

Original Research Article

A STUDY ON THERAPEUTIC EVALUATION OF VARIOUS ANTIBIOTICS USAGE FOR PAEDIATRIC INPATIENTS IN A TERTIARY CARE TEACHING HOSPITAL

ABSTRACT: Background: Paediatric population are very much prone to various infectious diseases and to treat them we use various antibiotics. Antimicrobial resistance is the major concern to evaluate the use of antibiotics as it affects the health care system.

Objective: To assess the therapeutic evaluation of various antibiotics usage for paediatric inpatients.

Methodology: A prospective observational study was conducted in paediatric department for 6 months. In-patients who were under antibiotic therapy and patients with co-morbid conditions were included in the study.

Results: A total of 160 patients were enrolled in this study. Results were analysed using MS Excel. In this study males 90 (56.25%) were more predominant than females 70 (43.75%). Majority of the subjects were aged between 1-11years which accounts 90 (56.25%). Respiratory tract infections (RTI) 53 (33%) were the most common. Ceftriaxone 103 (24.64%) was the commonly prescribed antibiotic. The average number of antibiotics per prescription were 2 agents 60 (37.5%). The common dosage form of antibiotics were injectables 382 (91.39%). A total of 40 drug-drug interactions were found among which 32 (80%) were antibiotics interacting with other drugs. In this study 11 (6.87%) subjects underwent antibiotic sensitivity testing, whereas remaining 149 (93.12%) did not undergo any such.

Conclusion: We conclude that in order to minimize the risk of antibiotic resistance in paediatric patients, prescriber should restrict empirical therapy and encourage diagnosis based definitive therapy. In addition, we advise the physicians to adopt a standard treatment guideline and to implement awareness program for the rational use of antibiotics.

Key Words: Antimicrobial resistance, Rational use, Respiratory Tract Infections,

Empirical therapy, Definitive therapy, Paediatrics.

INTRODUCTION: Paediatrics is a fascinating speciality which encompasses care of premature neonates and adolescents. It covers the age group less than 18 years of age. ¹ The paediatric population are often prone to various infectious diseases and in order to treat them the commonly used drugs are the antibiotics, these are the substance produced by microorganism or of biological origin or produced partially or wholly through synthetic means which at low concentrations can inhibit the growth of, or kill the other microorganisms. The antibiotics act by various mechanisms such as Inhibition of Cell wall synthesis, Breakdown of cell membrane structure or function, Inhibition of the structure and function of nucleic acid, Inhibition of protein synthesis and by blockage of key metabolic pathways. ²

Several studies reported that 50-85% of children receive antibiotics in developed and developing countries. ³ Misuse of antibiotics has an impact on health care costs, antibiotic resistance, treatment failure, hospitalization time and increased return visits to the physician. Children are at a greater risk for medication errors than adults and these errors are preventable when the antibiotics are used judiciously. ⁴

Antimicrobial resistance is associated with high mortality, frequent health-care visits, prolonged hospital stay and a huge economic burden on health care and hence it is a major threat to health care system. The main cause of antimicrobial resistance is the misuse of antimicrobials both in animal and human medicine globally. One of the primary causes of high incidence of antimicrobial resistance is thought to be the frequent use of antibiotics. ⁵

Different bacteria use different mechanisms to exhibit antibiotic resistance such as modifying the antibiotic molecule there by leading to destruction of the antibiotic (chemical alteration), Preventing the antibiotic from reaching the target site, by decreasing

antibiotic penetration and increasing efflux, by modifying target site, and by the global cell adaptive process.⁶

The Center for Disease Control and Prevention has identified drug resistant organisms as a particular threat and recommended increased surveillance, risk factor identification, and promotion of judicious antibiotic prescribing.⁷ The use of antibiotics is said to be rational when patients receive the drugs for right indication, the right dose, the right duration, the right route and at an affordable cost.⁸

Antibiotics play a crucial role in management of infections. It is widely prescribed in Paediatric population for the treatment of various infectious diseases. Misuse or overdose of such drugs may result in antibiotic resistance, adverse drug reactions and high treatment cost. Therefore, there is continuous need to monitor the usage of antibiotics in this group of patients. So, this study is planned to evaluate the usage of various antibiotics in paediatrics and also to reduce the risk of resistance and drug interactions in the prescriptions.

MATERIALS AND METHODS:

STUDY DESIGN: A Prospective observational study, was carried out in the Department of Paediatrics, VIMS, Ballari District, Karnataka for a period of six months (From March 2023- August 2023). This study was conducted after obtaining approval from institutional ethics committee of T.V.M college of Pharmacy Ballari (Ref.no: TVMCP/IEC/VPD/2022-23/01)

STUDY SAMPLE SIZE: The sample size was calculated by using the formula

$$n = Z^2 pq / d^2$$

$$n = (1.96)^2 * 0.9 * 0.1 / (0.05)^2$$

$$n = 138$$

n- Required sample size, Z-Reliability coefficient

p-estimated proportion, d- Margin of error

The required minimum sample size was 138 Paediatric patients. 160 was the achieved

sample size.

SOURCE OF DATA: Data was collected from patient case sheets.

STUDY CRITERIA:

The study was carried out by considering the following inclusion and exclusion criteria.

INCLUSION CRITERIA: Patient of either sex, patient aged under 16, In-patients under antibiotic therapy, cases with co morbid conditions and patients on antimicrobial therapy. **EXCLUSION CRITERIA:** Patients who are treated in an outpatient department, patients whose caretakers are not willing to give informed consent to participate in the study, and prescription with insufficient and incomplete data.

MATERIALS USED: Patients information sheet, Informed consent form, and Data collection form, Micromedex to look for drug interactions.

STUDY PROCEDURE: Regarding this project pilot study was done. Various articles were collected and reviewed pertaining to the project. A study protocol, including study design and design of Performa was prepared. The ethical consent prior to study was obtained. Patients were enrolled according to the inclusion and exclusion criteria. The Patient's details were collected from the case sheet and were evaluated for various antibiotics usage from patient treatment chart. The obtained information was represented in the form of graphs and tables by using MS Excel sheets, and the report was submitted.

RESULTS

Age and Gender wise distribution of the study population

In this study a total of 160 study subjects receiving antimicrobial therapy were recruited. Of these 90 (56.25%) were male and 70 (43.75%) were female as shown in the figure 01 which shows that males were very much prone to infections, and most of the study subjects were belonging to the age group of children (>1-11 years) 90 (56.25%) followed by infants (1-12 months) 48 (30%), adolescents (>11-19 years) 20 (12.5%) and neonates

(0-28 days) 02 (1.25%)

Figure 01: Gender distribution

Distribution of patients according to type of disease

Among 160 patients, 53 (33%) were suffering from respiratory tract infections, 27 (16%) had neurologic disorders, 24 (15%) were having other disease, 20 (13%) had infectious diseases, 10 (6%) had neurological disorders, 8 (5 %) had renal disorders, 8 (5%) had liver diseases ,6 (4%) had hematologic disorders,6 (4%) had nutritional disorders, 4 (3%) had cardiovascular disease, and 4 (3%) had lymphatic disease as shown in table 01. The other diseases were 24 (15%) which included dengue, dengue like illness, acute febrile illness, pyrexia of unknown origin hydrocarbon consumption and snake bites etc.

Table 01: Distribution Of Patients According to Type of Disease

SL. NO	TYPE OF DISEASE	MALE	FEMALE	No. OF PATIENTS	PERCENTAGE
1	Respiratory Tract Infections	28	25	53	33%
2	Others	14	10	24	15%
3	Infectious Diseases	12	8	20	13%
4	Neurologic Disorders	15	12	27	16%
5	Renal Disorders	3	5	8	5%
6	Liver Diseases	3	5	8	5%
7	Hematologic Disorders	3	3	6	4%
8	Nutritional Disorders	3	3	6	4%
9	Cardiovascular Diseases	2	2	4	3%
10	Lymphatic Disease	2	2	4	3%
	TOTAL	85	75	160	100%

Distribution of the patients according to clinical presentations

The clinical presentations of the enrolled participants were as follows, 73 (15%) were found with cough, 37 (8%) were found with cold, 109 (23%) were found with fever, 44 (9%) were found with hurried breathing, 17 (4%) were found with convulsions, 48 (10%) were found with vomiting, 27 (6%) were found with loose stools, 12 (2%) were found with pain in abdomen as shown in figure 02, the other clinical presentations included were 111 (23%) in number and included, chest pain, headache, breathlessness and drowsiness.

Figure No 02: Clinical Presentations

Distribution of patients based on co-morbid conditions

Among 160 patients, 87 (54%) of them did not have any co-morbidities, at least one co-morbid condition was observed in 41 patients (26%), 16 patients (10%) had 2 co-morbidities, 8 (5%) patients had 3 co-morbid conditions and 8 (5%) patients had more than 3 co-morbid conditions as shown in figure 03

Figure No 03: Comorbid Conditions

Distribution of Antibiotics prescribed

In this study the antibiotics prescribed were as follows, Ceftriaxone, Vancomycin, Piperacillin+Tazobactam, Meropenem, Azithromycin, Cefotaxime, Clindamycin, Doxycycline, Ceftazidime, Ciprofloxacin, Amoxicillin + Clavulanic Acid, Linezolid, Cefixime, Ofloxacin, Ampicillin, Clarithromycin, Colistin, Levofloxacin, Moxifloxacin and Penicillin as shown in table 02. The most commonly prescribed antibiotic was Ceftriaxone.

Table 02: Distribution of antibiotics prescribed

SL.NO	NAME OF THE ANTIBIOTIC	FREQUENCY	PERCENTAGE
•	Amikacin	26	6.22%
•	Amoxicillin + clavulanic acid	6	1.43%
•	Ampicillin	1	0.24%
•	Azithromycin	22	5.26%
•	Cefotaxime	17	4.07%
•	Cefixime	2	0.48%
•	Ceftazidime	6	1.43%
•	Ceftriaxone	103	24.64%
•	Ciprofloxacin	6	1.43%
•	Clarithromycin	1	0.24%
•	Clindamycin	16	3.83%
•	Colistin	1	0.24%
•	Doxycycline	15	3.59%
•	Levofloxacin	1	0.24%
•	Linezolid	5	1.21%
•	Meropenem	35	8.37%
•	Metronidazole	22	5.26%
•	Moxifloxacin	1	0.24%
•	Ofloxacin	2	0.48%
•	Penicillin	1	0.24%
•	Pipercillin+Tazobactam	54	12.92%
•	Vancomycin	75	17.94%
	TOTAL	418	100%

Distribution of Antibiotics based on class

The antibiotics which were prescribed to the study participants were further categorized based on their classes which are as follows, 128 (30.84%) drugs belonged to cephalosporins, 75 (18.07%) drugs were from glycopeptide class ,55 (13.25%) drugs

belonged to penicillin, 35 (8.43%) drugs belonged to carbapenem class, 27 (6.50%) drugs belonged to aminoglycosides, 22 (5.30%) drugs belonged to macrolides, 22 (5.30%) were from the nitroimidazole class, 16 (3.85%) drugs belonged to the lincosamide class, 14 (3.13%) drugs were from the tetracycline class 10 (3.37%) drugs were fluoroquinolones, 6 (1.44%) were from the aminopenicillins, and 5 (1.20%) drugs were from oxazolidinone class as shown in figure 04.

Figure No 04: Distribution Of Antibiotics Based on The Class

Number of Antibiotics per prescription

The number of antibiotics prescribed to each patient were as follows, 60 (37.5%) patients were treated with 2 agents, 41 (25.63%) patients were treated with 3 agents, 26 (16.25%) patients were treated with one agent, 20 (12.5%) patients were treated with 4 different antibiotics, 11 (6.88%) patients were treated with 5 agents and 2 (1.25%) patients were treated with 6 agents as shown in table 03.

Table no 03: Number of Antibiotics per prescription

SL.NO	No. of antibiotics	No. of antibiotics per prescription	Percentage
1	1 agent	26	16.25%
2	2 agents	60	37.5%
3	3 agents	41	25.63%
4	4 agents	20	12.5%
5	5 agents	11	6.88%
6	6 agents	2	1.25%
	TOTAL	160	100%

Dosage form of the Antibiotics prescribed

Different dosage forms of antibiotics were prescribed among 160 patients in which

injections were 382 (91.39%), syrup 20 (4.78%), tablets 14 (3.35%), capsule 1 (0.24%), eye drop 1 (0.24%) as shown in figure 05.

Figure 05: Dosage forms of the antibiotics prescribed

Drug- drug interactions associated with antibiotics

A total of 40 drug-drug interactions were found in this study out of which 32 (80%) were antibiotics interacting with other non-antibiotic drugs and 8 (20%) were antibiotics interacting with another antibiotic as shown in table 04.

Table no 04: Drug-drug interactions associated with antibiotics

SL.NO	DRUG -DRUG INTERACTIONS	NO. OF PATIENTS	PERCENTAGE
1	Antibiotics Interacting with Other Antibiotics	8	20%
2	Antibiotics Interacting with Other non-antibiotic Drugs	32	80%
	TOTAL	40	100%

Distribution of patients according to antibiotic culture and sensitivity test

Out of total 160 patients, only 11 (6.87%) subjects underwent antibiotic culture and sensitivity testing, whereas the remaining 149 (93.12%) subjects did not undergo any such antibiotic culture and sensitivity testing as shown in figure 06. This shows that therapy was not definitive.

Figure 6: Distribution of patients according to antibiotic culture and sensitivity test

Duration of hospital stay

Among 160 patients, there were 73 (45.63%) patients who stayed in the hospital for 4-6 days, followed by 43 (26.88%) patients observed for a period of 7-9 days, 19 (11.86%) patients remained under medical care for a duration of 10-12 days, 16 (10%) patients were admitted to the hospital and remained under medical care for a duration ranging from 1-3 days and 9 (5.63%) patients remained hospitalized for a duration exceeding 12 days as shown in figure 07.

Figure No 07: Duration of Hospital Stay

DISCUSSION: Our aim of the study was to evaluate the usage of antibiotics in paediatrics in order to avoid irrational use and also to prevent antimicrobial resistance which has become a challenging threat globally.

A total of 160 patients who satisfied inclusion criteria were enrolled for the study. Among 160 study subjects analysed, 90 (56.2%) were male and 70 (43.75%) were female. These results were similar to the study done by **Avanthi Bandela et al;**⁹ gender distribution reveals that the overall study population were predominantly male.

In the current study, out of 160 patients the highest age group of patients observed were children of age group (>1-11years) were 90 (56.25%), followed by infants (1-12 months) were 48 (30%), adolescents (>11-19years) were 20 (12.5%) and neonates (0-28days) were 2 (1.25%). This was similar to the results of the study conducted by **Sachin Vahadane et al;**⁷

In the current study, distribution of patients according to type of disease out of 160 patients, 53 (33%) were found with respiratory tract infections, 24 (15%) were found with other conditions , followed by 20 (13%) infections disease, 27 (16%) were with

neurological disorders, 8 (5%) were found to have renal disorders, 8 (5%) were with liver disorder, 6 (4%) were found with hematologic disorder, 6(4%) were found with nutritional disorder, 4 (3%) were found with cardiovascular disease, 4(3%) were found to have lymphatic disease .These results were similar to study conducted by **Rinta Mathew et al;**¹⁰ and **Majed Al-Armouti**¹¹ where the distribution of illness in paediatrics with respiratory infections of 112 (37%) were observed during their study period. So, we can conclude that children are very much prone to respiratory tract infections.

We assessed the frequency of antibiotics prescribed for total 160 study subjects in which Ceftriaxone was observed in 103 (24.64%) followed by vancomycin in 75 (17.94%), Piperillin+Tazobactam in 54 (12.92%), meropenem in 35 (8.37%), amikacin in 26 (6.22%), metronidazole in 22 (5.26%), azithromycin in 22 (5.26%), cefotaxime in 17 (4.07%), clindamycin in 16 (3.83%), doxycycline in 15 (3.59%), ceftazidime in 6 (1.43%), ciprofloxacin in 6 (1.43%), Amoxicillin + clavulanic acid in 6 (1.43%), linezolid in 5 (1.21%), cefixime in 2 (0.48%), ofloxacin in 2 (0.48%), ampicillin in 1 (0.24%), clarithromycin in 1 (0.24%), colistin in 1 (0.24%), levofloxacin in 1 (0.24%), moxifloxacin in 1 (0.24%), and penicillin in 1 (0.24%). These results were similar to study conducted by **Adane Yehualaw et al;**⁸ whereas the commonly prescribed single antibiotic in paediatric patients was ceftriaxone in 147 (45.91%) during their study period. In the study site ceftriaxone was used as drug of choice for prophylaxis.

In the present study, the distribution of antibiotics based on the class reveals that 128 (30.62%) drugs belonged to cephalosporins, 75 (17.94%) drugs belonged to glycopeptide class, 56 (13.41%) drugs belonged to penicillin, 35 (8.37%) drugs belonged to carbapenem class, 27 (6.46%) drugs belonged to aminoglycosides, 23 (5.49%) drugs belonged to macrolides, 22 (5.26%) were from the nitroimidazole class, 16 (3.83%) drugs belonged to the lincosamide class, 15 (3.59%) drugs were from the tetracycline class 10 (2.41%) drugs were fluroquinolones, 6 (1.43%) were from the aminopenicillins, and 5 (1.20%) drugs were from oxazolidinone class . These results were similar to the study conducted by **Rinta Mathew et.al;**¹⁰ where the major distribution of antibiotics by class observed during their study period in paediatrics was cephalosporins 224 (45%).

In the current study, we assessed number of antibiotics per prescription, out of 160 study

subjects, 60 (37.5%) were treated with 2 agents, 41(25.62%) were treated with 3 agents 26 (16.25%) were treated with one agent, 20 (12.5%) were treated with 4 different antibiotics, 11 (6.88%) were treated with 5 agents and 2 (1.25%) were treated with 6 agents. These results were similar to study conducted by **Mohammed Aamir Khan et.al;**¹² where (65.02%) were treated with two antibiotics and 20.62% were treated with 3 agents.

We also evaluated the dosage forms of antibiotics prescribed among 160 patients in which injections were 382 (91.39%), followed by syrup 20 (4.78%), tablets were 14 (3.35%), capsules were only 1 in number (0.24%) and one eye drop (0.24%) as. This result was similar to the study conducted by **Avanthi Bandela et.al;**⁸ where different types of dosage forms of antibiotics were used in patients during their study period such as injections 893 (82.13%) followed by syrups 110 (10.12%), followed by tablets 78 (7.18%) and capsules 5 (0.46%).

In the current study around 40 drug-drug interactions associated with antibiotics, out of which we found that 32 (80%) interactions were between antibiotics with other non-antibiotic drugs and 8 (20%) were that of antibiotic interacting with other antibiotics. These results were similar to the study conducted by **Firomsa Bekele et.al;**¹³ where they observed that antibiotics interacting with other drugs are 46 (60.53%) and antibiotics interacting with other antibiotics were 30 (39.47%) during their study period. Hence it is necessary to check for possible drug interactions prior to administration.

In the present study, we observed that out of total 160 subjects, only 11 subjects (6.87%) underwent antibiotic culture and sensitivity testing, whereas the remaining 149 subjects (93.12%) did not undergo any such antibiotic culture and sensitivity testing.

The duration of hospital stay of 160 patients was as follows 73 patients (45.62%) had stayed in hospital for 4-6 days, 43 patients (26.87%) were observed for a period of 7-9 days, 19 (11.86%) patients remained under medical care for a duration of 10-12 days, 16 (10%) patients were admitted to the hospital and remained under medical care for a duration ranging from 1-3 days and 9 (5.63%) patients remained in hospital for a duration exceeding 12 days. These results were similar to the study conducted by **Xu Hu et.al.,**¹⁴

where they observed that 4411 (79.65%) of the patients stayed in hospital for 0-10 days during their study period.

CONCLUSION

This study gives an overview of Therapeutic Evaluation of Various Antibiotics Usage for Paediatric Inpatients in A Tertiary Care Teaching Hospital. In this study, assessment based on antibiotic culture and sensitivity test reveals that treatment regimen implemented in most of the cases is without doing any culture sensitivity test which may lead to irrational prescription. As a result, precise monitoring of antimicrobial therapy is required. Based on the findings of our study, we advise that in order to minimize the risk of antibiotic resistance in paediatric patients. Prescriber should restrict empirical therapy and encourage effective diagnosis based definitive therapy. In addition, we advise the physicians to adopt a standard treatment guideline for rational use of antibiotics and suggested to implement a wide awareness programme about the rational use of antibiotics. So that the development of resistance may be minimized.

CONSENT FOR PUBLICATION:

The authors have given their consent for publication.

ETHICAL APPROVAL:

The protocol was verified by the Institutional Ethics Committee (IEC) of T.V.M college of pharmacy, Informed consent form (ICF) was obtained from the guardians of the study subjects.

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