

Antibiotic Prescription Pattern, Appropriateness, and Associated Factors in Patients Admitted to Pediatric Wards of Tibebe Ghion Specialized Hospital, Bahir Dar, North West Ethiopia

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Background: Irrational prescribing of antibiotics leads to the emergence of resistant bacteria. Despite this fact, antimicrobial agents are commonly prescribed in the inpatient setting, especially in infants and children.

Objective: The aim of this study was to assess the pattern of antibiotic prescription, appropriateness, and associated factors in pediatric wards of Tibebe Ghion Specialized Hospital (TGSH), Bahir Dar, North West Ethiopia, September 11th, 2021 to October 12th, 2021 GC (Gregorian Calendar).

Methods: An institution-based cross-sectional study was conducted in the pediatric wards of TGSH from September, 2020 to August, 2021 GC. Data were collected using a structured checklist containing each patient's socio-demographic characteristics, clinical information, list of prescribed drugs, and reason for prescription. A systematic random sampling technique was used to select pediatric patients' medical records containing prescribed antibiotics. The collected data were entered and analyzed using SPSS version 25 software.

Results: A total of 279 pediatric patients' medical cards including at least one antibiotic were reviewed. The study revealed that antibiotics were prescribed for most of the patients (88.9%) for empiric treatment purposes. The main medical conditions for which antibiotics were prescribed were pneumonia (16.8%) and early-onset neonatal sepsis (14.0%). Ceftriaxone was the most widely used (84.9%) antibiotic among the monotherapeutic antibiotics, while ceftriaxone plus metronidazole (23.5%) was the most frequently used combination of antibiotics. A high proportion (30.8%) of the pediatric patients was exposed to inappropriate treatment. Residence in rural areas ($P=0.046$) and being 1 year old or younger ($P<0.05$) were found to be independent determinants of inappropriate drug use.

Conclusion: Antibiotics were the most prescribed class of medications for pediatric patients in TGSH. Ceftriaxone and ampicillin were the most frequently prescribed antibiotics in the pediatric wards of TGSH. A high proportion of patients had been exposed to inappropriate antibiotic treatment. Early age and rural residence were found to be the factors that were significantly associated with inappropriate antibiotic utilization.

Keywords: antibiotics, pediatric, appropriateness, prescribing pattern, determinant factor

Introduction

Many of the antibiotics in use today are unnecessarily prescribed for viral infections, such as the common cold. Thus, using antibiotics to treat these viral infections is considered misuse or overuse of antibiotics. The availability of antimicrobial agents without prescription in many developing countries is a big problem, which has been facilitating the development of resistance.^{1,2}

About one-third of the total prescriptions in a hospital are antibiotics; about one-third of these antibiotic prescriptions are usually irrational, and about one-third of the hospital pharmacy budget is spent on antibiotics.^{3,4} There have been fewer studies on antibiotic use in children than in adult patients. The development of antibiotic

resistance is promoted by the use of antibiotics for viral infections and by the use of broad-spectrum antibiotics when a more selective and narrow-spectrum agent would be more appropriate.^{5,6} Irrational use of antibiotics can result in financial wastage and harm to patients and the pharmaceutical industry.^{7,8} The continual exposure of microorganisms to antimicrobial agents diminishes the wide ecologic effects, which enables the organisms to develop mechanisms to ensure their survival. Thus, the progeny of the resistant strain is unaffected by the drug and has the capability to produce disease, while the sensitive strains are exterminated by a process known as selective pressure. Intensive treatment with antibiotics such as azithromycin in the community has resulted in resistant *Streptococcus* pathogens through selective pressure.^{9,10}

Pediatric populations are different from adult populations in their physiology, pharmacokinetics, and pharmacodynamics. The market for children's medicines tends to be small and the range of doses used for any drug formulation may be wide because many drugs prescribed widely for infants and children are not available in suitable dosage forms, leading to a lack of attention to pediatric medicines.¹ A variety of factors have been found to influence (predict) antibiotic prescription. These include patient characteristics, such as low socioeconomic status, the age of the patient, and comorbidity; physician factors, such as educational qualifications, experience of the physician, and source of updating knowledge; and practice setting. Even promotion of a drug by the pharmaceutical industry can increase the chances of irrational prescribing.^{11–14}

Statement of the Problem

A government agency has calculated that there are around 250,000 *Clostridium difficile* infections in hospitalized patients every year due to incorrect prescribing of antibiotics.¹⁵ Knowledge of drug administration in children and infants lags behind that in adults for many reasons, including developmental differences that affect the pharmacodynamics and pharmacokinetic profiles of drugs, ethical and financial reasons, research capabilities, and regulatory guidelines and constraints. Irrational drug use, especially antimicrobials in a pediatric population, has become a commonly noted practice. A study in the USA and Canada showed that 50% and 85% of antibiotics, respectively, were prescribed inappropriately to children.¹

World Health Organization (WHO) reports have shown that efforts to promote rational antibiotic use are poor in developing countries, including Ethiopia.¹⁶ To promote a more rational use of antibiotics, many countries have implemented antibiotic stewardship programs. However, Ethiopia is a country that has no such program in the health sector. Considering the fact that timely access to healthcare services for infants and children is in the hands of parents or any other third party, which could adversely impact the health status of pediatric patients, healthcare workers are expected to play crucial and lifesaving roles by selecting the most appropriate drugs, including antibiotics, for pediatric patients.⁶ So far, no studies have been carried out to assess whether physicians are playing their expected crucial role in managing and saving the lives of pediatric patients admitted to Tibebe Ghion Specialized Hospital (TGSH), Bahir Dar, North West Ethiopia. Hence, this study aimed to assess the appropriateness of the antibiotic prescribing pattern and its determinants.

Significance of the Study

Assessment of the proper use of antibiotics at a ward level can generate detailed information about the magnitude and composition of antibiotic consumption, and gives an insight into the rationality of prescribing. Furthermore, this study could also provide information for policy makers on the real situation of antibiotic utilization, which can significantly help them to monitor, evaluate, and suggest corrections to the practitioners' prescription habits, and implement cost-effective policies to make patient care more reasonable and effective through the promotion of rational antibiotic use. This study could also be used as a basis to undertake studies at the national level on the appropriateness of antibiotic utilization and development of resistance.

Objective

General Objective

To assess the antibiotic prescribing practice, appropriateness, and associated factors among patients in the pediatric wards of TGSH, Bahir Dar, North West Ethiopia, in 2020–2021 GC (Gregorian Calendar).

Specific Objectives

- To determine the patterns of antibiotic prescription in the pediatric wards of TGSH.
- To evaluate the appropriateness of antibiotic prescription in the pediatric wards of TGSH.
- To determine the factors associated with inappropriate antibiotic prescription in the pediatric wards of TGSH.

Methods

Study Design and Period

A retrospective cross-sectional study was conducted from September, 2020 to August, 2021 GC.

Study Area

The study was conducted in TGSH, which is a teaching hospital of Bahir Dar University. The hospital is located in Bahir Dar city, 565 km away from Addis Ababa. The hospital currently provides inpatient and outpatient services for more than 7 million people in Amhara region and the surrounding Benishangul Gumuz region. The hospital provides pharmacy services, clinical laboratory services, surgery, gynecology and obstetrics, maternal and child health, emergency, and other healthcare services.

Population

Source Population

All pediatric patients who have been admitted to pediatric wards of TGSH.

Study Population

All admitted pediatric patients who had received antibiotics as treatment during the study period and fulfilled the inclusion criteria.

Eligibility Criteria

Inclusion Criteria

- Pediatric patients who had been admitted for 24 hours or more.
- Pediatric patients whose medical history cards contained complete information and with at least one prescribed antibiotic. For repeated admissions, antibiotics were taken from the last admission.

Exclusion Criteria

- Patient who had received topical/non-systemic antibiotics.
- Patients who had taken anti-TB medications only.

Variables of the Study

Dependent Variable

Appropriateness of antibiotics use.

Independent Variables

- Sex, age.
- Residence.
- Diagnosis.
- Comorbid conditions.
- Duration of hospital stay.
- Family preference.

Sample Size Determination and Sampling Procedure

Sample Size Determination

The sample size was determined using a single population proportion formula considering the prevalence of antibiotic prescriptions as 74.7%,⁴ with a 95% confidence level, a margin of error of 5%, and a 10% non-response rate. A correction for the finite population (the number of admitted pediatric patients in TGSH who received prescribed antibiotics in 2020/2021 was 2015) was also considered. The calculated size was 279 patient cards.

Sampling Technique

A systematic random sampling technique was used to select the admitted pediatric patients' medical records with prescribed antibiotics. Every seventh medical record of the pediatric patients was selected from a total of 2015 pediatric patients' medical records for 1 year (September, 2020 to August, 2021 GC). The first card was taken randomly from the first seven cards using a lottery method.

Definitions of Terms and Operational Definitions

Antibiotics: Chemotherapeutic agents with activity against microorganisms.

Antibiotic utilization: Use of antibiotics for the treatment of bacterial infections.

Antimicrobial stewardship (AMS): Coordinated interventions designed to improve and measure the appropriate use of antimicrobials by promoting the selection of the optimal antimicrobial drug regimen, dose, duration of therapy, and route of administration.

Appropriate antibiotics: Antibiotics which are prescribed for the right indication, at the right dose, frequency, and duration.

Empirical treatment: Administration of drugs without identification of the causative agent.

Infants: Individuals aged less than 1 year.

Kinetic treatment: Treatment undertaken after definitive identification of the causative agent.

Pediatrics: Individuals aged up to 14 years.

Resistance: Lack of responsiveness of microorganisms to antimicrobials, as a result of developing their own mechanisms.

Data Collection Tool

Data were collected from the medical records of patients on the pediatric wards using a pretested semistandard questionnaire. The data collection format contains the patients' socio-demographic characteristics, patterns of antibiotics prescription, clinical information, and suspected factors associated with antibiotic prescribing patterns. Once the data had been collected, the appropriateness of antibiotic therapy was evaluated using various references, including Medscape, UpToDate version 21.6, Micromedex, standard and updated text books, and specific guidelines from the Ministry of Health of Ethiopia and the American Academy of Pediatrics (AAP), based on the updated daily patient and clinical characteristics. Based on the above resources, treatment with antibiotics was considered appropriate if antibiotics were prescribed for the right indication, at the right dose and frequency, and for the correct duration. The questionnaire was developed in English.

Data Quality Assurance

Before starting the actual data collection, the data extraction sheet was pretested on 5% of the actual sample size of the patients' medical cards. Based on the findings of the pretest, the data extraction sheet was revised. Completeness of the data was checked on a daily basis.

Reassessment of the card was carried out to incorporate missing information.

Data Analysis Technique

The collected data were coded, entered, and analyzed using SPSS version 25 software. Data were described and presented using frequencies, tables, and charts. Crude and adjusted odds ratios with 95% confidence intervals (CIs)

were computed using univariable and multivariable logistic regression to identify factors associated with antibiotic prescribing patterns. A P -value ≤ 0.05 was considered statistically significant.

Ethical Considerations

Prior to commencement of the actual study, the proposal was approved by Bahir Dar University, College of Medicine and Health Sciences, Ethical Review Board. In addition, permission was obtained from the general director of TGSH and the dataset owner to use the information in databases/repositories for the purposes of the research conducted. As this was a retrospective study, the requirement for consent was waived by the ethics board/committees. Confidentiality was achieved by omitting patient identifiers. Our study was conducted in accordance with the Declaration of Helsinki.

Results

Socio-Demographic Characteristics of the Participant Pediatric Patients

A total of 279 admitted pediatric patients' medical records containing prescribed antibiotics were reviewed and analyzed for the evaluation of the appropriateness of antibiotic prescription and its associated factors in TGSH pediatric wards. Of these, 176 (69.1%) were male and about two-thirds (67.4%) were from rural areas. The mean age of the study population was 1.96 ± 3.48 years, and the majority of them ($n=181$, 64.5%) were neonates and infants. The body weight of the majority of the study population ($n=134$, 48.0%) was <5 kg, which was followed by 81 patients (29.0%) with a body weight of 5–9.99 kg (table 1).

Types of Diagnosis and Drug Prescription Pattern

Almost all (99.3%) of the pediatric patients included in this study had an empiric diagnosis. Concerning the purpose of therapy, 248 (88.9%) of the patients were prescribed with drugs for empiric treatment purposes. The numbers of antibiotics used for empiric, prophylactic, and definitive treatment were 546, 51, and 14, respectively. Regarding the number of diseases

Table 1 Socio-Demographic Characteristics of Pediatric Patients in TGSH Pediatric Wards, from September 1st, 2020 to August 31st, 2021 GC ($n=279$)

Socio-Demographic Characteristics	Frequency	Percent
Sex		
Male	176	63.1
Female	103	36.9
Residence		
Urban	92	33.0
Rural	187	67.0
Age		
< 1 month (neonates)	90	31.9
1 month to 1 year (infants)	91	32.6
1–3 years (toddlers)	48	17.2
3–5 years (preschool children)	8	2.9
5–10 years (school children)	25	9.0
10–14 years (adolescents)	18	6.5
Weight (kg)		
<5	134	48.0
5–9.99	81	29.0
10–14.99	33	11.8
15–19.99	7	2.5
20–24.99	10	3.6
≥ 25	14	5.0

diagnosed per individual patient, 101 (36.2%) had a single diagnosis, 78 (28%) had two diagnoses, and 100 (34.9%) had more than two diagnosed illnesses. The most common diagnosed diseases were pneumonia, early-onset neonatal sepsis (EONS), and meningitis, each accounting for $n=47$ (16.8%) $n=39$ (14%), and $n=21$ (7.5%), respectively (table 2).

Prescribing Pattern of Antibiotics

In this study, a total of 964 drugs were prescribed to the patients, of which 611 (63.38%) were antibiotics. Of the 53 (8.7%) antibiotics prescribed as a single agent, ceftriaxone ($n=45$, 84.9%) was the most frequently prescribed monotherapeutic agent. From the total of 558 (91.3%) antibiotics prescribed in combination, ceftriaxone + metronidazole ($n=53$, 23.5%) took the largest percentage share, followed by ampicillin + gentamicin ($n=49$, 21.7%), and ampicillin + ceftriaxone ($n=24$, 1%) (table 3).

The average number of drugs per patient was 3.46 and more than 90% of the patients were exposed to at least two drugs. The average number of antibiotics per prescription was 2.19 and most of the patients (83.2%) were treated with a combination of two or more antibiotics. The maximum number of drugs per patient was 10 and the maximum number of antibiotics per patient was seven (0.7%).

The parenteral route accounted for the administration of most (85.3%) of the prescribed drugs, and a shift from the parenteral to the oral route upon discharge was practiced in only 31 (11.1%) of the cases. The most common oral medication prescribed upon discharge was cefixime (48.6%). Nearly all (97.8%) antibiotic drugs were prescribed under their generic name.

Table 2 Common Conditions for Which Antibiotics Were Prescribed for Pediatric Patients in TGS Pediatric Wards, from September 1st, 2020 to August 31st, 2021 GC

Diagnosis Made for Antibiotic Use	Frequency	Percent
Pneumonia	47	16.8
EONS	39	14.0
Meningitis	21	7.5
Intussusception	14	5.0
Trauma	14	5.0
VLOS	14	5.0
Appendicitis	13	4.7
SAM	12	4.3
Abscess	11	3.9
SAM + AGE	11	3.9
HAI	11	3.9
LONS	10	3.6
SAM+SCAP	10	3.6
AGE	9	3.2
BO	8	2.9
Sepsis of GI onset	8	2.9
Meningitis + aspiration pneumonia	5	1.8
LONS + aspiration pneumonia	4	1.4
UTI	4	1.4
Congenital syphilis	3	1.1
Pertussis	3	1.1
HSD	2	0.7
Otitis media	2	0.7
Others	4	1.6

Abbreviations: BO, bowel obstruction; EONS, early-onset neonatal sepsis; VLOS, very late onset sepsis; SAM, Severe Acute malnutrition; AGE, acute gastro enteritis; LONS, late onset neonatal sepsis; SCAP, severe community acquired pneumonia; GI, gastrointestinal; HAI, hospital-acquired infection; HSD, Hirschsprung disease; UTI, urinary tract infection.

Table 3 Frequency and Percentage of Combination and Single Antibiotics Prescribed to Pediatric Patients in TGSH Pediatric Wards, from September 1st, 2020 to August 31st, 2021 GC

Names of Combination Antibiotics Prescribed	Frequency	Percent
Ceftriaxone + metronidazole	53	23.5
Ampicillin + gentamycin	49	21.7
Ampicillin + ceftriaxone	24	10.6
Ceftriaxone + vancomycin	16	7.1
Ampicillin + ceftriaxone + metronidazole	15	6.6
Ampicillin + gentamycin + ceftriaxone	6	2.7
Ceftriaxone + cephalexine	5	2.2
Ampicillin + ceftazidime	4	1.8
Ampicillin + ceftriaxone + gentamycin	3	1.3
Ampicillin + ceftriaxone + gentamycin	3	1.3
Ampicillin + gentamycin + metronidazole	3	1.3
Ciprofloxacin + vancomycin + metronidazole	3	1.3
Metronidazole + vancomycin	3	1.3
Others	39	17.3
Ceftriaxone	45	84.9
Amoxicillin	4	7.6
Crystalline penicillin	2	3.8
Ampicillin	1	1.9
Cloxacillin	1	1.9

Appropriateness of the Prescribed Antibiotics

In this study, only 69.2% of the participants were prescribed with the appropriate drug at the correct dose, duration, and frequency. The highest proportion of the patients (20.8%) was exposed to antibiotics that were not recommended for their condition, followed by inappropriate duration (16.1%), inappropriate dose (14%), and inappropriate frequency (4.7%).

The age, weight, and disease were considered as patient factors in stating that the dosage regimen was appropriate or inappropriate. The WHO Pediatric Handbook 2nd ed.,²¹ Nelson Textbook of Pediatrics 20th ed.,²² and Ethiopian standard treatment guidelines for general hospitals were used as references.²³

Drug interactions were found in 12.9% of the pediatric patients and the commonest drug interaction were antibiotics. In 20.8% of pediatric patients antibiotics were prescribed in the presences of contraindications. Ceftriaxone and azithromycin are prescribed drugs in the presence of contraindication (table 4).

Factors Associated with Antibiotic Prescription Appropriateness

The appropriateness of antibiotic prescription among pediatric patients was associated with various factors. There was more inappropriate drug therapy in pediatric patients from rural areas than urban ones (AOR=0.574, 95% CI=0.333–0.989, $P=0.046$). Significant associations were observed between the appropriateness of antibiotic prescription and both the age of the patients and parental negligence. Patients aged <1 month (AOR=4.933, 95% CI=1.577–15.428, $P=0.06$)

Table 4 Potential Drug–Drug Interactions Between Some Concomitantly Prescribed Drugs at TGSH, Bahir Dar, Ethiopia, from September 1st, 2020 to August 31st, 2021 GC

Drug Combination	Frequency	Potential Interaction
Gentamycin + furosemide	10	Increased nephrotoxicity and ototoxicity adverse effects
Vancomycin + gentamicin	4	Increased nephrotoxicity and ototoxicity with aminoglycosides
Vancomycin + furosemide	10	Increased nephrotoxicity and ototoxicity with furosemide
Bacteriostatic + bactericidal	17	Bacteriostatics decrease the effect of bactericidal activity

Note: Interactions between bacteriostatic and bactericidal drugs include the combination use of penicillins and fluoroquinolones/macrolides, cephalosporins and fluoroquinolones/macrolides, glycopeptide (vancomycin) and fluoroquinolones/macrolides.

Table 5 Bivariate and Multivariate Analysis of Factors Associated with Inappropriate Use of Antibiotics Among Pediatric Patients Admitted to Pediatric Wards of TGSH, Bahir Dar, Ethiopia, from September 1st, 2020 to August 31st, 2021 GC

Variables	Category	Antibiotic Prescription Appropriateness		Odds Ratio	
		Yes, N (%)	No, N (%)	COR (95% CI)	AOR (95% CI)
Residence	Urban Rural	50 (54.3) 78 (41.7)	42 (45.7) 109 (58.3)	0.614 (0.372–1.016)	0.574 (0.333–0.989)*
Age	<1 month 1 month to 1 year 1–3 years 3–5 years 5–10 years 10–14 years	32 (11.5) 37 (13.3) 26 (9.3) 5 (1.8) 15 (5.4) 13 (4.7)	57 (20.4) 54 (19.4) 22 (7.9) 3 (1.1) 10 (3.6) 5 (1.8)	4.412 (1.443–13.489)* 3.795 (1.247–11.549)* 2.200 (0.678–7.141) 1.560 (0.267–9.106) 1.733 (0.470–6.394)	4.933 (1.577–15.428)* 3.18 (1.166–11.225)* 1.917 (0.575–6.392) 1.871 (0.282–12.421) 2.038 (0.520–7.984)
Comorbidity	Yes No	73 (26.2) 55 (19.7)	104 (37.3) 47 (16.8)	1.629 (0.997–2.661)	0.134 (0.650–1.981)
Type of treatment	Empiric Definitive Prophylactic	108 (43.5) 1 (50.0) 20 (69.0)	140 (56.5) 1 (50.0) 9 (31.0)	2.881 (1.261–6.578) 2.222 (0.125–39.638)	1.694 (0.666–4.312) 0.289 (0.10–8.368)
Parental negligence	Yes No	3 (1.1) 125 (44.8)	20 (7.2) 131 (47.0)	6.462 (1.874–22.284)*	6.978 (1.872–20.017)*

Note: *P-value less than that taken to indicate statistically significance.

and 1 month to 1 year (AOR=3.18, 95% CI= 1.166–11.225, $P=0.026$) had higher levels of inappropriate drug therapy. Regarding parental negligence, patients whose parents were negligent during their child's treatment were more likely to have inappropriate drug therapy compared to those without parental negligence (AOR=6.978, 95% CI 1.872–20.017, $P=0.04$) (table 5).

Discussion

In this study, the majority of pediatric patients were male ($n=176$, 63.1%), were infants ($n=181$, 64.5%), and came from rural areas ($n=187$, 67%). The finding that the highest numbers of admission were in neonates and infants suggests that patients in these age groups are highly susceptible to infections. The weight was measured in all patients. However, there was a problem in failing to measure the body weight in a study conducted in Nekemte Referral Hospital, in which no weight was recorded for 29.03% of pediatric patients.⁶ This improvement regarding weight measurement in the pediatric wards of TGSH could be due to health professionals' intention in measuring weight for the calculation and administration of the correct doses of drugs. This activity is very important to provide the right dose to pediatric patients, who have a high risk of malnourishment.

Most of the pediatric patients (88.9%) were prescribed with drugs for empiric treatment purposes. This is similar to the results from studies conducted in two hospitals in Ethiopia, where 83.58% and 75.9% of the antibiotics were prescribed for empiric treatment in Nekemte Referral Hospital and Shenan Gibe Hospital, respectively.^{1,6} The high level of empiric treatment in higher level hospitals in the country could be related to the seriousness of diseases that need prompt management, the absence of diagnostic stewardship, late presentation to healthcare service delivery points, rural residence, and the associated low levels of healthcare-seeking behavior.

In this study, pneumonia was the most common reason for hospitalization, accounting for 47 (16.8%) of the cases, followed by early-onset sepsis ($n=39$, 14%) and meningitis ($n=21$, 7.5%). These results are in line with study a conducted in Shenan Gibe Hospital, where the major medical conditions for prescribed antibiotics were pneumonia ($n=125$, 38.5%), sepsis ($n=49$, 15.2%), and acute gastroenteritis ($n=41$, 12.7%).¹ These results are also in concordance with a study conducted in Jimma University specialized hospital, where the major medical conditions for prescribed antibiotics were

severe pneumonia (31.23%) and late-onset neonatal sepsis with meningitis (20.60%).¹⁷ The similarities in the reasons for hospitalization in pediatric patients in different hospitals in Ethiopia could provide a hint for identifying the most common pediatric infectious problems in the country.

In total, 611 antibiotics were prescribed for 279 patients; this indicated an average of 2.19 antibiotics per prescription. This value is similar to that in a study conducted in Jimma University specialized hospital, where the average number of antibiotics per patient was 2.17;¹⁷ however, it is a little lower than in a study conducted in Shenan Gibe Hospital, where it was 2.37.¹ Most of the patients (n=232, 83.2%) were treated with a combination of two or more antibiotics, while 47 (16.8%) were treated with a single antibiotic. The maximum number of antibiotics per prescription was seven, which was higher than in the study conducted in Hawassa University Referral Hospital pediatric ward, where it was found to be three,⁴ and Jimma University specialized hospital, where it was found to be four.¹⁷ The high level of antibiotics may be associated with the high level of antibiotic utilization for empiric treatment.

This study showed that ceftriaxone was the most frequently prescribed antibiotic, followed by ampicillin. This utilization is in line with the reasons for admission of pediatric patients. Most of the patients (n=238, 85.3%) were treated with injections. This could be due to the fact that the study was conducted in admitted patients, in which the parenteral route of administration is common practice, and that most of the disease conditions need immediate onset of action of the drugs.

According to the WHO recommendation, the percentage of drug prescription by generic name should be 100%.¹⁸ In this study, antibiotics have been found to be prescribed by their generic name in 97.8% of cases, which is very close to the WHO recommendation. Similarly, studies conducted in the pediatric wards of Bishoftu Hospital in East Ethiopia and in Jimma University specialized hospital found 97.5% and 99% generic prescriptions, respectively.^{17,19}

In this study, 30.8% of patients were exposed to an inappropriate drug, dose, frequency, or duration, alone or in combination, and the highest proportion of the patients (20.8%) was exposed to antibiotics that were not recommended for their condition. This result is in line with a study conducted in India, where the majority of patients (44%) were exposed to the wrong antibiotic indication,³ but it is not concordance with a study conducted in Adigrat General Hospital, where the majority of patients encountered inappropriate use of antibiotics due to high or low doses and the overall level of inappropriateness of antibiotic use was slightly lower (28.3%) than in our study.²⁰ Ceftriaxone has been prescribed to pediatric patients below 2 months of age even though the drug is contraindicated owing to its kernicterus adverse effect, and azithromycin has been prescribed to pediatric patients below 6 weeks of age even though it is contraindicated owing to its infantile hypertrophic pyloric stenosis (IHPS) adverse effects. However, these drugs may have been used because of the unavailability of safer alternative agents.

The multivariable logistic regression analysis showed that inappropriate antibiotic prescription was significantly associated with residence and age group. There was higher inappropriate drug therapy in pediatric patients from rural areas in those from than urban ones (AOR=0.574, 95% CI=0.333–0.989, $P=0.046$), which could be related to the poor health awareness of the patients' parents. There was also a significantly high level of inappropriate treatment in infants. This may be due to the complexity of infant case treatments, contraindications, and a scarcity of different dosage forms. This finding was not in line with the study conducted in Adigrat General Hospital, where children aged 6–10 years and 11–18 years had the highest odds of inappropriate drug therapy. This disparity could be due to differences in prescribers' attention in considering differences in dosing of school-age, adolescent, and adult patients.²⁰ In another study, conducted in Vietnam, comorbidities and duration of antibiotic treatment were significantly associated with inappropriate antibiotic usage.¹⁴

Conclusion

Antibiotics were the most utilized (64.4%) pharmacologic class of medications for the treatment of pediatric patients. Ceftriaxone and ampicillin were the most frequently prescribed antibiotics in the pediatric ward of TGSH. A high proportion of patients had been exposed to inappropriate antibiotic treatment. Early age, parental negligence, and rural residence were the factors that were found to be significantly associated with inappropriate antibiotic utilization.

Recommendations

Since most of the antibiotics are utilized for empiric treatment, periodic evaluation of the sensitivity of microorganisms to antibiotics with routine testing, and the implementation of an antimicrobial and diagnostic stewardship approach will produce better outcomes in the future. Prescribers should also consider the cost of long-term use of parenteral medications, and hence the shift to equivalent oral medications based on the patient's prognosis has to be encouraged.

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Disclosure

The authors report no conflicts of interest in this work.

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