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Exploring Antibiotic Prescription Practices in Pediatric Population: A Tertiary Care Hospital Perspective

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Abstract

This prospective observational study aimed to investigate the prescription pattern of antibiotics in the pediatric population of a tertiary care hospital. The study included pediatric patients aged 1-12 years with prescriptions containing antibiotics, excluding those below one month of age or prescriptions without antibiotics. Data was collected over six months from the Department of Pediatrics, Tertiary care Hospital. A total of 50 pediatric patients were included in the study.

Results showed that the male population (68%) was predominantly affected by infections compared to females (32%). The most common age group affected was 1-4 years (38%), followed by 9-12 years (28%). Bronchitis was the most diagnosed infection (22%), followed by meningitis (14%), acute gastroenteritis (10%), and urinary tract infection (18%). Ceftriaxone was the most commonly prescribed antibiotic, particularly for meningitis (87.5%) and UTI (60%). The majority of patients received monotherapy (66%), followed by dual therapy (32%), with a small percentage receiving triple therapy (2%).

The study highlighted a high rate of empirical antibiotic prescribing (46%) without confirmation of bacterial infection. However, overall adherence to prescribed medication was 89%, and no significant drug interactions were found. The study emphasizes the importance of rational antibiotic use in pediatric patients to combat antibiotic resistance and improve patient outcomes. Pharmacists were identified as playing a crucial role in monitoring and ensuring adherence to antibiotic guidelines.

Keywords: Antibiotics; Prescription Pattern; Pediatric Population; Tertiary Care Hospital; Rational Antibiotic Use; Empirical Therapy; Monotherapy; Bacterial Infection; Drug Interactions; Antibiotic Resistance

Abbreviations: AMA: Antimicrobial Agent; LOS: Length of Hospital Stay; BD: Bis a day; CDC: Centre for Disease Control; HIV: Human Immune Virus; ICAT: Infection Control Assessment Tool; ICD: International Classification of Diseases; EARSS: European Antimicrobial Resistance; MRSA: Methicillin resistant Staphylococcus Aureus; WHO: World Health Organization; AMR: Anti-Microbial Resistance; OD: Once a day; ESAC: European Surveillance of Anti-Microbial Consumption; AGE: Acute Gastroenteritis; TB: Tuberculosis; UTI: Urinary Tract Infection.

Introduction

Antibiotics are essential tools for fighting infections, but their overuse has led to the rise of antibiotic-resistant bacteria [1]. This poses a significant threat to public health and necessitates the development of new drugs [1]. Careful selection of antibiotics based on clinical judgment and a

thorough understanding of microbiology and pharmacology is crucial for judicious use [2]. Irrational drug use, a global problem, can lead to increased illness, death, and financial strain on healthcare systems [3,4]. The World Health Organization (WHO) estimates that over half of all medications are inappropriately prescribed, dispensed, or sold [5]. In India, reports suggest a concerning 37% rate of inappropriate antibiotic use [4]. Gathering information on drug administration in children and infants lags behind that of adults due to various factors, including: Developmental differences affecting how drugs behave in the body (pharmacokinetics and pharmacodynamics) [6]. Ethical considerations and financial limitations in research involving children [6].

Regulatory guidelines and restrictions [6]. Studies have shown inappropriate antibiotic use in pediatrics to be widespread, with estimates reaching 50% and 85% in the USA and Canada, respectively [7]. The incidence of medication errors in children is also higher than in adults [8]. Choosing the right antibiotic requires careful clinical judgment. The WHO has developed core drug use indicators to assess prescribing practices, patient knowledge, healthcare facility practices, and healthcare worker effectiveness. This evaluation can help establish prescribing standards, identify issues with understanding instructions, and potentially reduce patient costs [9].

Importance of the Study

While the exact reasons for inappropriate antibiotic use in pediatrics require further investigation, understanding current prescribing patterns is crucial. This study aims to provide baseline data on antibiotic use in our pediatric department to inform clinical education and optimize resource allocation.

Detailed knowledge of prescribing patterns is essential for designing interventions to reduce overall antibiotic use and promote the use of specific antibiotics when most effective. This study will analyze antibiotic consumption patterns for treating respiratory, urinary, and gastrointestinal infections in our pediatric department, which encompasses three units with 60 beds. Notably, no prior studies have been conducted at this rural hospital regarding pediatric antibiotic prescribing patterns.

By analyzing antibiotic utilization and prescribing patterns for these common infections, this study can contribute to promoting rational prescribing practices and minimizing prescription errors in our pediatric department.

This revised introduction removes unnecessary repetition and focuses on the specific challenges of antibiotic use in pediatrics. It also clarifies the purpose and significance of your study.

Patients who are known to be less than 15 years of age, but whose weight exceeds 36 kg may still be considered as pediatric patients given their chronological age. For calculating the child dose from adult dose, the weight of the child must be considered.

The following are the classifications of pediatric patients based on the age. This may assist prehospital personnel in their assessment and management of pediatric patients.

- **Neonate:** newborn up to first 28 days of life
- **Infant:** comprises neonatal period up to 12 months
- **Toddler:** 1-3 years
- **Pre-school:** 3-5 years
- **School-age:** 6-10 years
- **Adolescent:** 11-14 years

Proper information about antibiotic usage pattern and the pressing need to curtail resistance has become an absolute necessity for a constructive approach to the problems arising due to the inappropriate use of antibiotics, especially among the pediatric population [9,10].

Importance of Studying Pediatric Antibiotic Use

Limited local data exists on antibiotic prescribing trends in children. This study aims to establish baseline data on physician prescribing habits, benefiting clinical education and resource management.

Challenges in Pediatric Drug Research

- Several factors hinder research on drug administration in children compared to adults. These include:
- Developmental differences affecting drug behavior in the body
- Ethical considerations and research costs
- Limited research capabilities
- Regulatory hurdles
- Global Problem of Inappropriate Antibiotic Use

Studies reveal inappropriate antibiotic use is prevalent in pediatrics, reaching up to 85% in some regions. This highlights the higher incidence of medication errors in children compared to adults, with some research suggesting an average of 5.5 medications prescribed per child.

Proper antibiotic selection requires careful judgment. The World Health Organization (WHO) has established core

drug-use indicators to assess prescribing practices, patient knowledge, and healthcare system effectiveness. Evaluating these factors can improve prescribing standards, address patient understanding of instructions, and potentially reduce healthcare costs.

Understanding current prescribing patterns is crucial to develop strategies that reduce overall and specific antibiotic overuse in children. This study analyzes the structure of antibiotic use in treating respiratory, urinary, and gastrointestinal infections within a pediatric department with 60 beds. Notably, this rural hospital lacks prior research on pediatric antibiotic prescribing patterns. Therefore, this study aims to analyze antibiotic utilization and prescribing patterns for these infections, ultimately promoting rational prescribing and minimizing errors.

This revision removes verbatim copying and merges similar ideas into a more concise and focused explanation of the research rationale and objectives. It also clarifies the purpose of the WHO indicators and emphasizes the study's contribution to improving pediatric antibiotic use.

Materials and Methods

Objectives

- To know the common class of antibiotic prescribed and indication for therapy.
- To evaluate the number of single or combination of antibiotics in the prescription.
- To evaluate the rationality of the antibiotics used.
- To determine the association of microscopic, culture and sensitivity findings with antibiotic prescribing patterns.

Study design: This is a Prospective Observational Study.

Sources of Data: Data obtained from the pediatric prescriptions of inpatients and outpatients.

Inclusion Criteria

- All the pediatric patients between 6 months-12 years of age.
- Prescriptions containing antibiotics.

Exclusion Criteria

- Prescriptions which do not containing antibiotics
- Children under 6 months.
- Tuberculosis patients.
- HIV patients.
- Immune-deficient.
- Non prior infective illness.
- Patient with in complete follow up.

Methodology

The study was conducted by randomly collecting the prescriptions of pediatric patients containing antibiotics who were visiting the inpatient and outpatient pediatric department. The participants enrolled in the study only after filling in a properly written informed consent (Annexture-I). Basic demographic information and details of the prescribed antibiotics and their prescribing patterns, diseases for which they were indicated, dosage form of antibiotics and whether mono- or multi-therapy is used, were documented in all patients. Rationality and irrationality of prescription were assessed based on drug interactions and number of antibiotics prescribed in each prescription. The prescriptions were also be evaluated for any significant interactions which caused by the antibiotics. If interaction was significant the intervention was done. Appropriateness of the prescriptions was evaluated by considering various parameters like dose, dosage form, and duration of treatment, route, and frequency of administration. The data was collected, documented, and analyzed by using suitable statistical method.

Duration of the Study

The study was conducted over a period of 6 months.

Place of Study

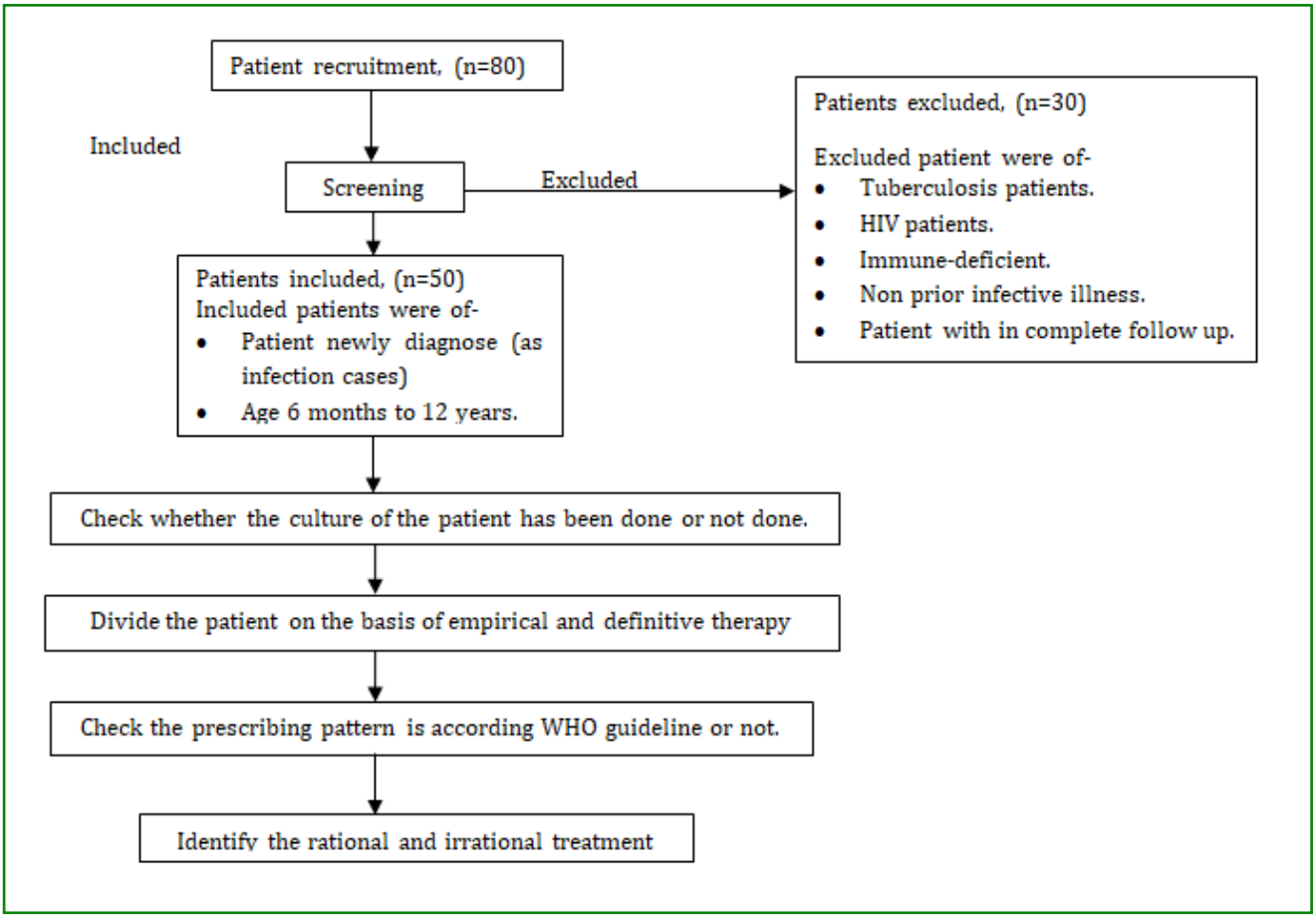
Department of pediatrics, Tertiary care Hospital

Data Collection

Performa were designed and used for entry of patient's specific information. The format provided the following information:

- Patient's Name,
- IP Number,
- Age, Sex,
- Body weight
- Vaccination status
- Locality
- Date of admission (DOA) and Date of discharge (DOD)
- Previous drug allergy,
- Diagnosis,
- Microbiological investigation
- Types of samples
- Micro-organism identified.
- Past medical & medication history,
- Dose of the drug,
- Dosage form,
- Route of administration,
- Frequency of administration,
- Antibiotics prescribed at the time of discharge.
- Patient demographic details, medical and medication history will collect and was documented in a suitably designed data collection form.

Plan of Work



Result

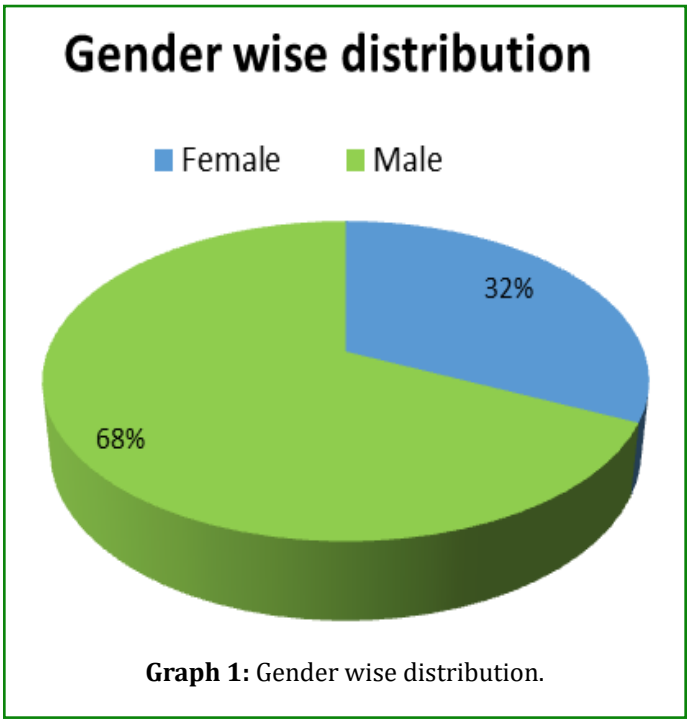
The study was carried out to assess the antibiotic use and prescribing pattern by medical practitioner in infectious disease. In our prospective study analysis, a total of 50 infectious disease patients were selected on the basis of W.H.O. guidelines. Hence the result was based on the data of 50 patients.

Distribution of Patients on the Basis of Gender

Gender	Number of Patients	% of Gender
Female	16	32%
Male	34	68%
Grand Total	50	100%

Table 1: Distribution of Patients on the Basis of Gender.

The demographic sample of study (N =50) indicates that male population (68%) were found to be predominantly having infection as compared to female population (32%) as shown in table 1 and Graph 1.



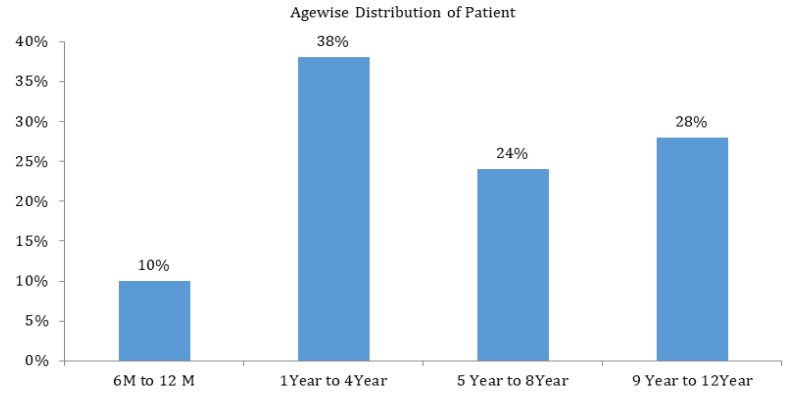
Graph 1: Gender wise distribution.

Description of Patient According to Age of the Patient

Age	Percentage of Patients
06 Month to12 Month	10%
1 Year to 4 Year	38%
5 Year to 8 Year	24%
9 Year to 12 Year	28%

Table 2: Description of Patient According to Age of the Patient.

Data from table 2 suggest that more number of patients were in between 1-4 years of age (38%) followed by number of patients between 9-12 years of age (28%). Least number of patients were in age group between 5-8 years of age (24%) followed by age 6-12 Months of age (10%).



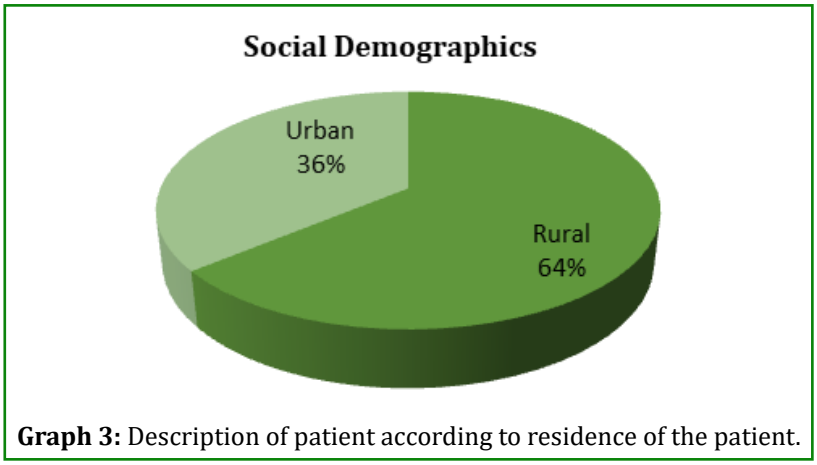
Graph 2: Distribution of patients on basis of their age.

Description of Patient According to Residence of the Patient

Area	No of patients	Count of Patient (%)
Rural	32	64%
Urban	18	36%
Grand Total	50	100%

Table 3: Description of patient according to residential area of the patient.

Table 3 suggested that more number of patient from rural (64%) as compared to urban area (36%).



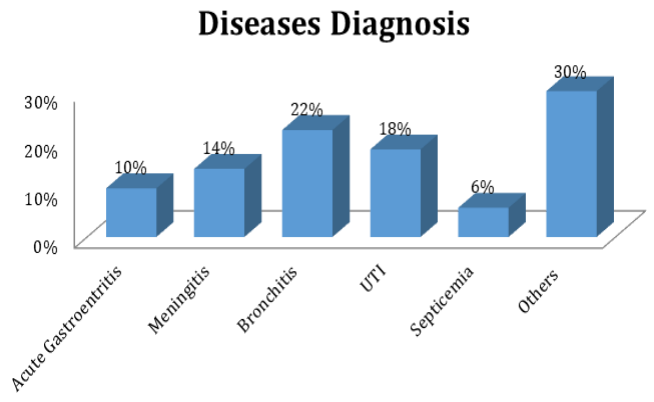
Graph 3: Description of patient according to residence of the patient.

Diagnosis With Causative Organism

Diagnosis	Causative Organism	Number of Patients (%)
Acute Gastroentritis	*E. Coli*	10
Meningitis	*Meningococal*	14
Bronchitis	*Staphylococcus aures, Mycoplasma Pneuminie*	22
UTI	*E.Coli*	18
Septicemia	*E.coli*	6
Others	N.A	30

Table 4: causative organisms along with the diagnosis.

In present study, the maximum infection disease diagnose was bronchitis (22%), followed by meningitis (14%), AGE (10%), UTI (18%), septicemia (06%). The pathogen flora were found *E. Coli, Meningococal, Staphylococcus aures, Mycoplasma Pneuminie.*



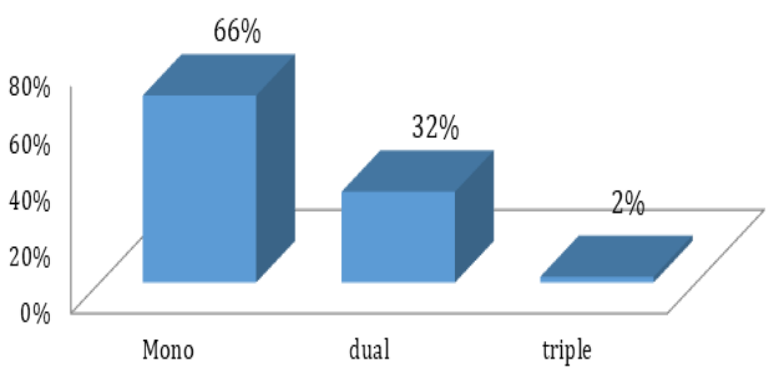
Graph 4: Disease diagnosis with causative organism.

Pattern of Antibiotic Prescribed With Percentage of Patient

Antibiotic Pattern	Number of Patients	Patient (%)
Mono therapy	33	66
Dual therapy	16	32
Triple therapy	1	2

Table 5: Pattern of antibiotic prescribed with percentage of patient.

The above table 5, Suggests that maximum number of patients (66%) on monotherapy followed by antibiotic dual therapy (32%). The least number of patients was antibiotic triple therapy (2%).



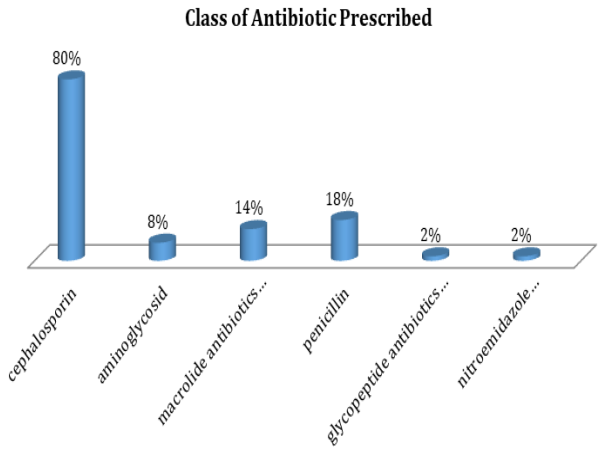
Graph 5: Distribution of patients on basis of antibiotics prescribed.

Distribution of Antibiotic Class Prescribed By Physician

Class of Antibiotics	N=50 (%)
Cephalosporin	80
Amino glycoside	8
Macrolide antibiotics	14
Penicillin	18
Glycopeptides antibiotics	2
Nitroimidazole	2

Table 6: Distribution of antibiotic class prescribed by physician.

In this study it was found that the maximum number of antibiotics prescribed by physician from class cephalosporin (80%) followed by penicillin (18%) and macrolide (14%), but least number antibiotic prescribed from class of glycopeptides (2%) and nitroimidazole (2%).



Graph 6: Distributions of Antibiotic Class Prescribed by Physician.

Distribution of Patients on the Basis of Type of Therapy

Empirical therapy	Definitive therapy
46%	52%

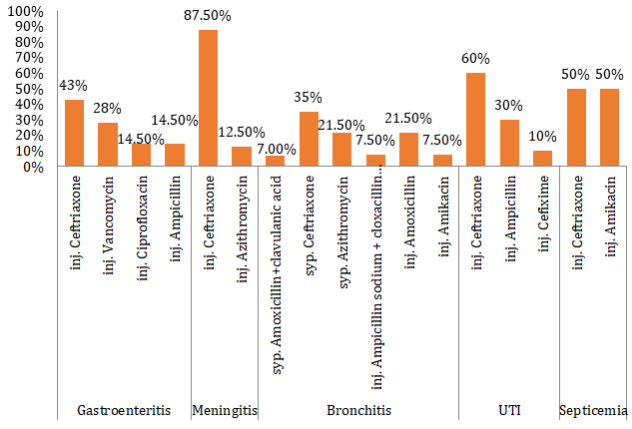
Table 7: Distribution of patients on the basis of type of therapy.

It was found that treatment was given based on definitive therapy 52% and empirical therapy 46% .In empirical therapy culture test was not done. One case (2%) in which physician prescribed antibiotic prophylaxis based on symptoms.

Distribution of Patients Basis of Antibiotics Prescribed for Infectious Disease

Diagnose	Antibiotic Prescribed	Patient (%)
Gastroenteritis	Inj. Ceftriaxone	43%
	Inj.Vancomycin	28%
	Inj.Ciprofloxacin	14.50%
	Inj. Ampicillin	14.50%
Meningitis	Inj. Ceftriaxone	87.50%
	Inj.Azithromycin	12.50%
	Syrup. Amoxicillin + Clavulanic acid	7%
Bronchitis	Syrup. Ceftriaxone	35%
	Syrup.Azithromycin	21.50%
	Inj.Ampicillin sodium + cloxacillin sodium	7.50%
	Inj.Amoxicillin	21.50%
	Inj. Amikacin	7.50%
UTI	Inj.Ceftriaxone	60%
	Inj. Ampicillin	30%
	Inj. Cefixime	10%
Septicemia	Inj.Ceftriaxone	50%
	Inj.Amikacin	50%

Table 8: Distribution of patients basis of antibiotics prescribed for infectious disease.



Graph 8: Distribution of patients on the basis of antibiotics prescribed for infectious disease.

During this study, the antibiotics predominantly prescribed under different categories. The maximum prescribed

antibiotics was ceftriaxone (87.5%) in case of meningitis patients, ,ceftriaxone (60%) in case of UTI patients, Amikacin (50%), Ceftriaxone (50%) in case of septicemia patients, Ceftriaxone (43%) in case of Gastroenteritis patients, Ceftriaxone (35%) in case of bronchitis, Ampicillin (30%) in case of UTI patients, Vancomycin (28.5%) in case of Gastroenteritis , Azithromycin (21%) and Amoxicillin (21%) in case of Bronchitis, Ciprofloxacin (14.5%) and Ampicillin (14.5%) in case of Gastroenteritis, Azithromycin (12.5%) in case of Meningitis patients, Cefixime (10%) in case of UTI patients, Amoxicillin + Clavulanic acid (7.1%), Amikacin (7.5%) and cloxacillin + ampicillin (7.5%).

Antibiotic Prescribed Vs Standard Guidelines

Diagnosis	Drug to be prescribed as per guidelines	Antibiotic prescribed	Frequency	Class of Antibiotic
Gastroenteritis (Salmonella, E.coli, complylobactor, shigella)	Ampicillin (100mg/kg) QID(5-7 Days) Penicillin	Inj. Ceftriaxone	BD	Cephalosporin
		Inj.Vancomycin	6 hourly (TDS)	Glycopeptides
		Inj.Ciprofloxacin	BD	Fluoroquinolones
		Inj. Ampicillin	QID	Penicillins
Meningitis (Meningococcal)	Benzylpenicillin (50mg/kg) 6 hourly (Penicillin) +3rd generation Cephalosporins ex-Cefotaxime for 10-14 days	Inj. Ceftriaxone	BD,OD,6Hourly	Cephalosporin
		Inj.Azithromycin	OD	Macrolide
Bronchitis (mycoplasma pneumonia, streptococcus pneumonia, haemophilus influenzae)	Amoxicillin(80-90mg/kg)BD for 10-12 days (1st generation cephalosporin)	Syrup. Augmentin	BD	Penicillin
		Syrup. Ceftriaxone	BD,OD	Cephalosporin
		Syrup.Azithromycin	OD	Macrolide
		Inj.Ampiclox	TDS	Penicillin
		Inj.Amoxicillin	TDS	Penicillin
		Inj. Amikacin	OD	Aminoglycoside
UTI Escherichia coli	Ampicillin+Aminoglycoside (3rd generation cephalosporin) 100-400mg/kg/day IM/IV	Inj. Ceftriaxone	BD	Cephalosporin
		Inj.Ampicillin	6Hourly	Penicillin
		Inj.Cefixime	BD	Cephalosporin
Septicemia Escherichia coli	Ceftriaxone/ Cefotaxime+Amikacin (3rd generation cephalosporin) (50-100mg/kg/day IM/IV	Inj.Ceftriaxone	BD,TDS	Cephalosporin
		Inj. Amikacin	BD,OD	Aminoglycoside

Table 9: Antibiotic prescribed vs standard guidelines.

Table 9 shows that the maximum prescribed antibiotics were rational (in terms of dose, duration and route of administration).

Duration Of Antibiotic Prescribed

DURATION OF ANTIBIOTICS PRESCRIPTION(IN DAYS)	
DURATION	**% OF ANTIBIOTICS**
1-5 DAYS	53%
6-10 DAYS	28%
>10 DAYS	19%

Table10: Duration of antibiotic prescribed.

The above table showed that the maximum duration/length of antibiotic prescribed days were 1-5 days and least duration was more than 10 days.

Antibiotic Status against Respective Pathogens.

Diagnosis	Type of Culture	Antibiotic Resistance	Antibiotic Sensitivity
Gastroenteritis	Blood	Penicillin	Chloramphenicol
			Colistin
			Imipenem
			Meropenem
Meningitis	Blood	Ceftriaxone	Nitrofurantoin
		Ampicillin	Amoxycilin
		Tazobactum	Colistin
		Piperacillin	Imipenem
			Meropenem
Bronchitis	Blood	Amoxicillin	Colistin
		Azithromycin	Imipenem
		Tazobactum	Meropenem Chloramphenicol
		Piperacillin	Amikacin
UTI	Urine	Ampicilin	Colistin
		Cefexime	Imipenem
		azithromycin	Meropenem
		chloramphenicol	Piperacillin
		amikacin	Tazobactum
			Vancomycin
Septicemia	Blood	Amoxicillin	Colistin
		Azithromycin	Imipenem
		Ceftriaxone	Meropenem
		Ampicillin	Chloramphenicol

Table 11: Antibiotic resistance and sensitivity status against respective pathogens.

Discussion

The most commonly prescribed drugs in children are antibiotics. The inappropriate and excessive use of antibiotics is a major public health issue. The study utilized the revised guidelines of antibiotics use in the department of pediatrics. This study analysis focused on antibiotic prescriptions for IPD /OPD child patients from the average time of antibiotic therapy, the range of antibiotics used and the appropriateness of the antibiotic utilization.

Nowadays, we are dealing with problems due to increasing health-care costs and the development of antibiotic resistance. Recent studies proved an association between antibiotics use and resistance development. Due to these emergent threats it is essential to be informed regularly about the antibiotics use in the hospital.

In present study, the demographic sample of study (N=50) indicates that male population were found to be predominantly having more infection (68%) as compared to female population (32%). Majority of children were in the age group of 1-4 year (38%), followed by children of age between 9-12 years (28%). The least no. of children were in age group between 5-8 years of age (24%), followed by age 6-12 months (10%).In another children 1-4 years received antibiotics. more frequently were similar kind with that of the study conducted by Van houten et al., 1998, which showed children <2 years received antibiotics more frequently than the older children. Over 46% of 50 antibiotic prescriptions were started on a clinical basis, without confirmation of a bacterial infection.

Result of this study show that, the majority of children were diagnosed with bronchitis (upper respiratory tract infection), (22%), followed by urinary tract infection (UTI) (18%), Meningitis (14%) acute gastritis (10%) and least with septicemia (6%). Results revealed that, ceftriaxone, ciprofloxacin, ampicillin and vancomycin were prescribed for gastroenteritis. It is in contrast to the study conducted by Palikhe et al., 2004, which reported that ampicillin was

used in case of gastroenteritis. In a previous study, URTIs and bronchitis were identified as the diagnosis most frequently associated with inappropriate antibiotic use. In this study similar bronchitis is much more common which shows a maximum use of inappropriate antibiotics for these conditions.

Majority of the children were prescribed with monotherapy 33 in number of patient (66;%) of antibiotic prescribed, followed by dual therapy in 16 number of patients (32 %) of antibiotic prescribed and least one of patient was prescribed triple therapy (2%). Antibiotics were prescribed for a duration of 1-5 days in children (53 %) followed by 6-10 days (28%) and more than 10 days in children (19%). In present study, the mean value of antibiotic duration/length in children with prescribed antibiotic therapy was 7 days. The longest duration/length was 14 days, and the shortest duration/length was 3 days. The finding is in contrast to the study conducted by shlaes, et al., 1997 which reported that the longest duration/length was 10 days. The shortest duration/length was 3 day.

The culture test was done in 26 children out of then blood culture was done in 19 children and urine culture in 7 children. Positive culture test were obtained 19 in blood culture 7 in urine culture is the indication for starting antibiotics was definitive (52%), followed by empirical in (48%) children and prophylactic in children (2%). Most of the prescriptions in this study contained the antibiotics given on empirical basis (46%) i.e. without the confirmation of the diagnosis. This finding is similar to the study conducted diagnosis in over 50% of the IPD/OPD children.

This study also identified a substantial increase in the use of 3rd generation cephalosporin in gastroenteritis, UTI and meningitis which is similar to the study conducted by Copp, et al. 2011, which reported the use of broad-spectrum 3rd generation of antibiotic in approximately one third of the UTI in standard antibiotic treatment visits which is an example of over prescribing broad-spectrum antibiotics on the basis of empirical therapy.

In this study, we identified 9 non-significant drug interactions (18%), 03 minor (6%),5 moderate (10%), and nil major interactions.

Conclusion

A high percentage of infected children received antibiotics on a clinical basis, without the Proof of bacterial, nor before the start of therapy neither afterward. The antibiotic Resistance develops in the same setting. The control on antibiotic use should focus on these patient population.

There was 89% complete adherence to the prescribed medication, no significant drug interaction were found in the study. Pharmacist plays a major role in monitoring, adherence of drug according to the guidelines, and drug interaction. This study helps to promote appropriate antibiotic usage and serve as a check mark to the heath-care professionals.

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