Original Research

Evaluation of antibiotic prescribing and treatment outcomes among paediatric patients to tertiary care hospital Ajman, United Arab Emirates.

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Abstract

Background: Infectious diseases and antimicrobial resistance are profoundly impacted by the extensive use of antibiotics, raising significant global concerns. Objectives: This study's primary objective is to assess antibiotic usage in pediatric patients admitted to a tertiary care hospital for various infectious diseases, evaluating treatment outcomes, adverse events, de-escalation duration, and duration of hospitalization.

Methodology: A retrospective study was conducted during from January 2022 to April 2023, at a tertiary care facility in Ajman, United Arab Emirates. Data was collected by physically reviewing patients' medical records/files, with eligibility based on predefined criteria for paediatric patients with infectious diseases. **Results:** A total of 200 paediatric participants were included in this study. The age distribution showed that most participants fell into the age groups of 3 to 5.9 years (35.0%) and 6 to 8.9 years (29.0%), rest 36.0% aged between 9 and 12 years old. Body Surface Area (BSA) ranged from 0.40 to 1.89 m2, with the majority (61.0%) ranges in-between 0.40 - 0.89 m2. Fever was the most recorded symptom in 196 (98%) patients followed by cough (150; 75%) and sore throat (146; 73%). Among the male participants (n=68), many infections were bacterial (88.2%), followed by viral (3.8%), bacterial and viral co-infections (2.5%), and parasitic infections (1.3%).The data reveals a relatively even distribution of re-admissions within 30 days among patients on combination therapy and monotherapy, with no significant difference (p = 0.643). **Conclusion:** The study concluded limited practices of culture & sensitivity testing prior to initiation of antibiotic prescribing. The study also reported high success rate among the study population. The combination or monotherapy prescribing has no impact on the clinical outcomes of the study

Keywords: Infectious Disease Trends, Treatment Outcomes, paediatric patients, Antimicrobial resistance

INTRODUCTION

The burden of emerging infectious diseases (EIDs) is enormous for both public health and the world's economies[1,2]. Admissions to general internal medical units for acute care result from a wide array of infections. The proportion of hospitalizations owing to infectious diseases (IDs) has increased, reflecting a rising trend in the burden of ID-related hospitalizations[1]. Worldwide, IDs are a major cause of illness and mortality. The burden of IDs has decreased because of significant advancements in sanitation, vaccine research, and other public health initiatives. The decline in the rate of hospitalizations for all causes in the latter half of the 20th century did not, however, apply to IDs[1-3].

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Over the past 20 years, several studies have demonstrated that morbidity and mortality from IDs are linked to considerable costs and burdens on the health care system[4,5,6]. Patients in internal medicine departments make up a complicated population, in addition to having chronic diseases, because of the range in disease severity and functional impairment[6,7].

Infectious disease control relies heavily on antibiotics, making it subject to frequent medication errors (MEs). Antimicrobial-resistant bacteria are a natural outcome of the extensive usage of antibiotics, increasing researchers' concern about this matter. Public health and the economy have suffered because of an increase in antimicrobial resistance and a parallel fall in the development of novel antimicrobials[8,9]. Despite general agreement and awareness that AMR (antimicrobial resistance) poses a threat, national and international solutions are still insufficient. From the standpoint of children's health, there is insufficient surveillance data on AMR that is unique to newborn and pediatric patients, making it difficult to create evidence-based recommendations and implement effective preventative strategies[10].

According to the World Health Organization (WHO), more than half of all medications are improperly supplied, distributed, or given. In India, 37% of antibiotics are being misused[10]. Research on children in the US and Canada indicates that 50% and 85%, respectively, of antibiotics are used improperly. According to the Antimicrobial Consume and Resistance in Australia (AURA) study, young children consume antibiotics at high rates: In

2014, 57% of children aged (0–4) received at least one antibiotic prescription. There aren't many additional Australian general practice studies providing pediatric-specific information to direct antimicrobial stewardship (AMS)[11,12]. In comparison to most other countries, Australian newborns were found to have greater rates of antibiotic exposure, according to a recent population cohort study in the Barwon district of Victoria[12].

Since prescribing the appropriate antibiotic is a challenging procedure, the WHO has developed a set of basic drug use indicators that assess prescriber performance, patient knowledge and experience at healthcare facilities, and the efficiency of the healthcare workforce. This assessment will support the establishment of standards for prescription, identify issues with patients' comprehension of consultants' recommendations, and even alleviate the financial burden on them[13]. The objective of the study was to evaluate the usage of antibiotics in terms of treatment outcomes (re-admission within 30 days and therapy outcomes upon discharge), adverse events, duration of de-escalation, and duration of hospitalizations among pediatric patients admitted to a tertiary care hospital due to various infectious diseases.

MATERIALS AND METHODS

Ethical Approval

The study is approved from the Institutional Review Board (IRB) number: IRB/COP/STD/07/Jan-2023 and adhering the standards of declaration of Helsinki & Good clinical practices (GCP).

Study Design and Setting

The study design was cross-sectional retrospective observational study. All the patients who were admitted at the tertiary care hospital from Jan 2022 to Dec 2022 were enrolled to the study. The data was collected from all paediatric patients admitted during the time mentioned above. The patient medication profile was the source of the data collection. All paediatric patients admitted with infectious diseases were enrolled based on the inclusion and exclusion criteria. These settings included general paediatric ward, intensive paediatric care unit and emergency department.

Study Population

The inclusion criteria of this study serve as a foundational framework to target cohort within the paediatric population.

Inclusion Criteria:

The study focused on paediatric patients aged 3 to 12 years' old who were admitted with infectious diseases. All types of infections were included in this study to explore the patterns of antibiotics used in paediatric population.

Exclusion Criteria:

Paediatric patients older than 12 years were excluded to ensure a consistent age range within the study group, enabling a more homogenous analysis of infectious disease impacts.

The patients with non-infectious physiological diseases. Patients from paediatric cardiac wards were excluded due to their unique medical complexities. Paediatric oncology wards were omitted due to distinctive cancer-related challenges that could interfere with the study's aims.

Data Extraction

The data collection was performed in way to anonymize the patients' names and hospital numbers were used instead to secure patient privacy. Authorized login and password were created to the researcher (N.E) to avoid any unauthorised access to the data to guarantee data confidentiality. The Google Form was used to securely record all the obtained data, which was then transferred to an Excel file for analysis. However, Ministry of Health and Prevention (MOHAP) or other partner hospitals may request the use of the data only for educational purposes, publications, or other specific purposes. To safeguard the participants' privacy, patient identifiers won't be disclosed to any outside parties.

Statistical analysis

The data was analysed using the Statistical Package for Social Sciences (IBM SPSS Statistics, Version 22.0, IBM Corp., Armonk, NY, USA). The analysed data is securely stored in the College of Pharmacy office at Gulf Medical University for a period of five years. The data is presented as proportions, mean±SD, or median and range, as appropriate. To explore differences between the numerical variables, ANOVA test was used. To determine the association between variables Chi-square test was used. The P-values less than 0.05 is considered statistically significant.

RESULTS & FINDINGS

Demographic characteristics of the study participants

A total of 200 paediatric participants were included in this study. The age distribution showed that most participants fell into the age groups of 3 to 5.9 years (35.0%) and 6 to 8.9 years (29.0%), with the remaining 36.0% aged between 9 and 12 years old. The mean±SD age of the participants was 7.5±2.8 years. Gender distribution showed that 66.0% were female. Regarding race, more than half of the participants (54.0%) were Arab. Body Surface Area (BSA) ranged from 0.40 to 1.89 m^2, with the majority (61.0%) inbetween 0.40 - 0.89 m^2. The mean±SD BSA was 0.90±0.29 m^2. The mean±SD body weight 26.314±14.03kg, with almost 48.5% of participants in 11 - 20.9 kg category, 21.5% (21 - 30.9 kg), 15.0% (31 - 40.9 kg), and rest 15.0% weighing over 40 kilograms (Table 1).

Frequency of Symptoms and adverse effects among study population

The fever was the most recorded symptom in 196 (98%) patients followed by cough (150; 75%) and sore throat (146; 73%). Wheezing was relatively rare, with only two patients (1%) experiencing it. Other reported symptoms were abdominal pain, diarrhea, and vomiting. Also, the data on the adverse effects has found that only two patients (1%) have developed

Table 1: Demographic Characteristics of the Study Participants (n=200)		
Demographic Information		**N (%)**
Age (years) group	3 – 5.9	70 (35.0)
	6 – 8.9	58 (29.0)
	9 – 12	72 (36.0)
Age (mean ± SD)		7.5 ±2.8
Gender	Female	132 (66.0)
	Male	68 (34.0)
Race	Arab	108 (54.0)
	Non-Arab	92 (46.0)
Body Surface Area (m^2) (mean ± SD)		0.90 ±0.29
Body weight (kg) (mean ± SD)		26.314 ±14.03

adverse effects from the antibiotic use. The frequency of various symptoms reported in 200 patients' hospital records appears in (Figure 1).

Infection Types by Gender and Infection Subtypes

Among the male participants (n=68), majority of the reported infections were bacterial (91.2%), followed by viral (4.41%), bacterial & viral co-infections (2.94%), and rest parasitic infections (1.47%). For female participants (n=132), majority of the reported cases were also bacterial infections (91.7%), with a lower prevalence of viral (1.5%), bacterial & viral co-infections (4.5%), and parasitic infections (2.27%). Upper respiratory tract infections were the most common infection reported in male and female patients (66.17% : 53.8%). Other infections were otitis media, gastroenteritis, urinary tract infections, and FLU A, each with varying frequencies among the genders. The distribution of infection types upon admission, categorized by gender for a total of 200 paediatric participants is presented in Table 2.

Antibiotic Categories and Antibiotic therapy pattern

Antibiotic therapy frequency was categorized into two groups: monotherapy and combination therapy. The prescribed antibiotics were classified into different categories based on the drug class; Aminoglycosides, Cephalosporin, Macrolides, Nitroimidazole, Penicillin, and Antivirals. The antibiotics prescribing patterns were significantly (p = 0.000) different among the different classes. The details of prescribing patterns of different antibiotics and frequency is presenting in Table 3.

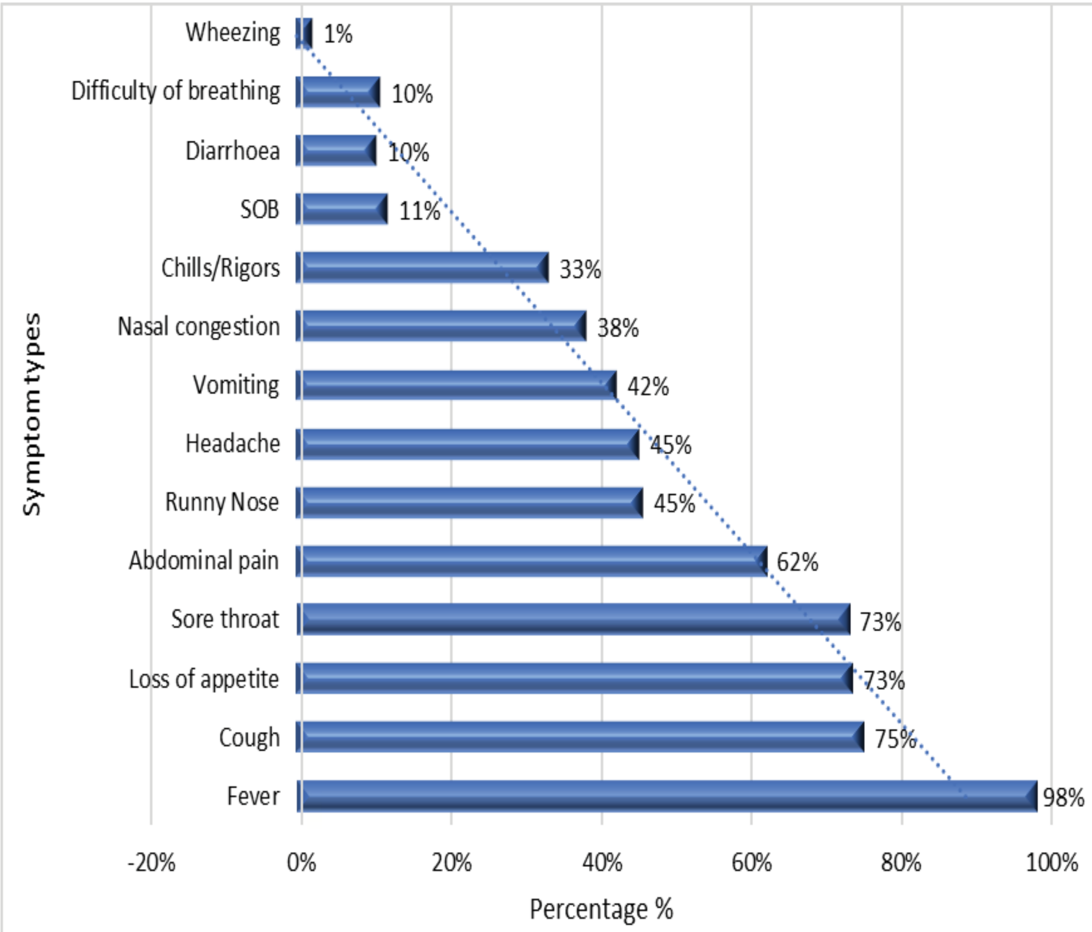

Figure 1. Percentage Distribution of Patient Symptom Types (n=200)

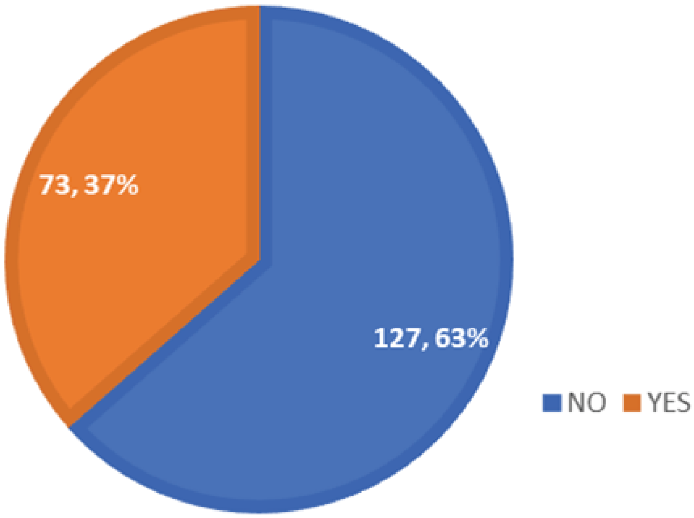

Figure 2. Prevalence of Culture Sensitivity Testing Before Antibiotic Use

Table 2 : Infection Frequency upon Admission by Gender (n=200)

Infection information		**Male (n=68) N (%)**	**Female (n=132) N (%)**
Type of infection	Bacterial	62 (91.2)	121 (91.7)
	Viral	3 (4.41)	2 (1.5)
	Bacterial and Viral	2 (2.94)	6 (4.5)
	Parasitic	1 (1.47)	3 (2.27)
Main infection upon admission	Upper Respiratory Tract Infection	45 (66.17)	71 (53.8)
	Otitis Media	10 (14.7)	14 (10.08)
	Gastroenteritis	9 (13.2)	16 (12.2)
	Urinary Tract Infection	2 (2.94)	29 (22.1)
	FLU A	2 (2.94)	2 (0.8)

Table 3: Patterns of Antibiotic prescribing among study population

	Antibiotic Therapy		**Frequency of Antibiotic Therapy**	
Antibiotic Categories	**Frequency (%)**			**P-value**
	Monotherapy	Combination		
Aminoglycoside[a]	0	5 (4.13)	5	
Cephalosporins[b]	71(51.4)	72 (59.5)	143	
Macrolide[c]	39 (28.2)	16 (13.2)	55	0.000*
Nitroimidazole[d]	0	11 (9.0)	11	
Penicillin[e]	1 (0.7)	11 (9.0)	12	
Antiviral[f]	27 (19.5)	6 (4.9)	33	
*Significant value (P-value using Chi square test)				

a “Amikacin”
b “Cefixime” “Ceftriaxone” “Cefdinir”
c “Azithromycin” “Clarithromycin”
d “Metroimidazole”
e “Co-amoxiclav”
f “Oseltamivir”

Symptoms and Different Types of Infection

Symptoms such as cough, sore throat, and diarrhea are examined in detail. The table below presents the number of cases with and without each symptom for each infection type, along with a total count. The relationship between symptoms and various types of infection, including bacterial, bacterial and viral, parasitic, and viral infections, is shown in Table 4.

Symptoms occurrence among patients admitted with different infections

Fever emerged as a significant indicator across various infections, with 121 patients exhibiting this symptom. Cough manifested prominently in 152 patients, while difficulty breathing was observed in 84 patients. Statistical analysis demonstrated noteworthy associations: fever ($P < 0.001$), cough ($P = 0.001$), and difficulty breathing ($P = 0.004$) with all infections. The distribution of symptoms among patients admitted with different types of infections is comprehensively detailed in Table 5.

Clinical Outcomes in Relation to Antibiotic Therapy

The data showed no significant difference in the rate of re-admissions within 30 days among patients on combination therapy and monotherapy ($P = 0.643$). Similar rates were observed in the clinical outcomes between the combination and monotherapy groups ($P = 0.995$). These findings suggests that the choice of antibiotic therapy, whether combination or monotherapy, did not appear to significantly impact short-term clinical outcomes or discharge status among the study population. The correlation between clinical outcomes and antibiotic therapy patterns is provided in (Table 6).

Culture & Sensitivity Test Before Antibiotic Use

The majority of patients 127 (approximately 63%), did not undergo C&S test. Only 73 patients (37%) had a culture & sensitivity test performed prior to antibiotic administration. The rate of culture sensitivity tests conducted before antibiotic use among the study participants is given in Figure 2.

Culture Sensitivity Testing and Clinical Outcomes

The data showed nonsignificant difference on the rate of re-admission within 30 days, between those who had the test (C&S) and those who hadn't ($P=0.713$). However, when considering therapy outcomes upon discharge, a significant association was found ($P=0.05$). Specifically, a higher percentage of participants who underwent culture & sensitivity testing were discharged with antibiotics (24%), while fewer were discharged with minor symptoms (14%). (Table 7)

Table 4 : Symptom occurrences among Patients Admitted with Different Types of Infection

Symptoms associated with the type of infection		Bacterial	Bacterial & viral coinfection	Parasitic	Viral	Total	P-value
Cough	NO	44	2	2	2	50	0.017*
	YES	136	6	0	5	147	
Total		180	8	2	7	197	
Sore throat	NO	46	1	2	4	53	0.032*
	YES	134	7	0	3	144	
Total		180	8	2	7	197	
Diarrhoea	NO	165	8	0	6	180	0.000*
	YES	15	0	2	1	18	
Total		180	8	2	6		
***Significant value (P-value using Chi square test)**							

Table 5 : Symptom Occurrence Associated with Different Infections upon Admission

Symptoms upon admission FLU A		**Infections upon admission**							
		Gastroenteritis	Pharyngitis	Otitis media	URTI**	UTI***	Total	P-value	
Fever	NO	0	0	1	0	1	0	2	0.000*
	YES	5	15	32	19	29	21	121	
Cough	NO	1	7	8	6	10	15	47	0.001*
	YES	5	16	25	16	72	18	152	
Difficulty of Breathing	NO	4	22	30	21	12	20	109	0.004*
	YES	3	0	5	2	70	4	84	
*Significant value (P-value using Chi square test)									
**Upper Respiratory Tract Infection									
***Urinary Tract Infection									

Table 6: Association between Clinical Outcomes and Antibiotic Therapy among study populations (n=200)

Clinical outcomes Combination		**Antibiotic therapy**		**Total**	**P-value**
		Monotherapy			
Re-admission with 30 days	No readmission	28	77	105	0.643
	Yes, with different type of infection	13	28	41	
	Yes, with same type of infection	18	36	54	
Therapy Outcomes on discharge	Discharged with antibiotics	18	42	60	0.995
	Discharged with minor symptoms	17	41	58	
	Discharged with no symptoms	24	58	82	
Total		59	141	200	

Table 7: Association between Culture Sensitivity Testings Prior to Antibiotic Use and Clinical Outcomes

Clinical outcomes	**Pre-ABs Culture Sensitivity Test**		**P-value**
	NO (%)	YES (%)	
Re-admission with 30 days			
No re-admission	67	38	
Yes, with different type of infection	24	17	
Yes, with same type of infection	36	18	0.713
Therapy Outcomes on discharge			
Discharged with antibiotics	36	24	
Discharged with minor symptoms	44	14	
Discharged with no symptoms	47	35	0.05*
Total	127	73	
*Significant value (P-value using Chi square test)			

DISCUSSION

This research revealed that a substantial number of young patients admitted to the advanced care hospital in Ajman were within the age range of 3 to 5.9 years (35.0%) and 6 to 8.9 years (29.0%). This pattern aligns with prior studies indicating a higher rate of hospitalization for infectious diseases in younger age groups[14]. On average, the study participants were approximately 7.5 years old, consistent with typical pediatric admissions. In terms of gender, 66.0% of the participants were female. While this gender distribution may not directly impact antibiotic prescriptions, it's crucial to consider potential gender-related differences in disease manifestation and response to treatment, as these factors could influence clinical outcomes[15].

Regarding ethnicity, over half of the participants (54.0%) were identified as Arab, reflecting the ethnic composition of the UAE's population. Ethnicity can play a role in susceptibility to diseases and responses to antibiotics due to genetic factors, emphasizing the importance of considering these factors in future studies[16]. Two critical factors for determining antibiotic dosages are Body Surface Area (BSA) and body weight. The study found that most participants fell into the 0.40 - 0.89 m^2 BSA group and the 11 - 20.9 kg body weight group, indicating a predominance of patients with relatively smaller BSA and body weight. Proper antibiotic administration is essential to ensure effectiveness and prevent adverse effects, highlighting the need to tailor antibiotic treatments to the specific characteristics of each patient[17].

The frequency of symptoms reported among the study population revealed that fever, cough, and sore throat were the most common symptoms. Fever, in particular, was highly prevalent, affecting 98% of patients. These findings align with the typical clinical presentation of infectious diseases in pediatric patients, where fever often serves as a cardinal symptom[18]. However, it's crucial to consider the diverse range of symptoms, including gastrointestinal symptoms, indicating the complexity of clinical presentations in this population. Furthermore, the relatively low rate of adverse effects from antibiotic use (1%) is a positive outcome, suggesting that antibiotic therapy was generally well-tolerated. Adverse effects of antibiotics can range from mild gastrointestinal symptoms to severe allergic reactions, emphasizing the importance of monitoring and minimizing the risk of adverse effects during treatment[18].

Moreover, the data suggested that a majority of the study population reported symptoms were abdominal pain, diarrhea, and vomiting. The presence of these gastrointestinal symptoms alongside respiratory symptoms underscores the diversity of clinical presentations in pediatric patients with infectious diseases. Healthcare providers need to consider these varied symptom profiles when making clinical assessments and treatment decisions. The distribution of infection types by gender highlighted that bacterial infections were predominant among both male and female participants, with upper respiratory tract infections being the most common. These findings emphasize the importance of antibiotic selection and appropriate treatment guidelines for common infections in pediatric patients[19].

Clinical outcomes focused on readmission rates within 30 days of the initial admission. More than half of the participants experienced no readmission, indicating successful recovery without the need for subsequent hospitalization. However, a notable portion of patients was readmitted, either with the same infection type or a different one. These findings underscore the importance of monitoring and optimizing treatment strategies to reduce the likelihood of readmission[20]. The study explored the frequency of antibiotic therapy and routes of administration upon admission and discharge. Monotherapy, particularly oral administration, was the most common form of antibiotic therapy. Combination therapy, involving various routes of administration, was also observed. The choice of antibiotic therapy and route of administration should be based on the specific infection and individual patient factors[21].

The research investigated the relationship between symptoms and various types of infection. Fever, cough, and difficulty breathing were significantly associated with multiple infection types. Understanding the symptom profiles associated with different infections can aid in early diagnosis and targeted treatment[22]. The occurrence of symptoms among patients admitted with different types of infections revealed significant associations between specific symptoms and infection types. Fever, cough, and difficulty breathing were found to be particularly relevant symptoms for various infections. Recognizing these associations can assist healthcare providers in making accurate clinical assessments and treatment decisions[23].

The study delved into the impact of antibiotic therapy patterns on clinical outcomes. No significant differences were observed in readmission rates or therapy outcomes upon discharge between combination therapy and monotherapy groups. This suggests that the choice of antibiotic therapy pattern may not significantly influence short-term clinical outcomes. However, long-term effects should be further explored in future studies[24].

CONCLUSION

The study concluded limited practices of culture & sensitivity testing prior to initiation of antibiotic prescribing. The study also reported high success rate among the study population. The combination or monotherapy prescribing has no impact on the clinical outcomes of the study. The upper respiratory tract infections (URTIs) were identified as the most reported infections among both male and female pediatric patients. The study further highlighted that cephalosporins and macrolides were the most frequently prescribed antibiotics for patients discharged with antibiotic treatment.

Based on the study's findings, the following recommendations are suggested for future research:

Multicenter Studies: Conduct multicenter prospective studies to encompass a more diverse patient population, thereby enhancing the generalizability of findings. This approach can provide a more comprehensive understanding of antibiotic therapy patterns and outcomes across different healthcare settings.

Long-Term Follow-Up: Investigate the long-term clinical outcomes and readmission rates beyond the initial 30 days. Extending the follow-up period will contribute to a more thorough assessment of the sustained impact of antibiotic therapy on patients' health and potential recurrent infections.

These recommendations aim to contribute to the refinement and expansion of knowledge in the field, fostering a more comprehensive understanding of antibiotic usage and its implications for pediatric patients.

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