JPPT | Research Letter

Indicators of Antibiotic Use in Pediatric Care: A Prospective Observational Study

Midhun Mathew K., PharmD; Vineeta Pande, MBBS MD; Renuka Jadhav, MBBS MD; Aanya Verma, PharmD; Godwin Geo Gigi, PharmD; and Harsh Patil, PharmD

ABBREVIATIONS DoT, days of therapy; DDD, defined daily dose

KEYWORDS antibiotics; infectious disease

J Pediatr Pharmacol Ther 2025;30(5):687–690

DOI: 10.5863/JPPT-24-00138

Misdiagnosis of infectious diseases has an impact on the health of the community, as well as the patients. This is because many infectious disorders are contagious. If they are disregarded or discovered too late, important steps to stop the spread of infectious agents may not be taken.[1]

A major inaccuracy in identifying an infectious illness occurs during the initial diagnosis, including the collection of a history and physical examination, recognizing urgency or complications, and testing.[2] One of the most misdiagnosed diseases is benign viral infections.[3]

Viral infections, particularly those of the upper respiratory tract infections, are frequently misdiagnosed as bacterial diseases, leading to unnecessary or ineffective antibiotic prescriptions.[4,5] While most respiratory tract infections in pediatrics are viral and self-limiting, there is substantial evidence that antibiotics are overused in treating respiratory disorders. Inappropriate antibiotic usage promotes the growth of resistant germs and exposes patients to unwanted side effects, which result in excessive expenses.[6]

Pediatric antimicrobial resistance is a growing global health threat, referring to the ability of bacteria, viruses, fungi, and parasites to resist the effects of antimicrobial drugs, thereby making infections more difficult to treat in children. While antibacterials can be highly effective in killing bacteria, their overuse or misuse can lead to bacterial resistance to multiple antibiotics.

To assess the use of antibiotics in the pediatric population, this study was conducted over a 6-month period from December 2022 to May 2023. Cases were collected from the pediatric inpatient departments until the day of discharge. Patients admitted to intensive care units and oncology departments were excluded from the study.

Data were collected using a well-structured electronic data collection form, which included patient demographics, infection type, prescribed antimicrobials, culture test results, patient medical and medication history, and interventions performed.

In this investigation, we examined the relationship between the antibiotics used and the days of consumption in pediatric inpatients. Categorical data were presented by number and percentage, and numerical data with mean ± SD. Univariate analysis of variance was the statistical tool used to identify the correlation between different factors. Type I error was determined as 5%, and a p value of < 0.05 was considered statistically significant.

Quantitatively assessing antibiotic consumption in pediatric patients based on using the recommended days of therapy (DoT) per 1000 Patient Days (PD), which will help to determine the number of antibiotics

Table 1. General Characteristics of Admitted Patients Aged Older Than 28 Days to 15 Years

Variable Frequency	Categories	Frequency
Total admissions		N = 185, %
Age*	Under 5	94, 50.8%
	Over 5	91, 49.2%
Patients treated with antibiotics†		n = 100, %
Sex	Male	56, 56%
	Female	44, 44%
Type of clinical diagnosis	Infectious disease	43, 43%
	Noninfectious disease	57, 57%
Age	Under 5	54, 54%
	Over 5	46, 46%
Length of hospital stay	≤5 days	41, 41%
	6–10 days	45, 45%
	> 10 days	14, 14%

* Age of patients categorized to under and above 5 years of age.
† Patients classified specifically based on receiving antibiotics.
‡ Clinical diagnosis classified based on infectious or noninfectious diagnosis.

Table 2. Antibiotics Used in Inpatients Aged Younger and Older Than 5 Years

Antibiotics	ATC Code*	DoT	DoT/1000 PD (Total PD = 1064)	Proportion of Patients Treated With the Antibiotic (n = 185, %)	Age	
					<5 yrs (n = 94, %)	≥5 yrs (n = 91, %)
Trimethoprim & Sulfamethoxazole	J01EE01	6	5.6	4, 2.1%	2, 2.1%	2, 2.1%
Ceftriaxone	J01DD04	283	265.9	55, 29.7%	32, 34.0%	23, 25.2%
Amoxicillin & Calvulanic	J01CR02	129	121.2	24, 12.9%	14, 14.8%	10, 10.9%
Azithromycin	J01FA10	51	47.9	10, 5.4%	8, 8.5%	2, 2.1%
Cefotaxime	J01DD01	72	67.6	16, 8.6%	8, 8.5%	8, 8.7%
Faropenem	J01DI03	7	6.5	2, 1.0%	1, 1.0%	1, 1.0%
Benzathine penicillin	J01CE08	2	1.8	2, 1.0%	0, 0	2, 2.1%
Doxycycline	J01AA02	16	15.0	2, 1.0%	1, 1.0%	1, 1.0%
Amikacin	J01GB06	39	36.6	7, 3.7%	4, 4.2	3, 3.2
Metronidazole	J01XD01	14	13.1	3, 1.6%	2, 2.1%	1, 1.0%
Amoxicillin	J01CA04	2	1.8	1, 0.5%	0, 0	1, 1.0%
Cefoperazone & Sulbactum	J01DD62	7	6.5	1, 0.5%	0, 0	1, 1.0%
Oxfloxacin	J01MA01	4	3.7	1, 0.5%	0, 0	1, 1.0%
Vancomycin	J01XA01	26	24.4	3, 1.6%	2, 2.1%	1, 1.0%
Ciprofloxacin	J01MA02	7	6.5	2, 1.0%	1, 1.0%	1, 1.0%
Piperacillin & Tazobactum	J01CR05	13	12.2	3, 1.6%	3, 3.1%	0, 0
Meropenem	J01BH02	19	17.8	3, 1.6%	2, 2.1%	1, 1.0%
Polymyxin B	A07AA05	3	2.8	1, 0.5%	0, 0	1, 1.0%
Clindamycin	J01FF01	7	6.5	1, 0.5%	1, 1.0%	0, 0
Aztreonam	J01DF01	7	6.5	1, 0.5%	0, 0	1, 1.0%
Cefexime	J01DD08	77	72.3	18, 9.7%	14, 14.8%	4, 4.3%

ATC, anatomical therapeutic chemical; DoT, days of therapy, PD, Patient Days

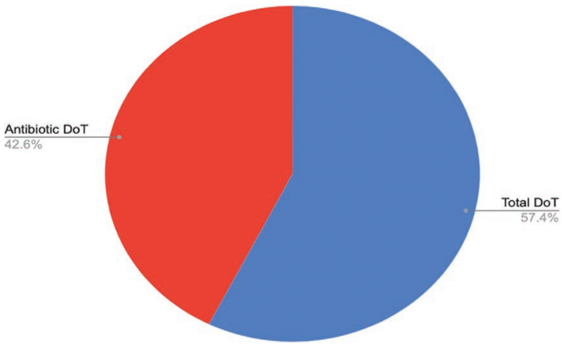
* The active substances are divided into different groups according to the organ or system on which they act and their therapeutic, pharmacological, and chemical properties.

used in the pediatric patients.[7] Because the defined daily dosage (DDD) is primarily meant for adults, it underestimates antibiotic intake in pediatrics due to weight variations. Pediatric-specific DDDs are lacking, and age-based dosing further complicates the applicability of DDDs in estimating antibiotic consumption accurately in the pediatric population. Therefore, we used DoT as an alternative for evaluating antibiotic usage density in pediatrics because it considers each drug and the number of days administered, allowing for independent contributions.[8]

A total of 185 individuals were accepted into the study, and 100 (54.1%) received at least 1 antibiotic (Table 1). Only 26% of patients receiving antibiotics underwent a microbiological culture test, whereas 74% of patients did not. Of the entire patient population, 52 (28.1%) had infectious disorders, while 133 (71.9%) had noninfectious ailments. Patients were administered antibiotics in such conditions, either suspecting that the underlying disease might lead to an infectious condition or thinking that an infectious condition can only lead to the current state of the patient's condition.

Within the group of patients on antibiotics, 43 of 100 (43%) were diagnosed with infectious diseases. Respiratory infections, such as pneumonia, bronchiolitis, and other upper and lower respiratory tract infections, were the most prevalent infections that were seen.

Figure 1. Distribution based on total days of treatment and days of treatment with antibiotics.



DoT, days of therapy.

Ceftriaxone, amoxicillin/clavulanic acid, cefixime, cefotaxime, and azithromycin were the 5 antibiotics that were the subject of the study (Table 2). With a DoT/1000 PD of 265.9, ceftriaxone had the highest consumption rate. Following that, the consumption rates for amoxicillin/clavulanic acid were 121.2 cefixime was 72.3, cefotaxime was 67.6, and azithromycin was 47.9 (Figure 1).

Our research found that 54.1% of the overall pediatric population received antibiotics. According to our study, ceftriaxone was the most frequently used antibiotic, with a DoT/1000 PD of 265.9 of 1064 total treatment days (accounting for 57.4% of total treatment time and antibiotic therapy consisted of 42.6% of the total DoT (Figure 2). This accounts for 29.7% of the total patients involved in the study, which serves as a warning to the healthcare profession about the increased use of third-generation cephalosporins, which may be a significant factor in the development of antimicrobial resistance in cephalosporins. A practice like this enables healthcare practitioners to optimize antibiotic therapy based on the precise identification of causative bacteria, supporting successful treatment and potentially minimizing antibiotic resistance problems.[9]

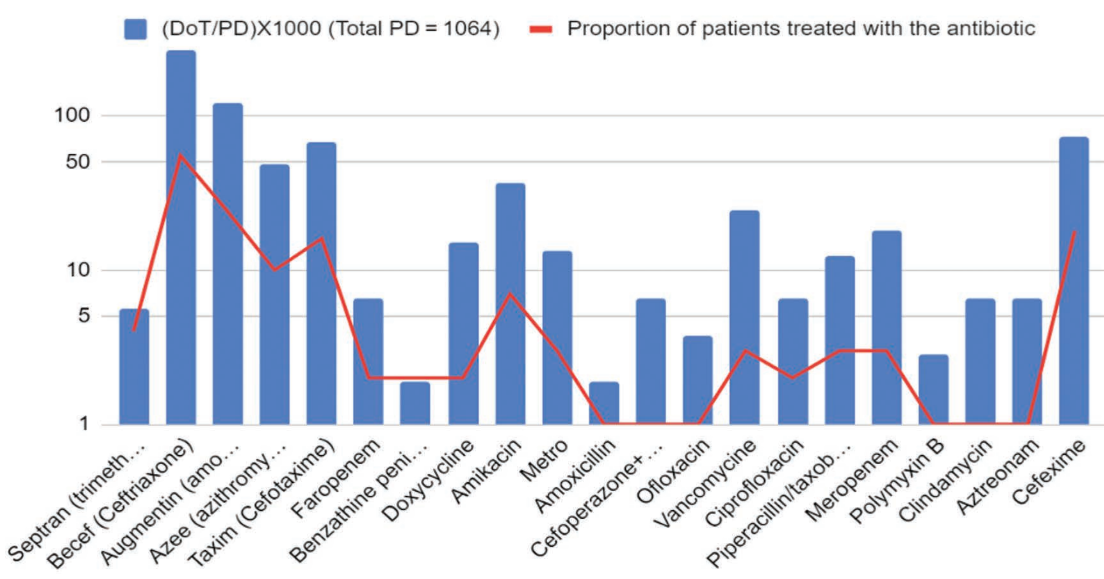
Article Information

Affiliations. Department of Pharmacy Practice (MMK), Dr. D. Y. Patil Unitech Society's, Dr. D.Y. Patil Institute of Pharmaceutical Sciences and Research, Pimpri, Pune, India; Department of Pharmacy Practice (MMK), Dr. D. Y. Patil Dnyan Prasad University, School of Pharmacy and Research, Pimpri, Pune, India; Department of Pediatrics (VP, RJ), Dr. D.Y. Patil Medical College Hospital, Pune, India; Department of Pharmacy Practice (AV, GGG, HP), Dr. D.Y. Patil Institute of Pharmaceutical Sciences and Research, Pune, India.

Correspondence. Midhun Mathew K., PharmD; midhunmkizhakethil@gmail.com

Disclosure. The authors declare no conflicts or financial interest in any product or service mentioned in the manuscript, including grants, equipment, medications, employment, gifts, and honoraria. The authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors attest to meeting the four criteria recommended by the ICMJE for authorship of this manuscript.

Figure 2. Distribution based on days of antibiotic therapy per 1000 patients to the proportion of patients treated with each antibiotic.



PD, Patient Days.

Ethical Approval and Informed Consent. Ethical approval was received from the institutional ethics committee of Dr. D. Y. Patil Medical College Hospital and the informed consent was taken from the patients before collection of the data from patients.

Submitted. December 2, 2024

Accepted. February 15, 2025

References

1. Haddad M, Sheybani F, Naderi H, et al. Errors in diagnosing infectious diseases: a physician survey. *Front Med (Lausanne)*. 2021;8:779454.
2. Schiff GD, Hasan O, Kim S, et al. Diagnostic error in medicine: analysis of 583 physician-reported errors. *Arch Intern Med*. 2009;169(20):1881–1887.
3. Ely JW, Kaldjian LC, D'Alessandro DM. Diagnostic errors in primary care: lessons learned. *JABFM*. 2012;25(1):87–97.
4. Singh H, Schiff GD, Graber ML, et al. The global burden of diagnostic errors in primary care. *BMJ Qual Saf*. 2017;26(6):484–494.
5. Singh H, Thomas EJ, Wilson L, et al. Errors of diagnosis in pediatric practice: a multisite survey. *Pediatrics*. 2010;126(1):70–79.
6. Dekker ARJ, Verheij TJM, van der Velden AW. Inappropriate antibiotic prescription for respiratory tract indications: most prominent in adult patients. *Fam Pract.* 2015:32(4):401–407.
7. Kreitmeyr K, von Both U, Pecar A, et al. Pediatric antibiotic stewardship: successful interventions to reduce broadspectrum antibiotic use on general pediatric wards. *Infection*. 2017;45(4):493–504.
8. Broyles MR. Impact of procalcitonin-guided antibiotic management on antibiotic exposure and outcomes: real-world evidence. *Open Forum Infect Dis*. 2017;4(4):ofx213.
9. Kizhakethil MM, Ranganathan JR, Gafoor TA, et al. Adverse drug reactions of antibiotics and it's management in a tertiary care hospital: a prospective observational study. *J Basic Pharmacol Toxicol*. 2020;4(1):10–15.