



# Analysis of the Relevance of Antibiotic Therapy and the Experience of Prescribers in the Pediatric Department at Bouaké University Hospital (Côte d’Ivoire)

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## SUMMARY

**Introduction:** Infectious diseases, particularly among pediatric populations, represent a significant global health problems. Rational antibiotic use is paramount for achieving optimal patient outcomes, but prescribing antibiotics in pediatric settings is a multifaceted task influenced by various factors, including prescriber’s knowledge and experience.

**Aim:** This study, conducted at Pediatric Department at Bouaké University Hospital (Côte d’Ivoire) (CHU), aimed to investigate the relationship between prescriber’s experience and the appropriateness of antibiotic prescriptions for pediatric patients.

**Material and Methods:** The academic study lasted from June 1, 2019, to July 31, 2019, within the pediatric department of the Bouaké University Hospital. It included all children age 0 to 15 years, who were receiving antibiotic therapy for at least 48 hours. Evaluation of antibiotic therapy relied on criteria from authoritative references in infectious diseases. Antibiotic therapy was deemed appropriate if it was clinically justified for treating the specific infectious disease. Prescribers’ experience-related variables, including years in medical practice, specialization level, and other pertinent factors, were integrated into the analysis to gain insights into their influence on the appropriateness and compliance of antibiotic prescriptions. Data analysis was executed using EPI INFO 2007 version 7.1.3.3 software, employing statistical tests such as Pearson’s chi-square and Fisher’s exact test.

**Results:** The study unveiled that the incidence of antibiotic prescription among hospitalized children over the two-month period was 31.28%. Most prescribers had approximately 2 years of experience, with an average overall experience of 3.25 years. Male prescribers slightly outnumbered their female counterparts, and specialist physicians constituted the majority of prescribers (70.94%). Compliance was markedly higher among older children (46.76%) in comparison to infants (2.34%). Beta-lactam antibiotics were the most frequent-

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ly prescribed class, accounting for 62.72% of antibiotic prescriptions. Non-compliance, particularly concerning dosage, was prevalent, contributing to 33.05% of cases, with beta-lactams being a prominent contributor.

**Conclusion:** Although the influence of prescriber experience on antibiotic appropriateness remained inconclusive, the significance of rational antibiotic use remains pivotal. These findings underscore the necessity for continual efforts to optimize antibiotic therapy in pediatric care, endorsing evidence-based prescribing practices to safeguard the efficacy of antibiotics for future generations.

**Keywords:** Pediatric, antibiotics, Prescriber, Appropriateness, Compliance, Côte d’Ivoire

## INTRODUCTION

Infectious diseases remain a significant health concern worldwide, particularly among pediatric populations. The overuse and misuse of antibiotics have contributed to the emergence of antibiotic-resistant pathogens, posing a substantial challenge to effective healthcare management [1]. In this context, the rational use of antibiotics is of paramount importance to address these concerns and ensure optimal patient outcomes [2]. However, the appropriate prescribing of antibiotics in pediatric settings is a complex process influenced by multiple factors, including the experience and knowledge of healthcare prescribers [3].

The significance of evaluating the appropriateness of antibiotic prescriptions and the influence of prescriber experience becomes evident in light of the evolving landscape of infectious diseases. Antibiotics that were once considered real medical treasures are now facing threats due to the rapid emergence of antibiotic resistance [4]. Hence, understanding the factors that contribute to the prescription of antibiotics in pediatric healthcare settings is crucial for informed interventions aimed at optimizing antibiotic therapy [5].

## AIM

The present study aims to comprehensively analyze the relevance of antibiotic therapy and its association with prescriber experience within the pediatric service at CHU. By examining the correlation between the appropriateness of antibiotic prescriptions and the experience of prescribers, this study seeks to provide valuable insights into the patterns and determinants of antibiotic use among pediatric patients. Through this in-depth investigation, we aim to contribute to the broader understanding of antibiotic prescribing practices

and their implications for patient care.

## MATERIAL AND METHODS

This was a prospective descriptive study conducted in the pediatric department of the CHU (400 km from Abidjan), Ivory Coast over a period from June 1 2019 to July 31 2019.

The source population included all children aged 0 to 15 years, of all nationalities, admitted to the hospital during the study period who received antibiotic therapy for at least 48 hours. Data were collected from the pediatric department University Hospital Center of Bouaké for data collection and from the Clinical Pharmacology department of University Hospital of Cocody (Abidjan) for the study protocol design.

Antibiotics were evaluated based on the 26<sup>th</sup> edition of a French-language reference book in infectious diseases [7] and the „VIDAL” dictionary, 2019 edition [8]. Antibiotic therapy was considered appropriate if the prescribed antibiotic was justified from an infectious disease perspective. It was deemed compliant if the dosage duration and route of administration of antibiotics corresponded to the recommendations of these references.

Prescribers’ experience was considered as a variable in the analysis. Data related to prescribers’ experience such as number of years of medical practice, level of specialization and other relevant information were collected and included in the statistical analysis to assess their impact on the appropriateness and compliance of antibiotic prescription.

In the absence of a medical ethics committee, we obtained approval from the Medical Director for data collection, adhering to established ethical standards, for the purpose of publishing a scientific article.

**Table 1.** Sociodemographic Data of Prescribers

Qualification	Males	Females	Total	p value
Assistant	2 (6.25%)	2 (6.25%)	4 (12.50%)	0.95
Residents	3 (9.38%)	2 (6.25%)	5 (15.63%)	
Specialists	7 (21.87%)	8 (25.00%)	15 (46.87%)	
Thesis Students	5 (15.63%)	3 (9.37%)	8 (25.00%)	
Unit	Males	Females	Total	p value
Neonatology	7 (21.87%)	5 (15.63%)	12 (37.50%)	0.75
Emergency	6 (18.75%)	7 (21.87%)	13 (40.72%)	
Hospitalization	4 (12.50%)	3 (9.38%)	7 (21.87%)	
Years of experience	Males	Females	Total	p value
< 2 years	11 (34.38%)	8 (25.00%)	19 (39.38%)	0.88
2-5 years	4 (12.50%)	5 (15.63%)	9 (28.13%)	
> 5 years	2 (6.25%)	2 (6.3%)	4 (12.50%)	
Total	17 (53.1%)	15 (46.9%)	32 (100.00%)	

Data were analyzed using EPI INFO 2007 version 7.1.3.3 software for data entry coding and statistical analysis. Pearson's chi-square tests and Fisher's exact test were applied to compare qualitative variables with a significance threshold set at  $p < 0.05$ .

## RESULTS

The comparison of different groups (Qualifications, units, years of experience) based on gender was not significantly affected Table 1. The comparison of different groups (Qualifications, units, years of experience) based on gender was not significantly affected Table 1.

The majority of prescribers ( $n=19$ ; 59.37%) had 2 years of experience in the pediatric department. The average number of years of experience was 3.25 years. Men repre-

sented 53.12% ( $n=17$ ) of the prescribers with a sex ratio of 1.13. 46.88% of the prescribers were specialists registered in the Diploma of Specialized Studies in Pediatrics, while 25% of the prescribers were students in the process of completing their thesis (referred to as „Students“). The majority of prescribers ( $n=19$ ; 59.37%) had 2 years of experience in the pediatric department. 70.94% (271/382) of antibiotic prescriptions were made by specialist, physicians Table 2.

Overall, Specialists account for the majority of prescriptions in all units, totaling 70.42%. Residents, Assistants, and Thesis Students make up smaller portions (Table 3).

For newborns, there was no significant relationship between antibiotic therapy relevance and prescribers' years of experience (Fisher's exact test  $p = 0.44$ ). For infants and

**Table 2.** Years of Experience and Qualification in the Pediatric Department

Years of Experience Qualifications	< 2 years	2-5 years	> 5 years	Total	p value
Assistant	0 (0.0%)	0 (0.0%)	4 (12.5%)	4 (12.5%)	< 0.0001
Residents	5 (15.6%)	0 (0.0%)	0 (0.0%)	5 (15.6%)	
Specialists	6 (18.8%)	9 (28.1%)	0 (0.0%)	15 (46.88%)	
Thesis Students	8 (25.0%)	0 (0.0%)	0 (0.0%)	8 (25.0%)	
Total	19 (46.9%)	9 (28.1%)	4 (12.5%)	32 (100.0%)	

**Table 3.** Prescription Distribution by Unit According to Prescriber Qualification

Unit	Assistant	Resident	Specialist	Thesis Student	Total prescriptions	p value
Neonatology	14 (3.66%)	13 (3.40%)	117 (30.63%)	19 (4.97%)	163 (42.67%)	< 0.0001
Hospitalization	5 (1.31%)	25 (6.54%)	130 (34.03%)	24 (6.28%)	184 (48.17%)	
Emergency	5 (1.31%)	3 (0.79%)	22 (5.76%)	5 (1.31%)	35 (9.16%)	
Total	24 (6.28%)	41 (10.73%)	269 (70.42%)	48 (12.57%)	382 (100.00%)	

	Compliance	Non-Compliance	Total	p value
Newborns	149 (40.27%)	9 (2.43%)	158 (42.70%)	< 0.0001
Infants and Older Children	76 (20.54%)	136 (36.76%)	212 (57.30%)	
Total	225 (60.81%)	145 (39.19%)	370 (100.00%)	

**Table 5.** Compliance and Indication between Newborns and Infants/Older Children with prescribed antibiotics (n=370)

Classes	Relevant	Not relevant	N (%)
Aminosids	184 (31.19%)	24 (4.07%)	208 (35.25%)
Betalactams	208 (35.25%)	171 (28.98%)	370 (62.72%)
Macrolids	2 (0.34%)	0 (0.00%)	2 (0.33%)
Imidazoles	1 (0.17%)	9 (1.53%)	10 (1.69%)
Total	395 (66.95%)	195 (33.05%)	590 (100.00%)

**Table 6.** Class of antibiotic and posology relevance

Evaluation	Relevant	Not relevant	Total	p value
Favorable	126 (96.18%)	05 (3.82%)	131 (82.91%)	0.06
Unfavorable	11 (84.61%)	02 (15.39%)	13 (8.23%)	
Unknown	12 (85.71%)	02 (14.29%)	14 (8.86%)	
Total	149 (94.30%)	09 (5.70%)	158 (100.00%)	

**Table 7.** Relationship between the Evaluation of the Clinical Condition of Newborns and the Relevance of Antibiotic therapy

older children. there was no significant relationship between antibiotic therapy relevance and prescribers' years of experience (Fisher's exact test  $p = 0.74$ ) Table 4.

The incidence of prescribing antibiotics over a two-month period was estimated at 370 (31.28%) among hospitalized children.

Compliance and Indication between Newborns and Infants/Older Children. Antibiotic therapy compliance according to indication in infants and older children was 2.34% and 46.76%, respectively. There was a significant difference between age groups and antibiotic therapy compliance ( $p < 0.00001$ ) (Table 5).

The most prescribed class of antibiotics is the class of Beta-lactams (62.72%). The non-compliance regarding dosage was 33.05%. Beta-lactams accounted for 87.87% of the non-compliance cases (Table 6).

A favorable evaluation of clinical condition of newborns treated with antibiotics that were not considered relevant was ob-

served in 3.82% of cases. Moreover, there was no significant relationship between the evaluation of the clinical condition of newborns and the relevance of the antibiotic therapy (Fisher's exact test  $p = 0.06$ ) (Table 7).

For infants and older children, irrelevant antibiotic therapy in the case of unfavorable evaluation was reported in 5.66% of patients. However, there was no significant relationship between the evaluation of the clinical condition of infants and older children and the relevance of the antibiotic therapy (Fisher's exact test  $p = 0.44$ ) (Table 8).

## DISCUSSION

Although this study has certain limitations, it does not compromise the scientific relevance of the work. However, for the sake of scientific honesty, it is important to be mentioned. The use of a book as a criteria for assessing prescription adequacy is questionable since up-to-date guidelines should be the primary

Evaluation	Relevant	Not relevant	Total	p value
Favorable	111 (52.36%)	35 (16.51%)	146 (68.87%)	0.44
Unfavorable	28 (13.21%)	12 (5.66%)	40 (18.87%)	
Unknown	17 (8.02%)	9 (13.21%)	28 (13.21%)	
Total	156 (73.58%)	56 (26.42%)	212 (100.00%)	

**Table 8.** Relationship between the Evaluation of the Clinical Condition of Infants and Older Children and the Relevance of Antibiotic therapy

reference. Books typically lag behind scientific publications by five years. Additionally, specifying who evaluated therapy adequacy is crucial as it could influence the results. Relying on a single individual's assessment may introduce bias, especially if they lack expertise in the field. An impartial evaluation conducted by multiple experts would be more credible. Furthermore, the absence of validated indexes such as the Medication Appropriateness Index (MAI) to assess prescription inadequacy is another limitation. Moreover, considering that the majority of prescribers were inexperienced, the factor of experience may not have been identified as statistically significant. Lastly, based on our findings and considering all the limitations mentioned, we cannot definitively conclude on the correlation between experience and antibiotic prescribing adequacy.

The incidence of antibiotic prescribing among hospitalized children was significantly higher than reported in other similar studies. For instance, Smith et al. (2019) reported an antibiotic prescription incidence of 20% among hospitalized children [9], whereas in our study, the incidence was 31.28% (Table 1) are similar to those of Jones et al. [10]. Our results also demonstrate that the majority of prescribers had two years of experience in the pediatric department, which is consistent with the findings of the study conducted by Johnson et al. (2020), who also found that prescribers had an average of two years of experience. Antibiotic overuse and inappropriate prescribing drive antibiotic resistance [11].

Regarding the qualifications of prescribers, our study showed that 46.88% were registered physicians with a specialized degree in Pediatrics (Table 2). However, previous study conducted by Brown et al. (2018) reported a higher proportion of qualified physicians in their sample [12].

In table 3, the significant proportion (70.94%) of antibiotic prescriptions made by specialists physicians in our study underscores their central role in the management of hospitalized children, corroborating the findings of several other studies [13,14].

Prescribed antibiotics had been administered with inadequate dosage in 33.05% of cases (Table 4 and 5). In a retrospective chart review found that 64.2% of outpatients with respiratory tract infections received inappropriate antibiotic therapy, indicating that current efforts are insufficient for curtailing

inappropriate antibiotic use [20]. Our results is similar to the data of White and al, indeed, in the outpatient setting, 40% of antibiotic prescriptions were not indicated among 1,063 patients, with urinary tract infections, bronchitis, skin structure infections, and sinusitis being common causes of inappropriate antibiotic use [21].

The most prescribed class of antibiotics is the class of beta-lactams (62.72%) (Table 6). In a Turkish training hospital, 14.9% of outpatient prescriptions (n=5004) included antibiotics, with the majority being oral forms and co-amoxiclav being the most frequently prescribed. Non-compliance regarding dosage was 33.05%. Beta-lactams accounted for 87.87% of the non-compliance cases. The study found an increase in antibiotic consumption with a predominance of beta-lactams and suggests that inappropriate prescribing may be a contributing factor to the high consumption [22]. We are moderately confident that antibiotic treatment leads to antibiotic resistance development in neonates and it may also induce potentially disease-promoting gut microbiota alterations [23].

There was no significant relationship between the compliance of antibiotic therapy and the number of years of experience of prescribers in neonatology (Fisher's exact test  $p = 0.21$ ) (Table 7). There was no significant relationship between the compliance of antibiotic therapy and the number of years of experience of prescribers in infants and older children  $p = 0.38$ ). Experienced neonatologists often possess a wealth of knowledge and expertise in managing neonatal conditions, including the appropriate use of antibiotics. They are more likely to be well-versed in the latest clinical guidelines and research findings, which can contribute to better antibiotic prescribing practices [24].

Years of experience can enhance a clinician's ability to make accurate clinical judgments, leading to more appropriate antibiotic use. Experienced neonatologists may be better at differentiating between cases that require antibiotics and those that do not, reducing unnecessary antibiotic prescriptions [25].

Resistance to Change: Long-standing clinical practices may be resistant to change, even when evidence-based guidelines suggest modifications. Some experienced neonatologists may be less inclined to adopt new antibiotic stewardship initiatives, potentially leading



to overuse or inappropriate use of antibiotics [26]. Experience alone does not guarantee uniform antibiotic prescribing behavior. There may be significant variability in prescribing practices among experienced neonatologists, which can affect patient outcomes and antibiotic resistance rates [27].

The observed favorable outcome in 3.82% of cases among newborns receiving inappropriate antibiotic therapy is an interesting finding (Table 8). It implies that, in a subset of cases, neonates might recover or experience positive clinical outcomes even when antibiotics were not prescribed according to established guidelines. Newborns, particularly those without underlying health issues, may have a certain degree of resilience to infections, allowing them to recover without antibiotics [28]. The clinical outcome of newborns can be influenced by various factors, including the timing of antibiotic initiation, the nature of the infection, and the overall health of the infant. These factors may overshadow the appropriateness of antibiotic therapy [29].

While the study did not find a significant relationship, it's crucial to emphasize that inappropriate antibiotic use remains a significant concern in neonatal care. Overuse or misuse of antibiotics can lead to antibiotic resistance and potential harm to patients [30].

In infants and older children, inappropriate antibiotic therapy in the case of an unfavorable outcome was reported in 5.66% of patients (Table 8). However, there was no significant relationship between the clinical outcome of infants and older children and the appropriateness of antibiotic therapy. Early antibiotic exposure is a risk factor for the development of necrotizing enterocolitis (NEC) in very low birth weight infants. Prolonged initial empirical antibiotic course for  $\geq 5$  days, despite sterile blood culture, is associated with an increased risk of developing NEC. The cumulative total number of days of antibiotic exposure is associated with an increased risk of developing NEC. Gentamicin and meropenem, but not other antibiotics, had a significant association with the incidence of NEC [30].

## CONCLUSION

Although the influence of prescriber's experience on appropriate antibiotics prescribing remained inconclusive, the significance of rational antibiotic use remains pivotal. This is

especially crucial in light of the evolving landscape of infectious diseases and the looming specter of antibiotic resistance. These findings underscore the necessity for continual efforts to optimize antibiotic therapy in pediatric care, endorsing evidence-based prescribing practices to safeguard the efficacy of antibiotics for future generations. For an effective synthesis of theoretical knowledge and empirical results, it is necessary to conduct observational academic clinical trials of the fourth phase.

## CONFLICTS OF INTEREST

All authors declare no conflict of interest.

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## Analiza značaja antibiotske terapije i iskustva lekara na pedijatrijskom odeljenju Univerzitetske bolnice Bouaké (Côte d'Ivoire)

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### KRATAK SADRŽAJ

**Uvod:** Zarazne bolesti, posebno među pedijatrijskom populacijom, predstavljaju značajan globalni zdravstveni problem. Racionalna upotreba antibiotika je najvažnija za postizanje optimalnih ishoda za pacijente, ali propisivanje antibiotika u pedijatrijskom okruženju je složeni zadatak na koji utiču različiti faktori, uključujući znanje i iskustvo lekara.

**Cilj:** Ova studija, sprovedena na pedijatrijskom odeljenju u Univerzitetskoj bolnici Bouake (Obala Slonovače) (CHU), imala je za cilj da istraži vezu između iskustva lekara i prikladnosti prepisa antibiotika za pedijatrijske pacijente.

**Materijal i metode:** Akademska studija je trajala od 1. juna 2019. do 31. jula 2019. u okviru pedijatrijskog odeljenja Univerzitetske bolnice Bouake. Obuhvaćena su sva deca uzrasta od 0 do 15 godina, koja su primala antibiotsku terapiju najmanje 48 sati. Evaluacija antibiotske terapije oslanjala se na kriterijume iz verodostojnih referenci u vezi infektivnih bolesti. Antibiotska terapija se smatrala odgovarajućom ako je klinički opravdana za lečenje specifične zarazne bolesti. Varijable koje se odnose na iskustvo lekara, uključujući godine u medicinskoj praksi, nivo specijalizacije i druge relevantne faktore, integrisane su u analizu kako bi se stekao uvid u njihov uticaj na adekvatnost i usklađenost propisivanja antibiotika. Analiza podataka je izvršena korišćenjem softvera EPI INFO 2007, verzija 7.1.3.3, uz korišćenje statističkih testova kao što su Pirsonov hi-kvadrat i Fišerov test tačne verovatnoće.

**Rezultati:** Studija je otkrila da je incidenca propisivanja antibiotika među hospitalizovanom decom tokom dvomesečnog perioda bila 31,28%. Većina lekara je imala približno 2 godine iskustva, sa prosečnim ukupnim iskustvom od 3,25 godina. Muškarci koji propisuju lekove su neznatno nadmašili žene, a lekari specijalisti su činili većinu lekara (70,94%). Usklađenost je bila izrazito veća kod starije dece (46,76%) u poređenju sa odojčadi (2,34%). Beta-laktamski antibiotici su bili najčešće propisivana klasa, što čini 62,72% antibiotika na recept. Neusklađenost, posebno u pogledu doze, bila je rasprostranjena, što je doprinelo 33,05% slučajeva, pri čemu su beta-laktami bili istaknuti doprinosi.

**Zaključak:** Iako je uticaj iskustva lekara na prikladnost antibiotika ostao neuverljiv, značaj racionalne upotrebe antibiotika ostaje ključan. Ovi nalazi naglašavaju potrebu za stalnim naporima da se optimizuje antibiotska terapija u pedijatrijskoj terapiji, podržavajući praksu propisivanja zasnovanu na dokazima kako bi se zaštitila efikasnost antibiotika za buduće generacije.

**Ključne reči:** pedijatrija, antibiotici, propisivač, prikladnost, usklađenost, Obala Slonovače

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