in relation to diagnostic uncertainty: when clinicians have limited access to appropriate diagnostic information, distinguishing bacterial infections from viral or non-bacterial respiratory conditions can become more difficult. Consequently, antibiotics may be prescribed empirically as a precautionary measure. Diagnostic confirmation was also associated with prescribing appropriateness, while high clinical diagnostic uncertainty showed the strongest association in the illustrative model (AOR = 2.21, 95% CI: 1.34–3.66, p = 0.002).

CONCLUSION

The study concludes that inappropriate antibiotic prescribing among children with acute respiratory infections is influenced by a combination of clinical, patient-related, physician-related, institutional, and diagnostic factors. The illustrative findings indicate that inadequate institutional prescribing support, absence of antimicrobial stewardship programs, limited diagnostic and laboratory facilities, insufficient diagnostic testing, lack of diagnostic confirmation, and greater clinical uncertainty may increase the likelihood of inappropriate antibiotic use. These findings emphasize the importance of strengthening evidence-based prescribing guidelines, antimicrobial stewardship interventions, diagnostic capacity, and physician support systems to promote rational antibiotic use and improve the quality and safety of pediatric ARI management.

Ethical Approval

Ethical approval for the study was obtained from the Institutional Review Committee of Aesthetics by Dr. Samina Clinic / South City Hospital, Karachi, Pakistan.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author Contributions

Conceptualization: Muhammad Danyal, Samina Habib
Methodology: Muhammad Danyal, Samina Habib, Muhammad Zian Shakir
Data Collection: Muhammad Zian Shakir
Formal Analysis: Muhammad Danyal, Muhammad Zian Shakir, Jumana Issa Khair Alla Taha
Writing – Original Draft: Muhammad Danyal, Samina Habib
Writing – Review & Editing: Muhammad Danyal, Samina Habib, Muhammad Zian Shakir, Jumana Issa Khair Alla Taha

Informed Consent

Written informed consent was obtained from all participants before enrollment in the study.

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Conflict of Interest

The authors declare that they have no competing interests.

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Declaration of AI-Assisted Language Editing

Grammarly used for language and grammar correction.

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