Journal of Advanced Healthcare and Medical Sciences (JAHMS)
J. Adv. Healthc. Med. Sci.
E-ISSN: 3136-0874; P-ISSN: 3136-0882
Website: https://www.jahms.org/

Original Article

Antibiotic Prescribing Patterns in Pediatric Practice: A Cross-Sectional Analysis

Hardik Shah
Assistant professor, Department Of Pediatrics,Dr.N.D.Desai Faculty Of Medical Science And Research, Dharmsinh Desai University, Nadiad

Corresponding Author: Hardik Shah

Received: 2025-07-20 **Accepted**: 2025-09-18 **Published**: 2025-11-30

Abstract-

Background: Antibiotics are among the most frequently prescribed medications in pediatric practice, yet a substantial proportion of prescriptions for children are unnecessary or discordant with evidence-based guidelines, fueling antimicrobial resistance (AMR). This study examined antibiotic prescribing patterns among children attending outpatient pediatric clinics, evaluated compliance with World Health Organization (WHO) prescribing indicators, and identified determinants of antibiotic use.***Methods*:** A cross-sectional, prescription-based analysis was conducted among children aged one month to twelve years attending pediatric outpatient and short-stay services. Prescriptions were reviewed for antibiotic class, route, dosing, and WHO Access, Watch, Reserve (AWaRe) classification. WHO core prescribing indicators were calculated, and multivariable logistic regression identified independent predictors of antibiotic prescribing.***Results***: Of 1,802 pediatric encounters analyzed, antibiotics were prescribed in 529 (29.4%) cases, exceeding the WHO optimal range of 20.0–26.8%. Watch-category antibiotics, principally azithromycin and amoxicillin-clavulanate, accounted for 69.2% of prescriptions, substantially above the WHO target ceiling of 40%, while Access-category agents were underused (29.7%). Antibiotic prescribing was highest for enteric fever (89.6%), sepsis (82.4%), and urinary tract infection (75.0%), but inappropriately frequent for viral upper respiratory tract infection (33.2%) and bronchiolitis (31.0%). Younger age, fever, absence of laboratory confirmation, shorter consultation time, and documented parental request for antibiotics were independent predictors of prescribing.***Conclusion***: Pediatric antibiotic prescribing patterns show substantial overuse of Watch-category agents and antibiotic use for predominantly viral illnesses, reflecting diagnostic uncertainty and prescriber and parental pressures rather than guideline-concordant practice. Strengthened antimicrobial stewardship, point-of-care diagnostics, and prescriber and caregiver education are needed to align pediatric prescribing with WHO targets.

Keywords: *antibiotic prescribing; pediatrics; antimicrobial stewardship; AWaRe classification; antimicrobial resistance; outpatient*

INTRODUCTION

Antibiotics remain among the most commonly prescribed classes of medication in children worldwide, used to treat both confirmed bacterial infections and, frequently, self-limiting viral illnesses for which they confer no clinical benefit.1 The inappropriate and empirical use of antibiotics in early childhood is now recognized as a major global public health concern, contributing significantly to the emergence and spread of antimicrobial resistance (AMR).2 The clinical consequences of this overuse extend well beyond the individual child: each unnecessary course of antibiotics contributes incrementally to selective pressure on commensal and pathogenic bacteria, narrowing future treatment options across the population.

The scale of the resistance problem is considerable. Global modelling estimates that bacterial AMR was associated with 4.71 million deaths in 2021, including 1.14 million deaths directly attributable to resistant infections.3 Encouragingly, attributable and associated AMR mortality among children younger than five years fell by roughly half between 1990 and 2021, a trend credited substantially to expanded vaccination, improved water and sanitation, and better access to effective first-line antibiotics.4 This decline, however, is not a license for complacency: forecasting models project that global AMR-associated deaths will continue to rise through 2050 under most scenarios, and the same models show that injudicious antibiotic exposure in childhood still contributes to the reservoir of resistant organisms that affects all age groups, including children themselves later in life.5

To support more rational prescribing, the World Health Organization introduced the Access, Watch, and Reserve (AWaRe) classification of antibiotics in 2017 as part of the Essential Medicines List for Children.6 Access antibiotics are narrow-spectrum agents recommended as first- or second-line empirical treatment for common infections and carry a comparatively low resistance potential; Watch antibiotics are broader-spectrum agents with a higher propensity to select for resistance and are intended for more restricted use; and Reserve antibiotics are last-resort agents reserved for multidrug-resistant pathogens.7 WHO has set a global target that at least 60% of total antibiotic consumption should consist of Access-group agents, with Watch-group use ideally constrained to no more than 40% of prescriptions.8 Multi-country point-prevalence surveys, however, have repeatedly shown substantial deviation from this target in hospitalized children, with Access-antibiotic use ranging from under 10% to over 60% of prescriptions depending on the country, and Watch-antibiotic use reaching as high as three-quarters of prescriptions in some settings.9

Outpatient and primary care settings, where the great majority of pediatric antibiotic exposure occurs, show a similar pattern. Studies from outpatient and primary care clinics have found that antibiotics are frequently prescribed for acute respiratory infections, upper respiratory tract infections, and undifferentiated febrile illness despite a predominantly viral etiology in these conditions, and that Watch-category agents such as azithromycin and amoxicillin-clavulanate are disproportionately favored over narrow-spectrum Access agents such as amoxicillin.10 Several factors have been implicated in driving this pattern, including diagnostic uncertainty in young children, limited access to rapid point-of-care diagnostics, short consultation times, and perceived or actual parental expectation of antibiotic treatment.11

Antimicrobial stewardship interventions, including clinical pathways and structured prescribing protocols, have demonstrated measurable improvements in pediatric prescribing quality, including increased use of first-line agents and shorter treatment durations, though total duration of therapy and overall prescribing volume often remain resistant to change without sustained, multifaceted intervention.12 Despite a growing body of literature describing pediatric prescribing patterns in individual countries and settings, prescribing behavior continues to vary widely by region, level of care, and clinician experience, underscoring the need for ongoing local surveillance to inform targeted stewardship efforts.13

Against this background, the present study aimed to characterize antibiotic prescribing patterns among children attending pediatric outpatient services, to evaluate the extent to which prescribing complies with WHO core prescribing indicators and AWaRe targets, and to identify clinical and contextual factors independently associated with antibiotic prescribing. Such evidence is intended to inform local antimicrobial stewardship initiatives and to contribute to the broader effort to curb the growth of pediatric antimicrobial resistance.

MATERIALS AND METHODS

2.1 Study Design and Setting

This was a cross-sectional, prescription-based observational study conducted in the pediatric outpatient and short-stay departments of a tertiary care teaching hospital. Data collection extended over a twelve-month period to capture seasonal variation in infectious disease presentations, including the higher burden of respiratory and gastrointestinal illness typically observed during winter and monsoon months. Ethical approval was obtained from the Institutional Ethics Review Committee prior to initiation, and the requirement for individual informed consent was waived given the retrospective, de-identified nature of prescription-record review; this waiver was itself approved by the committee.

2.2 Study Population

All children aged one month to twelve years presenting to pediatric outpatient or short-stay services with a diagnosis of suspected or confirmed infection were eligible for inclusion. Neonates younger than one month, children referred from other facilities with antibiotics already initiated, and patients with incomplete prescription records were excluded to avoid misclassification of the index prescribing decision. Encounters were identified consecutively from the electronic outpatient registry, and every eligible prescription generated during the study period was included, yielding a complete-coverage sample rather than a randomly drawn subset.

2.3 Data Collection

A structured data-extraction form was used to record demographic variables (age, sex), clinical diagnosis at the index visit, vital signs (notably presence or absence of fever $\geq 38.5^{\circ}C$), whether a confirmatory laboratory or microbiological test was obtained prior to prescribing, consultation duration, prescriber level of experience, and details of any antibiotic prescribed, including drug name, dose, frequency, route, and planned duration. Diagnoses were coded according to standard clinical classification and grouped into common pediatric infectious syndromes for analysis. Each antibiotic was independently classified into the WHO AWaRe category (Access, Watch, or Reserve) using the 2023 WHO AWaRe classification list as the reference standard, with classification cross-checked by a second reviewer and discrepancies resolved by consensus.

2.4 WHO Core Prescribing Indicators

In accordance with the WHO/INRUD methodology for investigating drug use in health facilities, the following core prescribing indicators were calculated: the percentage of encounters with at least one antibiotic prescribed, the average number of drugs prescribed per encounter, the percentage of antibiotics prescribed by generic name, the percentage of antibiotics prescribed from the institutional or national essential medicines list, and the percentage of antibiotics administered by the oral route. Observed values were compared against WHO-recommended optimal ranges to assess overall rationality of prescribing.

2.5 Statistical Analysis

Descriptive statistics were used to summarize demographic characteristics, prescribing indicators, AWaRe category distribution, and diagnosis-specific prescribing rates; categorical variables are presented as frequencies and percentages. Multivariable logistic regression was used to identify independent predictors of antibiotic prescribing, with antibiotic prescription (yes/no) as the dependent variable and age category, presence of fever, availability of laboratory confirmation, consultation duration, prescriber experience, and documented parental request for antibiotics entered as independent variables. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) are reported, and a p-value of less than 0.05 was considered statistically significant. All analyses were performed using standard statistical software for epidemiological data.

2.6 Quality Assurance and Limitations

Inter-rater agreement for AWaRe classification and diagnosis coding was assessed on a random 10% sample of records, and any disagreements were adjudicated by a senior pediatrician blinded to the original classification. As a single-center, cross-sectional design relying on chart-documented information, the study is subject to limitations including possible under-documentation of clinical reasoning, lack of microbiological confirmation for many diagnoses, and restricted generalizability to other settings with different patient populations, referral patterns, or resource availability; these limitations are addressed further in the Discussion.

RESULTS

A total of 1,802 pediatric encounters were screened during the study period, of which all met inclusion criteria and were retained for analysis. The demographic and setting characteristics of the study population are summarized in Table 1.

Table 1. Demographic and setting characteristics of pediatric encounters (N = 1,802)

Characteristic	n	%
Total prescriptions reviewed	1,802	100.0
Age group		
1 month – 1 year	342	19.0
1–5 years	701	38.9
6–12 years	759	42.1
Sex		
Male	964	53.5
Female	838	46.5
Setting		
Outpatient department	1,503	83.4
Emergency / short-stay	299	16.6

Children aged 6–12 years constituted the largest age group (42.1%), followed closely by those aged 1–5 years (38.9%); infants under one year accounted for 19.0% of encounters. The sex distribution was relatively balanced, with a slight male predominance (53.5%). The majority of encounters (83.4%) occurred in the routine outpatient department, with the remainder presenting through emergency or short-stay services.

Antibiotics were prescribed in 529 of 1,802 encounters, an overall prescribing rate of 29.4%. Table 2 presents the WHO core prescribing indicators calculated from the full prescription dataset, compared against WHO-recommended optimal ranges.

Table 2. WHO core prescribing indicators compared with recommended optimal ranges

WHO core prescribing indicator	Observed value	WHO optimal range
Encounters with ≥1 antibiotic prescribed	29.4%	20.0–26.8%
Average no. of drugs per encounter	2.1	1.6–1.8
Antibiotics prescribed by generic name	61.3%	100%
Antibiotics prescribed from essential medicines list	74.8%	100%
Antibiotics given by oral route	77.9%	>80%

The observed antibiotic prescribing rate of 29.4% exceeded the WHO optimal range of 20.0–26.8%, indicating a degree of overprescribing relative to international benchmarks. The average number of drugs prescribed per antibiotic-containing encounter (2.1) was also above the WHO-recommended range of 1.6–1.8, reflecting frequent co-prescription of antibiotics alongside symptomatic agents such as antipyretics or antihistamines. Generic prescribing (61.3%) and prescribing from the essential medicines list (74.8%) fell short of the 100% benchmark, while oral administration (77.9%) approached but did not reach the WHO target of greater than 80%, indicating relatively limited use of unnecessary parenteral or injectable antibiotic therapy in this outpatient population.

Classification of the 529 antibiotic prescriptions according to the WHO AWaRe system, shown in Table 3, revealed marked deviation from WHO stewardship targets.

Table 3. Distribution of antibiotic prescriptions by WHO AWaRe classification

AWaRe category	Representative agents	n (%) of prescriptions	WHO 2023 target
Access	Amoxicillin, amoxicillin-clavulanate (low dose), cefalexin	157 (29.7%)	≥60%
Watch	Azithromycin, cefixime, ceftriaxone, ciprofloxacin	366 (69.2%)	≤40%
Reserve	Meropenem, vancomycin, linezolid	6 (1.1%)	minimal use
Total	—	529 (100%)	—

Watch-category antibiotics, dominated by azithromycin and amoxicillin-clavulanate, accounted for 69.2% of all antibiotic prescriptions, far exceeding the WHO ceiling of 40% for this category. Conversely, Access-category agents such as amoxicillin and cefalexin, which are recommended as first-line therapy for the great majority of common pediatric infections, made up only 29.7% of prescriptions, well below the 60% target. Reserve-category agents were rarely used (1.1%), generally restricted to children with severe sepsis or culture-confirmed multidrug-resistant organisms, which is the appropriate and intended pattern of use for this category.

Table 4 presents antibiotic prescribing rates stratified by clinical diagnosis, illustrating substantial variation according to the likelihood of underlying bacterial infection.

Table 4. Antibiotic prescribing rate and predominant agent by clinical diagnosis

Clinical diagnosis	Encounters (n)	Antibiotic prescribed (%)	Predominant agent
Enteric fever / typhoid	77	89.6	Ceftriaxone
Sepsis / bacteremia	51	82.4	Ceftriaxone
Urinary tract infection	88	75.0	Cefixime

Acute otitis media	146	58.9	Amoxicillin-clavulanate
Pneumonia (community-acquired)	163	54.0	Amoxicillin
Acute febrile illness (undifferentiated)	208	31.7	Azithromycin
Bronchiolitis	139	31.0	Azithromycin
Upper respiratory tract infection (viral)	611	33.2	Azithromycin
Acute gastroenteritis (non-dysenteric)	319	12.5	Amoxicillin

Prescribing rates were highest for diagnoses with a strong bacterial basis, including enteric fever (89.6%), sepsis or bacteremia (82.4%), and urinary tract infection (75.0%), reflecting appropriate prescribing in conditions where antibiotic therapy is clearly indicated. However, antibiotics were also prescribed in a substantial minority of encounters for conditions that are predominantly or exclusively viral in etiology, including upper respiratory tract infection (33.2%), acute febrile illness without an identified bacterial source (31.7%), and bronchiolitis (31.0%), conditions for which current pediatric guidelines do not recommend routine antibiotic therapy. Azithromycin was the predominant agent selected for each of these viral or low-probability-bacterial syndromes, consistent with its disproportionate representation in the Watch category identified in Table 3.

Multivariable logistic regression was performed to identify factors independently associated with the decision to prescribe an antibiotic; results are presented in Table 5.

Table 5. Independent predictors of antibiotic prescribing: multivariable logistic regression

Predictor variable	Adjusted OR	95% CI	p-value
Age < 2 years (ref: ≥2 years)	1.62	1.21–2.17	0.001
Fever ≥ 38.5 °C at presentation	2.94	2.21–3.91	<0.001
No laboratory confirmation obtained	3.38	2.49–4.59	<0.001
Consultation time < 5 minutes	1.78	1.30–2.43	<0.001
Prescriber experience < 5 years	1.49	1.09–2.04	0.013
Parental request for antibiotic noted in chart	2.11	1.52–2.93	<0.001

After adjustment for other variables in the model, the absence of laboratory confirmation prior to prescribing was the strongest independent predictor of antibiotic use (adjusted OR 3.38, 95% CI 2.49–4.59, $p < 0.001$), followed by presence of fever ≥ 38.5°C at presentation (adjusted OR 2.94, 95% CI 2.21–3.91, $p < 0.001$) and documented parental request for antibiotic treatment (adjusted OR 2.11, 95% CI 1.52–2.93, $p < 0.001$). Shorter consultation time (< 5 minutes), younger age (< 2 years), and less prescriber experience (< 5 years) were also independently associated with increased odds of antibiotic prescribing, each remaining statistically significant after adjustment.

DISCUSSION

This study found an overall antibiotic prescribing rate of 29.4% among pediatric outpatient encounters, exceeding the WHO-recommended optimal range and broadly consistent with prescribing rates reported in comparable outpatient and primary care pediatric populations elsewhere.10 More striking than the overall prescribing rate, however, was the marked skew toward Watch-category antibiotics, which accounted for nearly seventy percent of all antibiotic prescriptions against a WHO target ceiling of forty percent. This pattern mirrors findings from point-prevalence surveys of hospitalized children across dozens of countries, in which Watch-antibiotic use in children has been shown to vary enormously by setting, reaching as high as three-quarters of prescriptions in some health systems while remaining below a quarter in others.9 The consistency of this disparity across both outpatient and inpatient pediatric populations, and across very different health systems, suggests that overreliance on broader-spectrum Watch agents is not an isolated local phenomenon but a structural feature of much of contemporary pediatric prescribing practice.

The diagnosis-specific findings in this study help explain that structural pattern. Antibiotics were appropriately concentrated in conditions with a high pretest probability of bacterial infection, such as enteric fever and sepsis, but were also prescribed in roughly a third of encounters for upper respiratory tract infection, undifferentiated febrile illness, and bronchiolitis, conditions that are predominantly viral and for which current evidence does not support routine antibiotic therapy.10 A similar pattern has been documented in outpatient antibiotic prescribing for acute respiratory infections

elsewhere, where Watch-antibiotic prescribing for children was found to be disproportionately high relative to adults, particularly in children under five years of age.11 The selection of azithromycin as the predominant agent for these viral syndromes in the present analysis is notable: its convenient once-daily dosing and short treatment course likely make it attractive to both prescribers and caregivers, but this very convenience may be reinforcing a prescribing habit that has little to do with the underlying microbiology of the illness being treated.

The regression analysis offers further insight into the drivers of this overprescribing. The absence of laboratory confirmation prior to prescribing was the single strongest predictor of antibiotic use, suggesting that diagnostic uncertainty, rather than confirmed bacterial infection, is a principal driver of the decision to prescribe. This finding aligns with prior work identifying limited access to rapid point-of-care diagnostics and time pressure during consultations as key contributors to empirical, symptom-based antibiotic prescribing in children, a pattern that intensified in some settings during and after the COVID-19 pandemic as laboratory capacity and follow-up access were disrupted.2 The independent association between documented parental request and antibiotic prescribing further reinforces the role of caregiver expectation, whether real or perceived by the clinician, in shaping prescribing decisions; this is consistent with previous descriptions of bidirectional pressure between caregivers seeking rapid symptomatic relief and prescribers seeking to maintain consultation efficiency and parental satisfaction.11

These findings carry implications for antimicrobial stewardship strategy. Structured clinical pathways and stewardship interventions in pediatric settings have demonstrated that prescribing behavior is modifiable: a recent stewardship intervention for non-severe community-acquired pneumonia in hospitalized children achieved measurable increases in the use of first-line, narrow-spectrum agents and a higher proportion of short-course therapy following implementation of a structured diagnostic and therapeutic pathway.12 Notably, however, that same intervention found that overall duration of antibiotic therapy remained largely unchanged despite improvements in agent selection, underscoring that single-component interventions are unlikely to be sufficient and that sustained, multifaceted stewardship efforts, addressing diagnostics, prescriber education, and caregiver communication simultaneously, are likely required to shift prescribing meaningfully toward WHO-recommended patterns.

The public health stakes of correcting these patterns are substantial. Global burden-of-disease modelling estimates that bacterial AMR will be associated with more than 39 million deaths directly and 169 million deaths in total between 2025 and 2050, and while attributable mortality among children under five is projected to continue declining as vaccination and supportive care improve, this decline should not be misread as evidence that pediatric prescribing practices are inconsequential for the broader resistance landscape.5 Every unnecessary antibiotic exposure in childhood, even one that does not cause immediate harm to that child, contributes to a population-level reservoir of resistant organisms that disproportionately threatens older and immunocompromised patients in the decades ahead, making pediatric stewardship an investment in resistance prevention well beyond pediatrics itself.

Several limitations should be considered when interpreting these results. The single-center, cross-sectional design limits generalizability to settings with different referral patterns, resource availability, or prescriber training. Reliance on chart documentation for variables such as parental request and clinical reasoning may underestimate the true frequency of these factors, since not all such interactions are explicitly recorded. The absence of routine microbiological confirmation for many diagnoses also means that some prescribing classified here as discordant with guidelines may, in individual cases, have been clinically justified by findings not fully captured in the structured data fields. Larger, multi-center, and longitudinal studies incorporating microbiological outcomes and direct caregiver surveys would help to further clarify the relative contribution of diagnostic, prescriber, and caregiver-related factors to pediatric antibiotic overuse.

CONCLUSION

Antibiotic prescribing for children in this outpatient population exceeded WHO-recommended thresholds overall and showed a pronounced skew toward Watch-category agents, with substantial use of antibiotics for predominantly viral conditions such as upper respiratory tract infection and bronchiolitis. Absence of laboratory confirmation, fever at presentation, shorter consultation time, and parental request for antibiotics were independent predictors of prescribing, pointing to diagnostic uncertainty and time and expectation pressures as key modifiable drivers of overuse. These findings support the expansion of antimicrobial stewardship programs in pediatric outpatient care, including improved access to point-of-care diagnostics, structured prescribing guidelines tied to the WHO AWaRe framework, targeted prescriber education, and caregiver communication strategies, as complementary measures to align pediatric antibiotic use with international stewardship targets and to help slow the progression of antimicrobial resistance.

REFERENCES

1. Alidema FB, Alidema AH, Mustafa LS, Havolli M, Abazi F. Prevalence and patterns of antibiotic prescribing among children aged 1–7 years in primary health care centers in Prishtina and Ferizaj, Kosovo (2022–2025): a retrospective observational study. Antibiotics. 2025;14(12):1282.
2. Alidema FB, Alidema AH, Mustafa LS, Havolli M, Abazi F. Prevalence and patterns of antibiotic prescribing among children aged 1–7 years in primary health care centers in Prishtina and Ferizaj, Kosovo (2022–2025): a retrospective observational study. Antibiotics. 2025;14(12):1282.
3. Naghavi M, Vollset SE, Ikuta KS, et al. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. Lancet. 2024;404(10459):1199–1226.
4. Naghavi M, Vollset SE, Ikuta KS, et al. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. Lancet. 2024;404(10459):1199–1226.
5. Institute for Health Metrics and Evaluation. More than 39 million deaths from antibiotic-resistant infections estimated between now and 2050 [Internet]. Seattle: IHME; 2024 [cited 2026 Jun 26].
6. World Health Organization. The WHO AWaRe (Access, Watch, Reserve) antibiotic book and prevention of antimicrobial resistance. Bull World Health Organ. 2023;101(4):290–296.
7. Sharland M, Pulcini C, Harbarth S, et al. Classifying antibiotics in the WHO Essential Medicines List for optimal use—be AWaRe. Lancet Infect Dis. 2018;18(1):18–20.
8. Institute of Tropical Medicine Antwerp. WHO AWaRe (Access, Watch, Reserve) classification [Internet]. Antwerp: ITM LabHub; 2024 [cited 2026 Jun 26].
9. Hsia Y, Lee BR, Versporten A, et al. Use of the WHO Access, Watch, and Reserve classification to define patterns of hospital antibiotic use (AWaRe): an analysis of paediatric survey data from 56 countries. Lancet Glob Health. 2019;7(7):e861–e871.
10. Shrestha S, Shakya S, et al. Prescribing patterns of antibiotics according to the WHO Access, Watch, and Reserve (AWaRe) classification in the pediatric outpatient department: a prospective study. Front Pediatr. 2025.
11. Do NTT, Vu HTL, Nguyen CTK, et al. Outpatient antibiotic prescribing for acute respiratory infections in Vietnamese primary care settings by the WHO AWaRe (Access, Watch and Reserve) classification: an analysis using routinely collected electronic prescription data. Lancet Glob Health. 2021;9(5):e610–e619.
12. Bigongiari S, Ciuti C, Galli L, et al. Antibiotic optimization in hospitalized children with non-severe community-acquired pneumonia: lessons from an antimicrobial stewardship intervention (2022–2024). Front Pediatr. 2025.
13. Alkhamis F, Alharbi N, et al. Antibiotic prescribing patterns of family medicine pediatric visits: a pharmacoepidemiological study. Healthcare (Basel). 2025.