*Nigerian Journal of Pharmaceutical and Applied Science Research*,
*Vol.14 (3):9-20; September 2025 ISSN: 2971-737X (Print); ISSN: 2971-7388.*
*Available at www.nijophasr.net https://doi.org/10.60787/nijophasr-v14-i3-623*

# Evaluation of antibiotic utilization and prescribing pattern in pediatrics using the WHO prescribing indicators in a Nigerian tertiary hospital

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**Article info**: Volume 14 Issue 3, September 2025; Received: 14 August 2025; Reviewed: 16 August 2025, Accepted: 22 August 2025; Published: 1 September 2025; *doi: 10.60787/nijophasr-v14-i3-623*

**ABSTRACT**

***Background****:* Medication use in children requires careful management given their increased risk of adverse effects. Inappropriate prescribing and use of antibiotics may intensify antibiotic resistance and compromise health outcomes. The World Health Organization (WHO) provides core prescribing indicators to assess rational drug use, emphasizing the importance of aligning with best practices. This study evaluates the prescribing patterns of antibiotics and other medications for pediatric patients in a Nigerian tertiary hospital using WHO core indicators, aiming to offer insights for improving medication utilization and antibiotic stewardship.

***Method****:* A retrospective cross-sectional analysis at the University of Uyo Teaching Hospital involved 600 pediatric prescription records from September 2023 to August 2024. Data collection included demographics, total drugs per prescription, antibiotic use, and adherence to generic prescribing and the essential drug list. The R programming language was used to analyze the prescribing metrics in comparison with the WHO standard.

***Results****:* The average number of drugs per encounter was 3.0, surpassing the WHO recommendation. Notably, 58.2% of prescriptions included antibiotics, substantially exceeding the suggested range of 20%–26.8%. However, 68.9% of medications were prescribed by generic names, and 90.3% of the drugs were prescribed from the essential drug list, revealing gaps in adherence to best practices. The predominant antibiotics prescribed were cefuroxime and amoxicillin, emphasizing reliance on commonly used agents.

***Conclusion:*** Results indicate a critical need for enhanced prescriber education on rational antibiotic use. The study underscores the importance of implementing stringent antibiotic stewardship programs to mitigate resistance and optimize treatment strategies in pediatric populations.

***Key words*****:** Antibiotic prescription, antibiotic stewardship, drug use, pediatric patients, WHO core indicators.

## 1. INTRODUCTION

Good prescribing practices in pediatrics are essential to ensure the safety and efficacy of treatments administered to children. In pediatric medicine, the judicious use of antibiotics is crucial in managing childhood infections. Antibiotics play a pivotal role in treating various bacterial infections that can be particularly dangerous for children due to their developing immune systems. This vulnerability manifests in a higher susceptibility to infections such as pneumonia, tuberculosis, and gastroenteritis, all of which necessitate prompt medical intervention [1, 2]. A study evaluating prescribing habits in pediatric settings highlighted that inappropriate prescribing can lead to adverse outcomes, including exacerbated antibiotic resistance [3]. Thus, antibiotics must be employed judiciously, balancing the necessity of treatment and the potential for harm due to inappropriate usage. The World Health Organization (WHO) has developed a set of core prescribing indicators under the International Network for the Rational Use of

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Drugs (INRUD) to assess and promote the rational use of medications across healthcare settings. These indicators serve as critical tools for evaluating various aspects of drug prescribing practices, including the average number of drugs prescribed per encounter, the percentage of medications that are prescribed by their generic names, and the proportion of encounters wherein antibiotics are dispensed [4, 5]. By utilizing these indicators, healthcare systems can identify areas for improving prescription patterns, promoting better health outcomes, and fostering responsible antibiotic use. Antibiotic prescribing trends in pediatric healthcare settings in Nigeria reveal a persistent issue of inappropriate usage that reflects broader global concerns regarding antibiotic resistance. For instance, a study conducted in Owerri found that antibiotics were predominantly prescribed for conditions such as pharyngotonsillitis, consistent with the recommendations of the Pediatric Association of Nigeria; nonetheless, the rates of antibiotic prescriptions remain significant, raising concerns about the overall rationality of such practices [6]. Furthermore, data indicate that a concerning number of outpatient pediatric patients received antibiotics for conditions where they may not be warranted, highlighting a trend toward irrational prescribing [7]. The implications of these practices are profound, contributing not only to the development of antimicrobial resistance but also increasing healthcare costs and the likelihood of adverse drug reactions among pediatric patients [8]. Currently, there is a notable deficit in available data specifically focused on the evaluation of pediatric antibiotic prescribing using the WHO core prescribing indicators in Nigeria. Although some studies have touched on general drug use patterns, limited application of these specific indicators to pediatric settings clouds the understanding of how well current practices align with global standards for rational drug use [9, 10]. This lack of research is concerning, as pediatric patients are uniquely vulnerable to the consequences of inappropriate prescribing, including adverse drug events and the development of antimicrobial resistance [3]. With rising rates of antimicrobial resistance posing a global health threat, establishing a clear evidence base regarding pediatric antibiotic prescribing practices is vital for effective stewardship efforts. Implementing these evaluations can aid in designing targeted educational programs for healthcare providers, improve clinical pathways, and ultimately enhance patient outcomes [11, 12] This study aimed to evaluate the pattern of antibiotic prescribing and medication use in pediatric patients in a tertiary hospital in Nigeria using the WHO core prescribing indicators. By systematically assessing these practices, this research seeks to generate valuable insights that can inform local health policies and contribute to enhanced antibiotic stewardship efforts within pediatric populations, ultimately promoting better health outcomes for children.

## 2. MATERIALS AND METHODS

### 2.1 MATERIALS

*2.1.1 Research tools*

The primary data collection tool used in this research was the WHO “prescribing indicator form," which encompasses several key variables essential for evaluating prescribing practices. The form captured the date of prescription, age of patients, specific drugs prescribed, antibiotics prescribed, injections prescribed, Essential Medicine List (EML) drugs, and the diagnosis [13].

### 2.2 Methods

*2.2.1 Study setting*

The study was conducted at the Pediatric Department of the University of Uyo Teaching Hospital (UUTH). The health facility is a pivotal healthcare institution located in Uyo, Akwa Ibom State, Nigeria. It serves as the sole tertiary hospital in the state, providing a wide array of healthcare services to both residents and individuals from neighboring states. UUTH is a focal point for medical education and research in the region, contributing significantly to the national healthcare landscape.

*2.2.2 Study design*

This research employed a retrospective cross-sectional study design to assess the medication use and antibiotic prescribing patterns in the pediatric department of the UUTH. The study utilized the WHO prescribing indicators to evaluate the rational use of drugs in the hospital setting.

*2.2.3 Sample size determination and sampling procedure*

The World Health Organization (WHO), in its publication “How to Investigate Drug Use in Health Facilities,” recommended that a minimum sample size of 600 encounters be included in any cross-sectional survey addressing drug use [13]. A total of 600 prescription papers spanning one year were analyzed, following WHO's guidance. The methodology employed for selecting specific prescription papers involved a systematic random sampling technique, utilizing prescription numbers as the framework for sampling. The analysis considered a total of 4,324 prescription papers dispensed between September 1, 2023, and August 31, 2024. To derive the sampling interval, the total number

of prescription papers (4,324) was divided by the target sample size of 600, resulting in a calculated sampling interval of 7. Each prescription paper was noted to have a unique identification number. To facilitate systematic sampling, all prescriptions issued during the specified study period were arranged in ascending order based on their identification numbers. Consequently, every 7th prescription paper was selected for inclusion in the study sample.

*2.2.4 Inclusion and exclusion criteria*

The inclusion criteria comprised prescriptions that contained at least one medication and ensured legibility for the clear identification of the medications prescribed. Conversely, prescriptions were excluded based on several criteria, including those with illegible handwriting that hindered the clear identification of medications and duplicate prescriptions or those that fell outside the designated study time frame. In instances where every 7th prescription selected through the sampling method did not meet the inclusion criteria, that particular encounter was skipped, and the next sequentially numbered prescription eligible was selected. This process continued until the requisite sample size of 600 eligible prescriptions was achieved.

*2.2.5 Data collection*

Data was collected from the prescription records of the pharmacy units. The variables extracted included patient demographics, specifically sex and age, total number of drugs prescribed per prescription, number of antibiotics prescribed, names and classes of antibiotics, number of injections prescribed, number of drugs prescribed by generic name, and number of drugs sourced from the essential drug list. To ensure consistency and accuracy in the data collection process, a structured data extraction form was utilized.

*2.2.6 Ethical consideration*

The study received ethical approval from the Health Research Ethics Committee (HREC) of the University of Uyo Teaching Hospital (UUTH) (reference: NHREC/24/06/22/UUTH). Patient confidentiality was maintained by anonymizing data and ensuring that the information was coded.

**2.3 Data analysis**

The collected data was analyzed using R programming language, employing descriptive statistics to derive key metrics that included the following: the average number of drugs per encounter, calculated by dividing the total number of different drug products prescribed by the number of encounters surveyed; the percentage of drugs prescribed by generic name, which was determined by dividing the number of drugs prescribed by generic name by the total number of drugs prescribed, then multiplying by 100; and the percentage of encounters with an antibiotic prescribed, as well as the percentage of encounters with an injection prescribed, both calculated by dividing the number of patient encounters during which an antibiotic or injection was prescribed by the total number of encounters surveyed and multiplying by 100. Additionally, the percentage of drugs prescribed from the essential drugs list or formulary was calculated by dividing the number of products prescribed that were either listed on the essential drugs list or the local formulary (or equivalent), by the total number of products prescribed, multiplied by 100. The results were then compared against World Health Organization (WHO) standard values for each indicator to assess adherence to rational prescribing practices [13, 14].

**3 RESULTS**

**3.1 Completeness of the prescription**

Demographic data of patients (age, weight, and sex) as well as the date of prescription were mentioned in all the prescriptions reviewed. Drug-related information, such as the name of the drug, strength, frequency, and duration of treatment, prescriber, and dispenser information, was also completely mentioned in all of the prescriptions reviewed. The diagnosis of ailments was not recorded in any of the prescription papers.

**3.2 Population characteristics**

In this study, we examined a sample of 600 pediatric prescriptions obtained from the children's pharmacy of the UUTH spanning from September 2023 to August 2024. The age analysis shows that the largest number of prescriptions were for children aged between 1 to 3 years, accounting for 26.0% of the sample, while the smallest were for those aged 28 days or less and those aged 16 to 18 years, each representing 5.7%. The average age recorded in the prescriptions is 6.2 years with a standard deviation of 5.1 years, indicating a variability in age among the subjects. In terms of weight, the majority falls within the 11 to 20 kg range, comprising 42.8% of the sample, while the least represented weight categories are those over 50 kg, which constitute only 1.3%. The average weight among the prescriptions is reported as 20.7 kg with a standard deviation of 13.1 kg, suggesting significant diversity. Lastly,

the majority of prescriptions (52.5%), were prescribed for males (refer to Table 1).

Table 1: Overview of the study sample's demographic information (N = 600)

| Characteristics | Frequency | Percentage |
|---|---|---|
| Age | | |
| ≤ 28 days | 34 | 5.7 |
| < 12 months | 63 | 10.5 |
| 1 – 3 years | 156 | 26.0 |
| 4 – 6 years | 101 | 16.8 |
| 7 to 9 years | 76 | 12.7 |
| 10 – 12 years | 84 | 14.0 |
| 13 -15 years | 52 | 8.7 |
| 16 – 18 years | 34 | 5.7 |
| Average patient age(years), (SD) | 6.2(5.1) | |
| Weight | | |
| < 5 kg | 34 | 5.7 |
| 5 – 10 kg | 63 | 10.5 |
| 11 – 20 kg | 257 | 42.8 |
| 21 – 30 kg | 159 | 26.5 |
| 31 – 40 kg | 53 | 8.8 |
| 41 – 50 kg | 26 | 4.3 |
| >50 kg | 8 | 1.3 |
| Average patient weight(kg), (SD) | 20.7(13.1) | |
| Sex | | |
| Male | 315 | 52.5 |
| Female | 285 | 47.5 |

**3.3 Overview of drug prescriptions**

The most common scenario involved a single drug being prescribed, with 132 prescriptions (22.0%), indicating a relatively straightforward treatment approach. Encounters with two drugs accounted for 129 prescriptions (21.5%), while encounters involving three drugs totaled 118 prescriptions (19.7%). This suggests that many patients received treatment with a moderate number of medications. The data show that four drugs were prescribed in 81 cases (13.5%) and five drugs in 110 cases (18.3%), reflecting a growing complexity in treatment as the number of medications increases. However, only 30 prescriptions (5.0%) involved six drugs, highlighting that cases requiring a high level of polypharmacy are less frequent (Table 2).

Table 2: Summary report of the number of drugs per encounter

| Number of Drugs per Encounter | Frequency | Percentage (%) |
|---|---|---|
| One | 132 | 22.0 |
| Two | 129 | 21.5 |
| Three | 118 | 19.7 |
| Four | 81 | 13.5 |
| Five | 110 | 18.3 |
| Six | 30 | 5.0 |

**3.4 WHO drug use indicators**

A total of 1,798 drugs were prescribed across 600 encounters, resulting in an average of 3.0 drugs per encounter, above the WHO standard value range of 1.6 to 1.8. A significant concern arises from the high percentage of encounters involving antibiotics, at 58.2%, which notably exceeds the recommended range of 20% to 26.8%. Additionally, the percentage of encounters with injectable medications was recorded at 17.8% again within acceptable limits as per WHO standards, which range from 13.4% to 24.1%. Regarding the prescription of generic

names, adherence stands at 68.9%, falling short of the WHO guideline, which advocates for 100% generic name prescriptions. Conversely, the percentage of drugs prescribed from the essential drug list is commendably high at 90.3%. While this is a strong indicator of adherence to essential medication protocols, it still does not meet the WHO standard of 100%. The details are shown in Table 3.

Table 3: WHO prescribing indicators calculated based on 600 prescriptions

| Prescribing Indicators | Total Number of Drugs/Encounters | Average/Percentage | WHO Standard Value |
|---|---|---|---|
| Average number of drugs per encounter | 1798 | 3.0 | (1.6 – 1.8) |
| Percentage of encounters with antibiotics | 349 | 58.2 | (20 -26.8) |
| Percentage of encounters with injection | 107 | 17.8 | (13.4 -24.1) |
| Percentage of drugs prescribed by generic name | 1238 | 68.9 | 100 |
| Percentage of drugs from the essential drug list | 1624 | 90.3 | 100 |

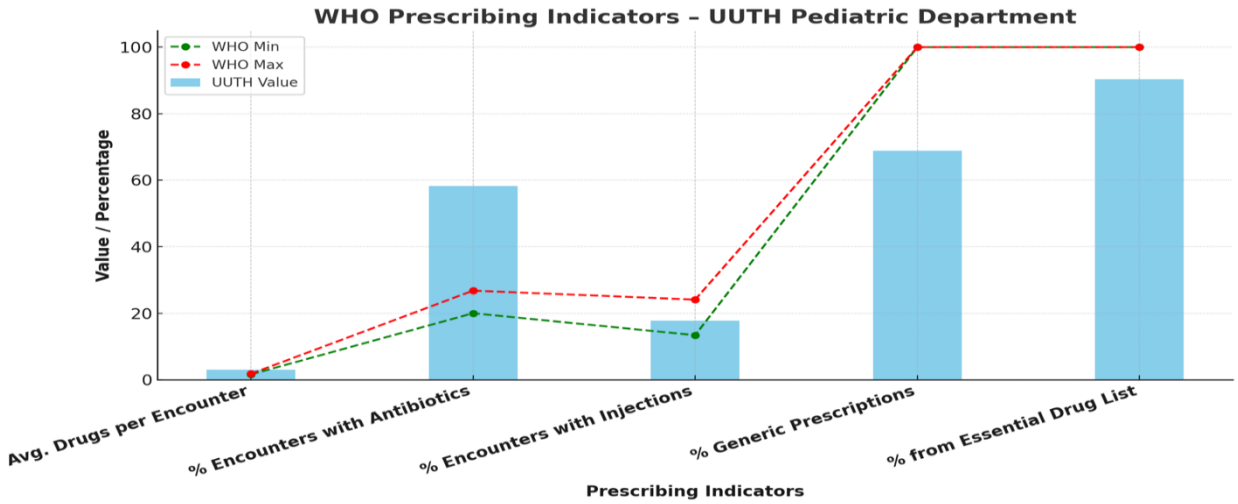


Figure 1: WHO Prescribing Indicators at the UUTH Pediatric Department

**3.5 Antibiotic prescription patterns in encounters**

The analysis of antibiotic usage across 349 encounters reveals a predominance of single antibiotic prescriptions, accounting for 84.8% (296 encounters), followed by two antibiotics at 14.9% (52 encounters). Notably, only 0.3% (1 encounter) resulted in the prescription of three antibiotics. In total, 403 antibiotics were prescribed, which constitutes 22.4% of all medications dispensed in these encounters (Table 4).

Table 4: Summary report of the number of antibiotics per encounter (Total number of encounters with antibiotics = 349**)**

| Number of antibiotics per encounter | Frequency | Percentage (%) |
|---|---|---|
| One | 296 | 84.8 |
| Two | 52 | 14.9 |
| Three | 1 | 0.3 |
| Total antibiotics prescribed | 403 | 22.4%* |

*Percentage of the total drugs prescribed

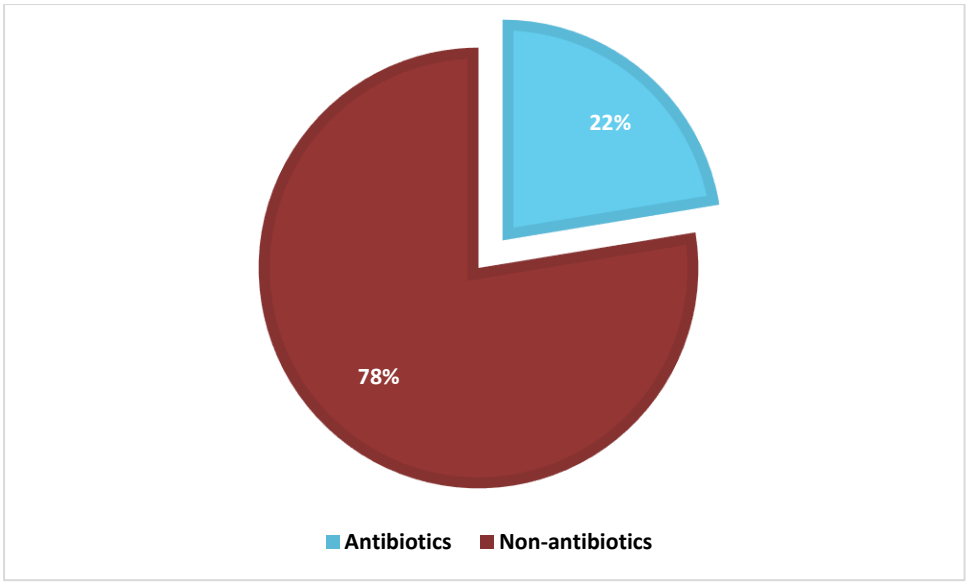


Figure 2: Distribution of the prescribed drugs: antibiotics vs non-antibiotics

**3.6 Prevalence of antibiotic types and classes**

The most frequently prescribed antibiotic was cefuroxime, with 131 prescriptions, accounting for 32.5% of total usage. Amoxicillin follows prescribed 105 times (26.1%), while azithromycin, ceftriaxone, and cefixime had lower frequencies, with 43 (10.7%), 35 (8.7%), and 25 (6.2%), respectively. The less commonly prescribed antibiotics include gentamicin (23 prescriptions, 5.7%), mupirocin (13, 3.2%), and metronidazole (12, 3.0%), with other antibiotics contributing 4.0% (16 prescriptions) (Figure 3). The antibiotic classes reveal notable trends, with cephalosporins being the most prescribed class (197 prescriptions, 48.9%), followed by penicillins (103, 25.6%). The macrolide class (46, 11.4%) and aminoglycosides (25, 6.2%) contributed less to the overall prescribing patterns, while monoxycarbolic acid and nitroimidazole classes were minimally used (3.2% and 3.0%, respectively) (Table 5).

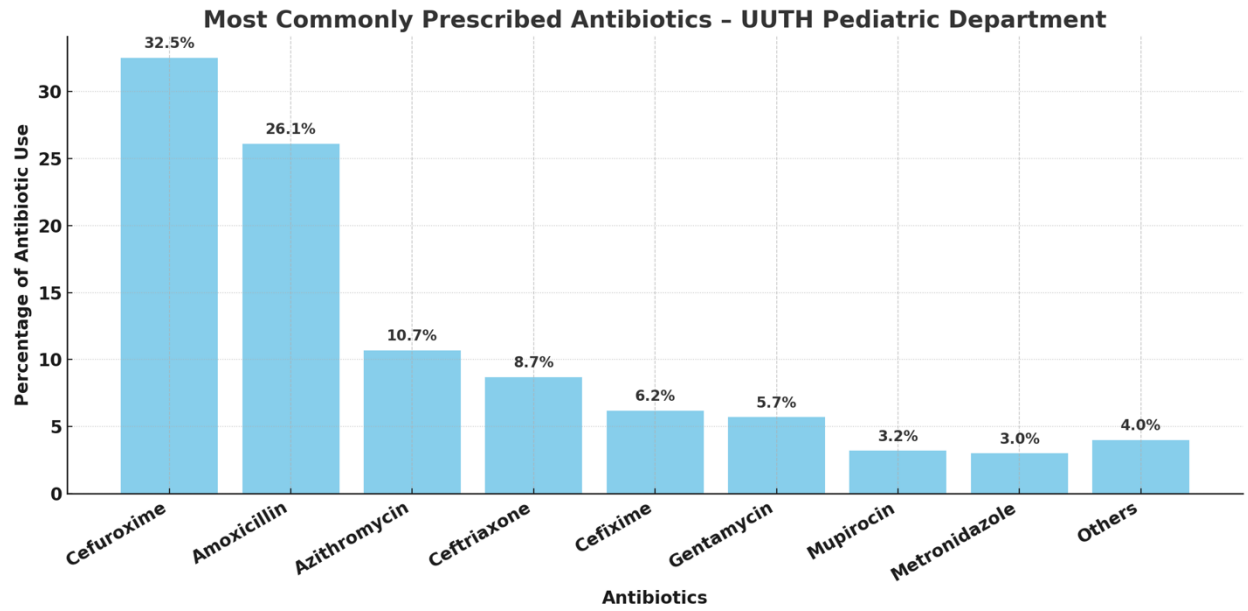


Figure 3: Distribution of Prescribed Antibiotics in Pediatrics at UUTH

Table 5: Summary of Most Commonly Prescribed Classes of Antibiotics at UUTH, pediatric department

| Antibiotics Classes | Frequency | Percentage |
|---|---|---|
| Cephalosporin | 197 | 48.9 |
| Penicillin | 103 | 25.6 |
| Macrolide | 46 | 11.4 |
| Aminoglycoside | 25 | 6.2 |
| Monoxycarbolic acid | 13 | 3.2 |
| Nitroimidazole | 12 | 3.0 |
| Others | 7 | 1.7 |

## 4 DISCUSSION

The predominance of single-drug (22.0%) and dual-drug (21.5%) regimens aligns with the recommendations for antibiotic stewardship endorsed by various health organizations, including the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) [12, 15]. These guidelines advocate for minimizing the use of antibiotics to combat the growing concern of antimicrobial resistance. Hence, there is a need to continue prioritizing the use of single- and dual-drug regimens in pediatric care, in line with antibiotic stewardship guidelines. Despite the apparent benefits of simpler regimens, the observed complexity of treatment through increased polypharmacy (31.8% of prescriptions comprising four or five drugs) raises pertinent concerns. The issue of polypharmacy in pediatric populations has been widely documented, as highlighted in a systematic review revealing that inappropriate antibiotic prescriptions can lead to exacerbated health issues, such as increased rates of drug interactions and antibiotic resistance [16]. This can be as a result of pressure on prescribers from caregivers to prescribe medication for every symptom or condition-even minor ones, and the robust drug promotion by pharmaceutical companies is known to influence doctors' prescribing practices. These factors might have contributed to the polypharmacy observed in this study. Polypharmacy is known to increase health care costs, prolong hospital stay due to adverse reactions, drug interactions, non-adherence, and antibiotic resistance, especially in a pediatric population that may have different pharmacokinetic and pharmacodynamic responses to medications compared to adults [17, 18]. While polypharmacy may be justified in specific clinical scenarios, such as severe infections or co-morbid conditions, it necessitates careful monitoring to prevent adverse outcomes. The relatively low percentage of prescriptions involving six drugs (5.0%) is noteworthy, indicating that while polypharmacy is present, extremely complex regimens are less frequent. Nevertheless, in clinical practice, a six-drug regimen can indicate a complex medical condition or multiple concurrent illnesses. Studies have shown that polypharmacy can have deleterious effects, including increased risk for adverse drug reactions, a greater chance of non-adherence due to the complexity of regimens, and heightened healthcare costs [15]. Research has demonstrated that when antibiotics are combined with other medications, the likelihood of negative interactions and potential complications increases, particularly in vulnerable populations such as children [16]. Therefore, while the need for more than five antibiotics may occasionally be justified, such as in cases of severe infections or multidrug-resistant pathogens, providers must carefully evaluate the necessity of such complex regimens. In some cases, the rationale for polypharmacy may be the symptomatology present rather than a well-coordinated, evidence-substantiated treatment plan, leading to implications for patient safety. The average number of medications per prescription serves as a critical parameter, indicating prescribing habits. Our study revealed an average of 3.0 drugs per patient prescription, exceeding the WHO standard of 1.6 – 1.8 [14]. Some studies [19, 20] have reported optimal or near-optimal averages (1.8 – 2.0), but our findings align with the range of values observed in studies in Afghanistan (2.9) and Sierra Leone (3.77) [17, 18]. However, values greater than 2.0 (WHO standard) indicate polypharmacy. Our study indicated that 58.2% of prescriptions involved antibiotics, significantly higher than the WHO-recommended threshold of 20% to 26.8%. Similar results were reported in other studies [17, 19]; however, two studies [8, 20] reported lower values of 28.2% and 26.3% respectively. The higher value in the study indicates a concerning trend of excessive antibiotic use, which could enhance the risk of developing antimicrobial resistance [21]. The overuse of antibiotics, particularly in pediatric patients, can result in negative outcomes, including disturbances in the gut microbiome and increased healthcare costs owing to resistant infections [22]. This elevated figure raises questions regarding the appropriateness of antibiotic utilization within the pediatric population, especially considering the widespread global concern regarding antibiotic resistance. Studies have consistently demonstrated that excessive antibiotic prescriptions contribute not only to resistance but also to increased healthcare costs and complications arising from adverse drug effects [16]. The observed figures suggest potential over-prescribing or inappropriate prescribing practices that may necessitate targeted educational interventions and quality improvement measures aimed at encouraging adherence to evidence-based clinical guidelines. The injection prescribing rate of 17.8% falls

within the WHO standard range of 13.4% to 24.1%. This is in agreement with another study in Nigeria [8], which reported a value of 13.5%. The finding that 68.9% of prescribed drugs were by their generic names falls short of the WHO target of 100%. This is in agreement with previous studies [23, 24] that recorded 60.2% and 70% respectively. While the use of generics contributes significantly to ensuring that patients receive effective treatment, the lower rate here might suggest barriers to their widespread adoption, potentially due to prescribers' preferences for branded medications, influence from pharmaceutical companies to prescribe a particular brand of medication, or lack of familiarity with the benefits of generics. The percentage of drugs prescribed from the essential drug list stands at 90.3%, which, while commendable, still does not meet the WHO recommendation of 100%. The essential drug list is designed to ensure the availability of effective medicines that meet the most important health care needs of a population. A high percentage signifies alignment with best practices, but the goal should be to continue striving for full compliance to ensure that every patient has access to the necessary medications for their treatment [25]. The predominance of single antibiotic prescriptions (84.8%) indicates a cautious approach to treatment, which is generally viewed positively in the context of antibiotic stewardship. This is particularly relevant since the WHO emphasizes minimal use of antibiotics to combat the rising prevalence of antimicrobial resistance (AMR) [12]. Research has shown that in many healthcare settings, especially in low-income communities, the reliance on single-agent treatment is essential to maintaining control over antibiotic resistance by limiting unnecessary prescriptions [15]. The fact that only 14.9% of encounters involved dual antibiotic regimens suggests that clinicians may be selective about employing combination therapy. This approach might be justified in specific situations where co-infections are suspected or increased efficacy is critical. However, the occurrence of tri-antibiotic therapy in only 0.3% of encounters raises questions about the types of cases that necessitate such complexity. This low percentage can be interpreted as a healthy threshold, as multiple antibiotic use can complicate treatment plans and present heightened risks of side effects and drug interactions [16]. The finding that antibiotics constitute 22.4% of all medications prescribed across these encounters is noteworthy. This percentage aligns with the recommended range of antibiotic prescriptions typically documented in pediatric care (commonly cited as around 20-26% of total prescriptions) [26]. However, there is a need for ongoing scrutiny of antibiotic utilization within clinical settings to ensure that prescriptions are both appropriate and evidence-based. The predominance of cefuroxime and amoxicillin suggests a clinical inclination toward commonly prescribed antibiotics, which may be attributed to their broad-spectrum efficacy and favorable safety profiles in children. Cefuroxime, as a second-generation cephalosporin, provides effective coverage against various bacterial infections, which is an essential consideration in pediatric populations at risk for infections [12]. Amoxicillin, a penicillin derivative, is well-established as a first-line agent for many infections, including respiratory tract infections, further reflecting clinician reliance on established therapeutic protocols [27]. On the flip side, the relatively lower prescription rates for antibiotics such as azithromycin, ceftriaxone, and cefixime reflect more selectivity in their use, which may correlate with specific clinical criteria guiding treatment decisions. Cephalosporins and their derivative classes tend to be preferred for their broader coverage, especially in cases where resistant organisms may be suspected [15]. Lower rates of aminoglycosides and macrolides suggest that healthcare providers are more cautious or conservative in employing these classes, potentially due to concerns over nephrotoxicity associated with aminoglycosides and the adverse effects linked to the prolonged use of macrolides in pediatric patients [16]. The data suggesting that cephalosporins represent nearly half of all antibiotic prescriptions (48.9%) indicates a significant reliance on this class in pediatric practice. This finding not only underscores the effectiveness of cephalosporins against common pediatric pathogens but also raises concerns about the potential development of resistance if these antibiotics are overprescribed without appropriate clinical justification. For instance, concerns regarding the selective pressure placed on bacterial populations through broad-spectrum antibiotic use are well documented [28]. Additionally, the overreliance on cephalosporins can compromise the efficacy of these agents over time, necessitating balanced prescribing practices [26]. Conversely, penicillins, while used notably less than cephalosporins, still maintained a robust presence (25.6%) in treatment regimens. This reflects adherence to established treatment guidelines that recommend their use as first-line agents in uncomplicated infections [29]. Studies have demonstrated that maintaining a favorable balance in antibiotic class usage can lead to improved patient outcomes while simultaneously mitigating risks associated with antimicrobial resistance [30]. Cephalosporins and penicillins in the study, being the most prescribed antibiotics, are in agreement with the studies [31, 32], which reported that the most common antimicrobial agents prescribed were cephalosporins. Cephalosporins and penicillins are the mainstay of therapy for infectious diseases, and a higher prescription rate could be attributed to their broad spectrum of activity, clinical efficacy, and tolerance across all age groups. [20, 31]. The study employs a retrospective design, and this inherently restricts the ability to control for confounding factors that may influence prescribing practices, such as clinician bias or variations in patient presentation over time. Moreover, the study's reliance on prescription data from a single hospital limits the generalizability of the findings; results may not be representative of wider prescribing practices across different contexts or regions within Nigeria. Additionally, there were no diagnoses recorded in the prescriptions, which may

have affected the justification for antibiotic use and raises concerns about the appropriateness of prescribing practices. Finally, although the selected sample size of 600 prescriptions was consistent with WHO recommendations, the financial constraints that limited sample size could lead to underrepresentation of certain patient demographics or conditions prevalent in pediatric care.

## 5 CONCLUSION

In conclusion, the evaluation of antibiotic prescribing patterns in pediatric patients at the University of Uyo Teaching Hospital reveals significant challenges in aligning with the World Health Organization's core prescribing indicators. The study identified a concerning 58.2% of encounters with antibiotic prescriptions, substantially exceeding the WHO's recommended range of 20% to 26.8%. This trend raises urgent concerns regarding the potential for increased antimicrobial resistance and highlights the need for immediate interventions. Furthermore, while the high percentage of drugs prescribed from the essential drugs list (90.3%) is commendable, a notable deficit in the prescription of generic names (68.9%) underscores areas requiring attention to enhance drug accessibility and reduce costs. Overall, the findings suggest a critical need for enhanced education targeting prescribers on rational antibiotic use, adherence to clinical guidelines, and the promotion of antimicrobial stewardship programs to mitigate the risks associated with inappropriate antibiotic prescribing. It is essential to implement robust antimicrobial stewardship programs within pediatric healthcare settings in Nigeria. These programs should prioritize educational initiatives that focus on appropriate antibiotic prescribing practices, with special emphasis on using established guidelines that limit unnecessary antibiotic use. Regular audits of prescribing practices should be conducted to monitor compliance with rational drug use principles. Additionally, enhancing the focus on generic name prescriptions would not only help reduce costs but also improve accessibility for families with limited financial resources. Policymakers should also consider instituting stricter regulations regarding prescription monitoring and the availability of antibiotics to curb over-the-counter sales that contribute to misuse and self-medication among caregivers. Ultimately, bolstering these efforts will significantly improve patient outcomes and combat the growing threat of antimicrobial resistance in pediatric populations.

## DECLARATIONS

**Acknowledgment**

The authors are grateful to the management and staff of the University of Uyo Teaching Hospital for their support and cooperation.

**Conflict of Interest**

There is no conflict of interest associated with this publication.

**Funding Information**

This work was not funded by any organization

**Contribution of the Authors**

This study was conceptualized and designed by Mfonobong E. Umoh. Data collection, analysis, and manuscript writing were carried out by Mfonobong E. Umoh, Martin C. Nwofia, and Bassey A. Andong. Critical revision of the manuscript was performed by Sunday O. Awofisayo. All authors approved the final version of the manuscript for submission.

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