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A Study on Utilisation of Antibiotics in Pediatric Patients

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Abstract

Introduction: Antibiotics are drugs that are used in the treatment or prevention of bacterial infections produced by micro-organisms, which are either natural substances artificially modified or totally human created. Pediatric is the study of diagnosis and treatment in age group of 0-14 years patients.

Objectives: To study the utilization of antibiotics in Pediatric patients.

Methodology: This was a Prospective and Observational study performed on 150 patients for a period of 06 months at Apollo Multi-Speciality Hospital, Bengaluru. This study included inclusion and exclusion criteria, which was assessed and evaluated by suitable statistical method.

Result: Out of 150 patients enrolled in the study, 94 (62.7%) were males and 56 (37.3%) were females. The most commonly diagnosed disease was found to be acute Gastroenteritis (17). The highest number of antibiotics prescribed were of class penicillin group (17).The highest distribution of antibiotics prescribed was found in age group of 1-5 years with 51 patients (34%) and the lowest was found to be in 13-14 years with 3 patients (2%).

Conclusion: Among 150 total patients, the study shows highest sample distributed between the age group of 1-5 yrs with 51 patients (34%) which includes 29 male patients (30.9%) and 22 female patients (39.3%) and less distributed in the age group 13-14 yrs including 3 patients (2%) which contribute 2 male (2.1%) and 1 female patients (1.8%). The maximum number of class of antibiotics prescribed were 3rd generation cephalosporin with a frequency of 61 accounting for 40.7%.

Keywords: Prescription usage; Antibiotics; Paediatric patients

Introduction

Antibiotics are drugs that are used in the treatment or prevention of bacterial infections. Strictly speaking, antibiotics are natural substances produced by micro-organisms as opposed to semi-synthetic antibiotics, which are either natural substances artificially modified or totally human created respectively. In common parlance and clinical practice this distinction is not used currently. Antibiotics form part of a wider range of antimicrobial agents, a group which also includes antifungals, antivirals, antiprotozoals, and disinfectants. This group is also known as chemotherapeutic agents [1]. Antibiotics may be informally defined as the subgroup of anti-infectives that are derived from bacterial sources and are used to treat bacterial infections. Others classes of drugs, most notably the sulfonamides, may be effective antibacterials. Similarly, some antibiotics may have secondary uses, such as the use of demeclocycline (declomycin, a tetracycline derivative) to treat the syndrome of inappropriate antidiuretic hormone secretion. Other antibiotics may be useful in treating protozoal infections [2]. Some of the studies have shown that antibiotics are one of the most commonly prescribed drugs among physicians and have identified its overuse. Antibiotic substances are technically chemical compounds produced by living cells and that inhibit, in very low concentrations, the growth of micro-organisms although the term has come to refer to all systemic drugs used to treat bacterial infections. Although antibiotics have been isolated from tissues of higher plants and animals, the term generally has come to refer to inhibitory substances of microbial origin. The historical development of the field of antibiotics began with the discovery by chain, Florey, and associates at Oxford University who discovered the favorable therapeutic and Pharmacological properties of extracts of cultures of the molds *Penicillum notatum*, found to produce penicillin by Fleming in 1929. The introduction of various acids, amines, or amides into the medium in which the mold is developing leads to the production of biosynthetic penicillins [3]. Antibiotics are medicines used to treat infections or disease caused by bacteria e.g. respiratory tract infection such as pneumonia and whooping cough. Antibiotics are used for a range of other infections caused by bacteria, including urinary tract infections, skin infection and infected wounds. Antibiotics have saved millions of life since they were first introduced in the 1940s and 1950s however, be caused they have been overused, many antibiotics are no longer effective against the bacteria they once killed [4]. Antibiotics work by blocking vital processes in bacteria killing the bacteria or stopping them from multiplying. This helps the body natural immune system to fight the bacterial infection. Antibiotics that affect the wide range of bacteria are called broad spectrum antibiotics (e.g. amoxicillin and gentamycin). Antibiotics that affects only few type of bacteria are called narrow spectrum antibiotics (e.g. penicillin) Different types of Antibiotics work in different ways [5]. For example, penicillin destroys bacterial cell wall, while other Antibiotics can affect the way the bacterial cell work. Physician choose an antibiotic according to the bacteria that usually cause a particular infection sometimes a test is carried out to identify the exact type of bacteria causing the infection and its sensitivity to particular Antibiotics.

Classification of Antibiotics

Antibiotics can be simply classified based on their chemical

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structure. Thus Antibiotics within a structural class will generally show similar patterns of effectiveness, toxicity and allergic potential.

Penicillins

These are the oldest class of antibiotics and have a common chemical structure which they share with the cephalosporins and are both known as the beta-lactam antibiotics [6] and are bactericidal (they act by killing bacteria) penicillin can be sub-divided into : natural penicillins based on the original penicillin G structure, penicillinase-resistant penicillins, notably methicillin and oxacillin, which are active even in the presence of the bacterial enzyme that inactivates most natural penicillins. Aminopenicillins such as ampicillin and amoxicillin have an extended spectrum of action compared with the natural penicillins; extended spectrum penicillins are effective against a wider range of bacteria. These generally include coverage for *Pseudomonas aeroginosa* and may provide the penicillin in combination with a penicillanase inhibitor. Examples of penicillin group antibiotics are amoxicillin, ampicillin etc. these are mostly used in combination with beta-lactamase inhibitors such as clavulanic acid, sulbactam and tazobactam.

Cephalosporins

Cephalosporins and the closely related cephamycins and carbapenems, like the penicillins, contain a beta-lactam chemical structure [7] and are pattern of cross-resistance and cross-allergenicity among the drug in these classes .the "cepha" drugs are among the most diverse classes of antibiotics and are themselves sub grouped into 1st, 2nd and 3rd generations. Each generation has a broad spectrum of activity that the previous. In addition, cefoxitin a cephamycin is highly active against anaerobic bacteria which can be used in treatment of abdominal infections. The 3rd generation cross the blood brain barrier and can be used in treatment of meningitis and encephalitis. Cephalosporins are the usually preferred agents for surgical prophylaxis. Examples are cefexime, cefuroxime, cefotaxime, cefpodoxime, cephalexin etc.

Floroquinolones

These are synthetic antibacterial agents, not derived from bacteria. They can be readily interchanged with traditional antibiotics [8]. An earlier related class of a Antibacterial agents, the quinolones were not well absorbed, and could be used only to treat urinary tract infection. The floroquinolones which are based on the older group are broad-spectrum bacteriocidal drugs that are well distributed into bone tissues, and so well absorbed that in general they are as effective by the oral route as by intravenous infusion. Examples are moxifloxacin, ofloxacin etc.

Tetracyclines

Got their name because they share a chemical structure that has four rings. They are derived from a species of Streptomyces bacteria [9]. Broad spectrum bacteriostatic agents, the tetracyclines may be effective against a wide variety of micro-organisms, including rickettsia and amoebic parasites. Examples are doxycycline, tetracycline etc.

Macrolides

Are derived from *Streptomyces* bacteria, and got their name because they all have a macrocyclic lactone structure. Erythromycin are prototype of this class, has a spectrum and use similar to penicillin newer drugs like azithromycin and clarithromycin are particularly useful for their high level of lung penetration [10]. Clarithromycin has been widely used to treat *helicobacter pylori* infection the cause of stomach ulcer. Other classes of antibiotics include the aminoglycosides, which are particularly useful for their effectiveness in treating *Pseudomonas aeruginosa* infections. Lincosamides, against anaerobic pathogens. Antibiotics can be used as prophylaxis during pre and post surgeries as well as for treatment of infections such as Respiratory tract infections, chronic obstructive pulmonary disorders, urinary tract infections, skin infections, meningitis, tuberculosis, septicemia, encephalophitis, malaria, inflammatory bowel diseases, cirrhosis and alcoholic liver diseases, acute and chronic renal failures, syphilis, gonorrhea, pneumonia, typhoid, bacterial dysentery [11]. Gestational age (GA) is defined as a no. of weeks from the first day of the mother`s last normal menstrual period to the birth of the new born. Postnatal age (PNA) is the no. of weeks since birth. Postmenstrual age previously known as post-conceptional age (PCA)] is defined as the sum of the gestational age and postnatal age. A new born at 38-41 weeks GA is considered a full-term new born [12]. Neonates are between weeks 0 and 4 weeks of postnatal age. The term neonate may also be applied to a premature newborn. Neonates born prior to 38 weeks GA are considered premature. A post-term newborn is of 42 weeks are more of gestational age. The term infant is used for 1 month to 1 year, child from 1 year to 12 years, and adolescent from 13 to 18 years of age. The pediatric population comprised only about 33% of the total world population in 2007; however numerous acute and chronic disease can affect this subpopulation. Premature neonates have poorly developed organ function and are at highest risk of eliciting unexpected toxicity or poor clinical response from suboptimal dosage regimens of drugs due to altered pharmacokinetics or dose requirements in this population. The dose requirement / kg / day of drugs is often highest among children and lowest in premature infants, with adults in the middle. Children below the age of six years may need extemporaneously prepared dosage forms (such as oral suspensions) due to their inability to swallow tablets and capsules and the fact that doses are tailored (not fixed) based on body weight. Patients are dependent on parents or caregivers to receive optimal drug therapy [13]. Finally the social and economic status of parents directly influences the care they can offer to their children. Over 80% of the drugs marketed for adults are not approved for infants and children, although many are commonly used in clinical practice. Unlabelled or off-label use of drugs is common among pediatric patients. Over 60% of children in hospitals and 90% of those in intensive care units receive unlicensed or off-label drugs. Examples of such drugs are captopril, levofloxacin (except prophylaxis of and post exposure treatment of anthrax inhalation), gabapentin, and morphine (oral).

Clark's rule: (for infants and children)

$$\frac{(\text{Weight in pounds}) \times (\text{Adult dose})}{150}$$

Fried's rule: (for infants and children up to 1-2 years)

$$\frac{(\text{Age in months}) \times (\text{adult dose})}{150}$$

Young's rule: (for children 1-12 years)

$$\frac{(\text{Age in years}) \times (\text{Adult dose})}{\text{Age} + 12}$$

These formulae are not in general use in the US because age alone is no longer considered a singularly valid criterion in determining a child's dose and the calculated dose can easily under or overestimate

the desired dose. Body surface area (BSA) may be used for calculating the doses of certain drugs such as chemotherapy agents [14]. This is because BSA may correlate better with organ function, and thus the dose requirements for certain drugs. The Mosteller formula is most commonly used in practice.

$$\text{BSA}\left(\text{m}^2\right)=\text{Square root}\left[\left(\text{Body weight in kg}\times\text{height in cm}\right)/3600\right]^4$$

Child dose based on body surface area can be calculated with the following formula as:

$$\text{Child Dose} = \frac{\text{BSA of child}\times\text{adult dose}}{1.73\text{m}^2}$$

Objective

General objective

- To study the utilization of antibiotics in pediatric patients.

Specific objectives

- To study the age distribution of study population
- To assess the prescribing pattern of antibiotics
- To evaluate the cost analysis of prescribed antibiotics
- To assess and evaluate the severity of drug interaction

Methodology

Study site

The study was conducted in pediatric wards and medical record department (MRD) of Apollo Multi-Specialty Hospital & Research Center, Bengaluru.

Study design

This was a prospective and observational study, performed on 150 patients to access the current prescribing patterns of antibiotics in pediatrics.

Sample size:

A total of 150 patients from pediatric wards of Apollo Multi-Specialty hospital & Research Center, who satisfied the study criteria and consented to participate in this study were included for the study.

Study period:

The study was conducted over a period of six months staring from November 2017 to April 2018.

Ethical approval

Ethical committee clearance was obtained by the Institutional Ethical Committee of Apollo Multi Speciality Hospital & Research center

Study criteria

Inclusive criteria:

- Pediatric in-patient aged between 0-14 years
- Patients who are under antibiotic theory of any clinical condition
- Patients irrespective of gender

Exclusive criteria:

- Patient aged over 14 years
- Patients who are not willing to participate in study

Source of data: Patient's demographic, clinical findings, laboratory and therapeutic data were collected from inpatients. The main sources for collection of data were:

- Patient's case notes
- Treatment chart
- Lab data reports
- Data collection form

Study Procedure

Patient enrollment

A hospital based prospective study was conducted in the Apollo Multi Specialty Hospital & Research Center. The study was conducted on 150 Pediatric patients who had undergone treatment with antibiotics. Patients who were not willing to participate & who were below 14 years were excluded from the study [15].

Methods of data collection

This was a Prospective study. This study was conducted in Pediatric wards and Medical Record Department (MRD) Apollo Multi Specialty Hospital & Research center. Those who meet the inclusive criteria were enrolled for the study, for evaluating the prescribing pattern. The demographic details of the patients, drug use and disease details were documented in data collection form. Then the results were analyzed by using various standard references like Joseph T Dipiro, Eric T Herfindal, Roger and Walker, Goodman and Gillman and the report was assessed by suitable Statistical tool [16].

Determination of prescription pattern

A prospective review of treatment charts was conducted to collect the data pertaining to the study of the prescribing pattern of antibiotics for the treatment of disease in the General medicine, pediatrics, OBG and Urology departments of the hospital [17]. After the diagnosis was confirmed the entire relevant & necessary baseline information such as socio demographic details of the patient & details on visit for the treatment (first or return) were obtained directly from the patients case note. Details like patient age, educational background, date of admission, date of discharge, the occupation were collected. Therapeutic data such as name of drugs, doses, and route of administration, duration & other laboratory data were collected and documented in a suitably designed documentation form. The follow - ups of the patients were done and the changes in the prescribing drugs or their doses or duration were also documented. The prescriptions and treatment charts have been reviewed. The category of the antibiotic and possible side effects due to drug, to the mother and the foetus were checked from the available sources.

Statistical methods

This model was Descriptive statistics, frequency and percentage was drawn and charts were used to represent the consoliated data for inferential statistics. Chi-square test of independent of attribution were used to test the categorized data. Statistical study [18].

Significant figures:

+ Suggestive significance (P value: 0.005<P<0.10)

*Moderately significant (P value: 0.01<P ≤ 0.05)

**Strongly significant (P value: P ≤ 0.01)

Statistical software

The statistical software namely SPSS 20.0 version was used for the analysis of the data and as drawn charts and graph etc.

Results

The participation of male and female with total expression with the percentage was statistically calculated and presented with the above table and pie diagram. The number of male and female patients were found to be 94 and 56 respectively accounting for 62.67% and 37.33% respectively. The age distribution of patients studied was found ranging from the day of birth to14 yrs [19]. The highest age distribution was found in the age group between 1-5 yrs with a total number of 51 patients accounting for 34%. The lowest age distribution was found in the ranging of above 13 yrs and less than 14 yrs with a total number of 3 patients accounting for 2% of total study population. The distribution according to age and gender was statistically calculated and found to be highly distributed between the age group of 1-5 yrs with a total of 51 patients accounting for 34% which includes 29 male patients and 22 female patients with 30.9% and 39.3% respectively [20]. It was found to be less distributed in the age group between 13-14 yrs including 3 patients accounting for 2% which contribute 2 male and 1 female patients respectively with 2.1% and 1.8% respectively. Based on final diagnosis, the maximum number of antibiotics prescribed was found to be in acute gastroenteritis in which total 17 antibiotics were prescribed. The least number of antibiotics were prescribed to acute appendicitis, acute appendicitis with obscess, acute bacillary dysentery, acute laryngo tonsillitis with gastritis, acute left pyelonephritis, acute pharyngitis, displaced radius, jaundice, gonu valgum, grade 4 adenoid hypertrophy, Hodgkins lymphoma, hand foot mouth disease, osteofibrous dysplaria and proximal penile, pypopadias with chordac in which only one antibiotics were prescribed respectively [21]. The distribution of antibiotics based on age group were studied and represented statically. The maximum number of antibiotics were prescribed to the age group between 1 to 5 years with the frequency of 51. The minimum number of antibiotics were prescribed to the age group between 13 to 14 years with the frequency of 3. The statistical analysis of distribution according to class of antibiotics were performed statically. The maximum number of class of antibiotics prescribed were 3rd generation cephalosporin with a frequency of 61 accounting for 40.7%. It was found to be low in the combination of 1st generation cephalosporin with fusidane class, combination of two 2nd generation cephalosporin, combination of 2nd generation cephalosporin with aminoglycosides, combination of 3rd generation cephalosporins with macrolides, combination of Fluoroquinolones with 3rd generation Cephalosporin, Aminoglycosides, combination of Aminoglycoside with Oxazolidinones, combination of Fluoroquinolones with Penicillin Group, combination of 1st generation Cephalosporin & Fluoroquinolones, Antifungal Agents, Antineoplastic Antibiotics, Fusidane Class, Glycopeptide antibiotics, combination of Penicillin group with 3rd generation Cephalosporins, combination of Tetracycline with 3rd generation Cephalosporin, Lincosamide, combination of Aminoglycoside with 1st generation Cephalosporin, combination of Polypeptide with 3rd generation Cephalosporin, Macrolide antibiotics, combination of Tetracycline with Glycopeptide antibiotics with a frequency of 1 accounting for 0.7% respectively [22]. Total cost based on prescribed antibiotics was performed statically. In a monotherapy, inj ceftriaxone was found to be the costliest drug with total cost of Rs 10568.05. the least costliest drugs were inj penicillin with total cost of Rs 43.2. In a combinational therapy, inj piperacillin + Tazobactum, inj Doxycycline and syp Azithromycin was found to be the costliest drug with Rs 31,127.92. The least costliest drugs were Beclomethasone + clotrimazole with Rs 49.25. Distribution of sample according to class of antibiotics and antibiotics prescribed were studied. The maximum prescribed class of antibiotics were found to be 3rd generation cephalosporin in which the most prescribed antibiotics were inj ceftriaxone and the least prescribed antibiotics were syp ceftriaxone, syp cefotaxime and tab ceftriaxone. The least prescribed antibiotics were found to be inj amikacin and ceftriaxone of 2nd generation cephalosporin and aminoglycosides followed by syp azithromycin, inj cefotaxime and inj amoxicillin, inj moxifloxacin + ketorolac of macrolide, 3rd generation cephalosporin and penicillin group, Fluoroquinolones respectively [23]. The drug interaction with antibiotics based on severity were analyzed statically. The result shows 5 major interactions with the antibiotics prescribed including ondansetron and doxycycline as an interacting drugs. Sample distribution according to frequency was studied and it shows that the monotherapy of BD is more with frequency of 68 with 45.3% and monotherapy of SOS is less with frequency of 1 with 0.7%. Whereas in case of combined frequency, BD and BD therapy is more with a frequency of 20 accounting for 13.3% and less in BD,OD and TID, BD, BD and TID, OD,BD and BD, QID, BD and OD, OD, OD and BD, TID and TID, TID, OD and BID with the frequency of 1 accounting for 1% respectively [24]. Sample distribution according to duration of prescribed antibiotics was studied. The highest prescribed duration were 3 days with a frequency of 57 accounting for 26.4%. The least prescribed duration were 13 days with a frequency of 1 accounting for 0.5%. Distribution of antibiotics with interacting drugs were studied statically. The frequent interacting drug was found to be ondansetron with the frequency of 1 accounting for 25% respectively. In patients prescribed as monofrequency, the distribution according to frequency of prescribed antibiotics were found to be more in patients with BD therapy with the frequency of 141 accounting for 65.3% and least in patients with ATD and SOS therapy with the frequency of 2 accounting for 0.9% [25].

Discussion

Antibiotics are the key drugs for treatment of infections and are among the most commonly prescribed drugs in pediatric department. Worldwide population constitute of about 28% of children and infants who are most susceptible to diseases due to under development of immune system [26]. In addition, pediatric groups are among the most vulnerable population groups to contact illnesses and cause harmful effects of drugs due to differences in pharmacodynamic and pharmacokinetics. The use of antibiotics has become a routine practice for the treatment of pediatric illness.

Gender

As per the Table 1 and Figure 1, the participation of male and females with total expression was found to be 94 male and 56 female patients with the percentage of 62.67% and 37.33%. Therefore more number of male patients were enrolled in the study. Similar finding were found in the study conducted [27]. Prescribing patterns of antibiotics in pediatrics for respiratory tract infections/disorders in tertiary care hospital. In this study the number of male patients was comparatively more than the number of female patients accounting for 62% and (38%) respectively.

Age

As per the Table 2 and Figure 2, the age distribution of patients

Gender	Frequency	Percent
Male	94	62.7
Female	56	37.3
Total	**150**	**100.0**

Table 1: Distribution according to gender.

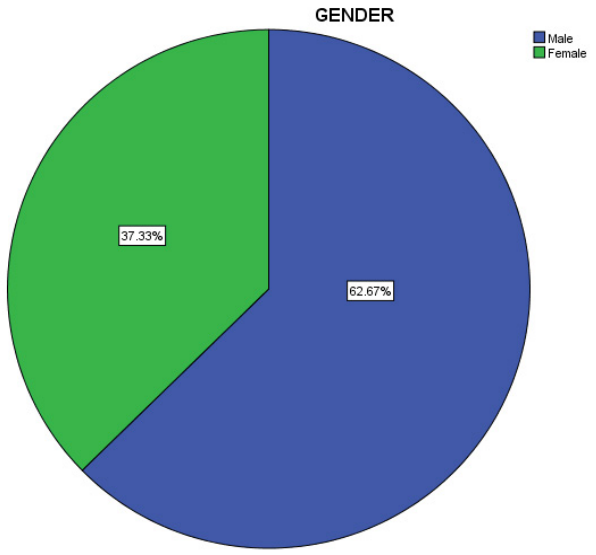

Figure 1: The number of male and female patients

Age group	Frequency	Percent
Below 1 Year	31	20.7
1 to 5 Years	51	34.0
5 to 10 Years	46	30.7
10 to 13 Years	19	12.7
Above 13 Years	3	2.0
Total	**150**	**100.0**

Table 2: Distribution according to age group.

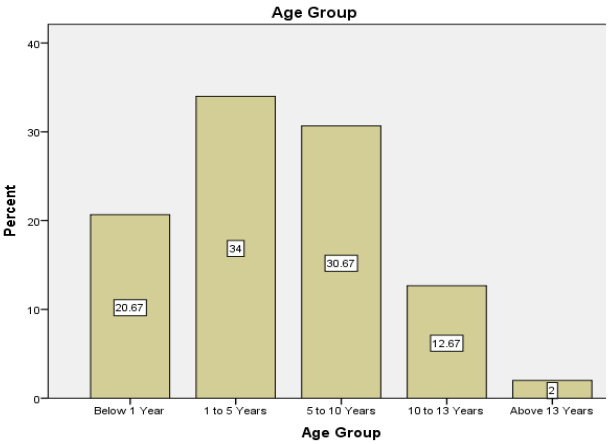

Figure 2: Age distribution of patients.

studied was found ranging from the day of birth to14 yrs. The highest age distribution was found in the age group between 1-5 yrs with a total number of 51 patients accounting for 34%. The lowest age distribution was found in the ranging of above 13 yrs and less than14 yrs with a total number of 3 patients accounting for 2% of total study population [28]. Similar findings were found in the study conducted. Prescribing patterns of antibiotics in pediatrics for respiratory tract infections/disorders in tertiary care hospital. In this study the highest age distribution was seen between the age group of 1-6 yrs.

Gender and age group

As per the Table 3 and Figure 3, the distribution according to age and gender was statistically calculated and found to be highly distributed between the age group of 1-5 yrs with a total of 51 patients accounting for 34% which includes 29 male patients and 22 female patients with 30.9% and 39.3% respectively [29]. It was found to be less distributed in the age group between 13-14 yrs including 3 patients accounting

Final diagnosis	Antibiotics	Total
Acute Appendicitis	Inj. Cefotaxime	1
	Total	1
Acute Appendicitis with abscess	Inj. Cefotaxime & Inj. Amoxicillin	1
	Total	1
Acute Bacillary Dysentry	Inj. Amikacin & Inj. Ofloxacin	1
Acute Febrile Illness	Total	1
	Inj. Amikacin & Ceftriaxone	2
	Inj. Cefixime	1
	Inj. Ceftriaxone	1
	Inj. Ceftriaxone & Syp. Cefixime	1
	Inj. Cefoperazone & Inj. Amikacin	1
	Inj. Vancomycin & Syp. Linezolid	2
	Total	8
Acute Gastroenteritis	Inj. Amikacin	1
	Inj. Amikacin & Inj. Ofloxacin	3
	Inj. Amikacin & Ceftriaxone	1
	Inj. Ceftriaxone	7
	Inj. Ceftriaxone & Syp. Cefixime	2
	Inj. Cefpodoxime	2
	Tab. Ceftriaxone	1
	Total	17
Acute Tonsilitis	Inj. Amoxicillin & Clavulanic Acid	1
	Inj. Ceftriaxone	1
	Syp. Cefprozil	1
	Total	3
Acute Laryngo Tonsilitis with Gastritis	Inj. Amoxicillin & Clavulanic Acid	1
	Total	1
Acute Left Pyelonephritis	Inj. Cetriaxone & Inj. Gentamycin	1
	Total	1
Acute Pharyngitis	Inj. Ceftriaxone & Syp. Azithromycin	1
	Total	1
Adenoid Hypertrophy	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	1
	Inj. Ceftriaxone	1
	Inj. Cetriaxone & Syp. Cefuroxime	1
	Total	3
Bronchiolitis	Inj. Amoxicillin & Clavulanic Acid	2
	Inj. Cefixime	1
	Total	3
Broncho Pneumonia	Inj. Ceftriaxone & Inj. Amoxicillin + Clavulanic Acid	1
	Inj. Moxifloxacin + Ketorolac	1
	Inj. Piperacillin + Tazobactum, Inj. Doxycycline & Syp. Azithromycin	1
Chronic Adeno Tonsilitis	Total	3
	Inj. Amoxicillin & Clavulanic Acid	1

	Inj. Ceftriaxone	3
	Inj. Ceftriaxone & Inj. Cefpodoxime	2
	Inj. Cefuroxime	1
	Inj. Cefuroxime & Syp. Cefuroxime + Clavulanic Acid	1
	Inj. Cefuroxime & Tab. Cefpodoxime	1
Chronic Hypertrophic Rhinitis	Total	9
	Inj. Amoxicillin & Clavulanic Acid	1
	Cephalexin Drop	2
Cysts	Total	3
	Inj. Ceftriaxone	1
	Inj. Clindamycin & Inj. Amikacin	1
	Inj. Penicillin	1
	Total	3
Dengue Fever	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	1
	Inj. Ceftriaxone	5
	Inj. Ceftriaxone & Syp. Cefixime	2
	Inj. Cefotaxime	1
	Inj. Cefpodoxime, Syp. Moxifloxacin & Syp. Cefixime	1
	Inj. Piperacillin + Tazobactum, Inj. Doxycycline & Syp. Azithromycin	1
	Total	11

Table 3: Distribution according to gender and age group.

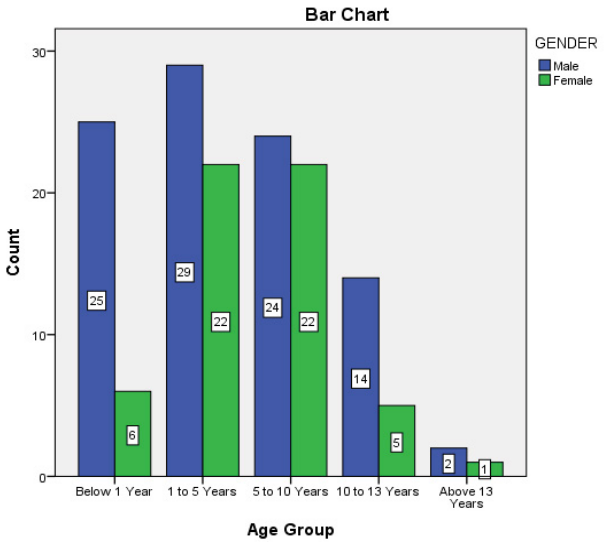

Figure 3: Distribution according to age and gender.

for 2% which contribute 2 male and 1 female patients respectively with 2.1% and 1.8% respectively. Similar findings were found in the study conducted. Prescribing patterns of antibiotics in pediatrics for respiratory tract infections/disorders in tertiary care hospital. In this study the number of male patients was comparatively more than the number of female patients accounting for 62% and 38% respectively and the highest age distribution was seen in the range of 1-6 yrs age group which were similar to the findings with our study [30].

Antibiotics based on final diagnosis

As per the Table 4, Based on final diagnosis, the maximum number of antibiotics prescribed was found to be in acute gastroenteritis in which total 17 antibiotics were prescribed. The least number of antibiotics were prescribed to acute appendicitis, acute appendicitis

Displaced Radius	Inj. Cefotaxime	1
	Total	1
Deep Laceration Froutal Region	Inj. Cefotaxime	1
	Syp. Cefixime	1
	Total	2
Enteric Fever	Inj. Ceftriaxone & Syp. Cefixime	1
	Inj. Cefuroxime	1
	Total	2
Jaundice	Cephalexin Drop	1
	Total	1
Fracture Bone	Inj. Ceftriaxone & Syp. Cefixime	1
	Syp. Cefixime	1
	Total	2
Fever & Diarrhea	Inj. Amoxicillin & Clavulanic Acid	1
	Inj. Piperacillin + Tazobactum	1
	Total	2
Gonu Valgum	Cephalexin Drop	1
	Total	1
Grade 4 Adenoid Hypertrophy	Inj. Ceftriaxone	1
	Total	1
Hodgkins Lymphoma	Inj. Doxycycline & Inj. Ceftriaxone	1
	Total	1
Hand Foot Mouth Disease	Fusidic Acid Ointment	1
	Total	1
Hypophosphatemic Ricket	Inj. Cefotaxime & Syp. Cephalexin	1
	Syp. Cefotaxime	1
	Total	2
Ileocolic Intussception	Inj. Amikacin & Inj. Linezolid	1
	Inj. Amikacin & Ceftriaxone	1
	Inj. Cefixime	2
	Inj. Ceftriaxone	1
	Inj. Cefotaxime	1
	Total	6
LRTI	Inj. Amikacin & Ceftriaxone	2
	Inj. Amoxicillin & Clavulanic Acid	5
	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	1
	Inj. Cefixime	1
	Inj. Cefixime & Inj. Cefuroxime	1
	Inj. Ceftriaxone	4
	Syp. Ceftriaxone	1
	Total	15
Osteofibrous Dysplaria	Inj. Cefotaxime	1
	Total	1
Nesal Facture	Inj. Cefixime & Inj. Cefuroxime	1
	Syp. Cefixime	1
	Total	2
Neonatal Hyperbilirubin anemia	Inj. Moxifloxacin & Inj. Amoxicillin + Clavulanic Acid	1
	Moxifloxacin Drop	1
	Total	2
Phimosis	Inj. Ceftriaxone & Syp. Cefixime	1
	Inj. Cefuroxime & Syp. Cefpodoxime	1
	Tab. Cefotaxime	1
	Total	3
Proximal Penile, Pypopadias with Chordac	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	1
	Total	1
Polytrauma	Inj. Cefixime & Inj. Cefuroxime	1
	Inj. Cefoperazone & Inj. Amikacin	1
	Total	2

Right Paracardiac Pneumonia	Inj. Amikacin & Ceftriaxone	2
	Total	2
Ricket	Inj. Amikacin & Ceftriaxone	1
	Inj. Cefotaxime	2
	Syp. Cefotaxime	1
	Total	4
RIF Mass	Inj. Cefoperazone & Inj. Amikacin	1
	Total	1
Recurrent UTI	Inj. Amikacin & Ceftriaxone	1
	Inj. Ceftriaxone	5
	Moxifloxacin Ointment	1
	Total	7
Shigellosis	Inj. Ceftriaxone	1
	Inj. Ceftriaxone, Inj. Ofloxacin & Inj. Cefotaxime	1
	Total	2
Secondary Apnea	Inj. Cefoperazone & Inj. Amikacin	1
	Total	1
Septic Arthritis Left Hip	Inj. Vancomycin	1
	Total	1
Syncope Seizure	Inj. Ceftriaxone	1
	Total	1
Supra Candylar Fracture	Inj. Ceftriaxone & Syp. Cephalexin	1
	Inj. Ceftriaxone & Inj. Cefpodoxime	1
	Total	2
Traumatic Brain Surgery	Inj. Amoxicillin & Clavulanic Acid	1
	Syp. Cefpodoxime	1
	Total	2
Tubecular Meningitis	Beclomethasone + Clotrimazole	1
	Inj. Ceftriaxone	1
	Total	2
URTI	Inj. Ceftriaxone	2
	Inj. Ceftriaxone & Inj. Amoxicillin + Clavulanic Acid	1
	Total	3
Viral Ferver	Inj. Amoxicillin & Clavulanic Acid	1
	Tab. Cefotaxime	1
	Total	2
Wilms Tumor	Inj. Cetriaxone & Inj. Gentamycin	1
	Inj. Doxycycline & Inj. Ceftriaxone	1
	Inj. Tazobactum	1
	Total	3
	Grand Total	**150**

Table 4: Distribution according to antibiotics based on final diagnosis.

with obscess, acute bacillary dysentery, acute laryngo tonsillitis with gastritis, acute left pyelonephritis, acute pharyngitis, displaced radius, jaundice, gonu valgum, grade 4 adenoid hypertrophy, Hodgkins lymphoma, hand foot mouth disease, osteofibrous dysplaria and proximal penile, pypopadias with chordac in which only one antibiotics were prescribed respectively. Similar findings were found in the study conducted on antibiotic prescribing among pediatric in-patients with potential infections in two private sector hospitals in central India [31]. In this study patients diagnosed with Acute Gastroenteritis were most prescribed with antibiotics accounting for 30% (51/168) comparatively higher than other diagnostic conditions.

Antibiotics based on age group

As per the Table 5 the maximum number of antibiotics were prescribed to the age group between 1 to 5 years with the frequency of 51. The minimum number of antibiotics were prescribed to the

Age group	Antibiotics	Total
Below 1 Year	Inj. Amikacin & Ceftriaxone	3
	Inj. Amoxicillin & Clavulanic Acid	2
	Inj. Cefixime	1
	Inj. Ceftriaxone	11
	Inj. Ceftriaxone & Syp. Cefixime	2
	Inj. Cetriaxone & Inj. Gentamycin	1
	Inj. Cefotaxime	1
	Inj. Cefoperazone & Inj. Amikacin	3
	Cephalexin Drop	3
	Fusidic Acid Ointment	1
	Inj. Tazobactum	1
	Moxifloxacin Drop	1
	Tab. Ceftriaxone	1
	Total	31
1 to 5 Years	Inj. Amikacin	1
	Inj. Amikacin & Inj. Linezolid	1
	Inj. Amikacin & Inj. Ofloxacin	3
	Inj. Amikacin & Ceftriaxone	3
	Inj. Amoxicillin & Clavulanic Acid	6
	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	3
	Inj. Cefixime	2
	Inj. Ceftriaxone	8
	Inj. Ceftriaxone & Syp. Cefixime	2
	Inj. Ceftriaxone, Inj. Ofloxacin & Inj. Cefotaxime	1
	Inj. Ceftriaxone & Inj. Cefpodoxime	2
	Inj. Ceftriaxone & Inj. Amoxicillin + Clavulanic Acid	1
	Inj. Cetriaxone & Syp. Cefuroxime	1
	Inj. Cefuroxime	2
	Inj. Cefuroxime & Syp. Cefuroxime + Clavulanic Acid	1
	Inj. Cefuroxime & Syp. Cefpodoxime	1
	Inj. Cefpodoxime	2
	Inj. Cefpodoxime, Syp. Moxifloxacin & Syp. Cefixime	1
	Cephalexin Drop	1
	Inj. Doxycycline & Inj. Ceftriaxone	1
	Inj. Moxifloxacin + Ketorolac	1
	Inj. Moxifloxacin & Inj. Amoxicillin + Clavulanic Acid	1
	Inj. Penicillin	1
	Inj. Piperacillin + Tazobactum	1
	Inj. Vancomycin & Syp. Linezolid	2
	Moxifloxacin Ointment	1
	Syp. Cefotaxime	1
	Total	51

5 to 10 Years	Beclomethasone + Clotrimazole	1
	Inj. Amikacin & Inj. Ofloxacin	1
	Inj. Amikacin & Ceftriaxone	2
	Inj. Amoxicillin & Clavulanic Acid	4
	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	1
	Inj. Cefixime	1
	Inj. Cefixime & Inj. Cefuroxime	2
	Inj. Ceftriaxone	11
	Inj. Ceftriaxone & Syp. Cefixime	3
	Inj. Ceftriaxone & Syp. Cephalexin	1
	Inj. Ceftriaxone & Syp. Azithromycin	1
	Inj. Ceftriaxone & Inj. Cefpodoxime	1
	Inj. Cetriaxone & Inj. Gentamycin	1
	Inj. Cefotaxime	4
	Inj. Cefotaxime & Syp. Cephalexin	1
	Inj. Cefotaxime & Inj. Amoxicillin	1
	Inj. Doxycycline & Inj. Ceftriaxone	1
	Inj. Vancomycin	1
	Syp. Cefixime	3
	Syp. Ceftriaxone	1
	Syp. Cefotaxime	1
	Syp. Cefpodoxime	1
	Syp. Cefprozil	1
	Tab. Cefotaxime	1
	Total	46
10 to 13 Years	Inj. Amikacin & Ceftriaxone	2
	Inj. Amoxicillin & Clavulanic Acid	2
	Inj. Cefixime	1
	Inj. Cefixime & Inj. Cefuroxime	1
	Inj. Ceftriaxone	4
	Inj. Ceftriaxone & Syp. Cefixime	1
	Inj. Ceftriaxone & Inj. Amoxicillin + Clavulanic Acid	1
	Inj. Cefotaxime	2
	Inj. Cefuroxime & Tab. Cefpodoxime	1
	Inj. Clindamycin & Inj. Amikacin	1
	Inj. Piperacillin + Tazobactum, Inj. Doxycycline & Syp. Azithromycin	2
	Tab. Cefotaxime	1
	Total	19
13-14 Years	Inj. Ceftriaxone	1
	Inj. Cefotaxime	1
	Inj. Cefoperazone & Inj. Amikacin	1
	Total	3
	Grand Total	**150**

Table 5: Distribution according to antibiotics based on age group.

age group between 13 to 14 years with the frequency of 3.Similar findings were found in the study conducted [32]. Prescribing patterns of antibiotics in pediatrics for respiratory tract infections/disorders in tertiary care hospital. In this study the highest age distribution was seen in the age group between 1-6 yrs which were similar to the findings with our study.

Class of antibiotics distributed

As per the Table 6 and Figure 4, the maximum number of class of antibiotics prescribed were 3rd generation cephalosporin with a frequency of 61 accounting for 40.7%. It was found to be low in the combination of 1st generation cephalosporin with fusidane class, combination of two 2nd generation cephalosporin, combination of 2nd generation cephalosporin with aminoglycosides, combination of 3rd generation cephalosporins with macrolides, combination of Fluoroquinolones with 3rd generation Cephalosporin, Aminoglycosides, combination of Aminoglycoside with Oxazolidinones, combination of Fluoroquinolones with Penicillin Group, combination of 1st generation Cephalosporin & Fluoroquinolones, Antifungal Agents, Antineoplastic

Class of antibiotics	Frequency	Percent
1st Gen. Cephalosporin	3	2.0
1st Gen. Cephalosporin & Fusidane Class	1	.7
2nd Gen. Cephalosporin	3	2.0
2nd Gen. & 3rd Gen. Cephalosporin	2	1.3
2nd Gen. & 2nd Gen. Cephalosporin	1	.7
2nd Gen. Cephalosporin & Aminoglycoside	1	.7
3rd Gen. Cephalosporin	61	40.7
3rd Gen. & 3rd Gen. Cephalosporin	12	8.0
3rd Gen. & 1st Gen. Cephalosporin	2	1.3
3rd Gen. Cephalosporin & Aminoglycoside	14	9.3
3rd Gen. Cephalosporin & Macrolide	1	.7
3rd Gen. & 2nd Gen. Cephalosporin	3	2.0
3rd Gen. Cephalosporin & Penicillin Group	3	2.0
3rd. Cephalosporin, Fluoroquinolones & 3rd Gen. Cephalosporin	1	.7
Aminoglycoside	1	.7
Aminoglycoside & Oxazolidinones	1	.7
Aminoglycoside & Fluoroquinolones	4	2.7
Fluoroquinolones	2	1.3
Fluoroquinolones & Penicillin Group	1	.7
1st Gen. Cephalosporin & Fluoroquinolones	1	.7
Antifungal Agent	1	.7
Antineoplastic Antibiotic	1	.7
Fusidane Class	1	.7
Glycopeptide & Oxazolidinones	2	1.3
Glycopeptide	1	.7
Penicillin Group	17	11.3
Penicillin Group & Aminoglycoside	2	1.3
Penicillin Group & Macrolide	2	1.3
Penicillin group & 3rd Gen. Cephalosporin	1	.7
Tetracycline & 3rd Gen. Cephalosporin	1	.7
Lincosamide, Aminoglycoside & 1st Gen. Cephalosporin	1	.7
Polypeptide & 3rd Gen. Cephalosporin	1	.7
Macrolide, Tetracycline & Glycopeptide	1	.7
Total	**150**	**100.0**

Table 6: Distribution according to class of antibiotics.

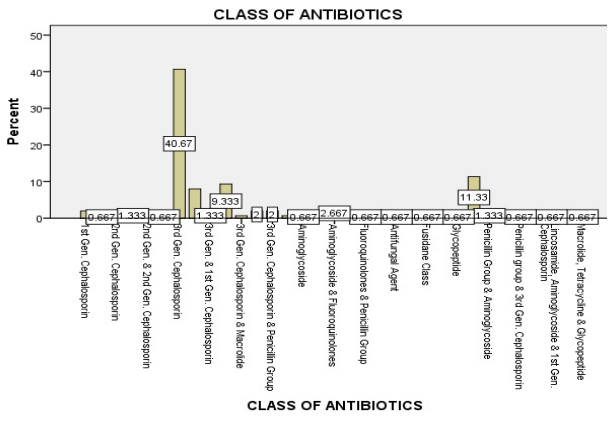

Figure 4: Statistical analysis of distribution according to class of antibiotics.

Antibiotics, Fusidane Class, Glycopeptide antibiotics, combination of Penicillin group with 3rd generation Cephalosporins, combination of Tetracycline with 3rd generation Cephalosporin, Lincosamide, combination of Aminoglycoside with 1st generation Cephalosporin, combination of Polypeptide with 3rd generation Cephalosporin, Macrolide antibiotics, combination of Tetracycline with Glycopeptide antibiotics with a frequency of 1 accounting for 0.7% respectively. Similar findings were found in the study conducted on antibiotic prescribing among pediatric in-patients with potential infections in two private sector hospitals in central India. In this study broad spectrum antibiotics were the most commonly prescribed antibiotic class in their study namely 3rd generation cephalosporins with J01DD (69%) [33].

Total cost based on prescribed antibiotics

As per the Table 7, total cost based on prescribed antibiotics was performed statically. In a monotherapy, inj ceftriaxone was found to be the costliest drug with total cost of Rs. 10568.05. The least costliest drugs were inj penicillin with total cost of Rs. 43.2. In a combinational therapy, inj piperacillin + Tazobactum, inj Doxycycline and syp Azithromycin was found to be the costliest drug with Rs. 31,127.92. the least costliest drugs were Beclomethasone + clotrimazole with Rs. 49.25. Similar studies were found in the study conducted on pharmacoeconomical analysis of rational use of antibiotics for treatment of childhood pneumonia [34]. In this study the cost of treatment course with ceftriaxone for one pediatric patient is $7.15 which is comparatively higher than other prescribed drugs like cefazolin ($ 6.15).

Antibiotic class and antibiotics prescribed

As per the Table 8, distribution of sample according to class of antibiotics and antibiotics prescribed were studied. The maximum prescribed class of antibiotics were found to be 3rd generation cephalosporin in which the most prescribed antibiotics were inj ceftriaxone and the least prescribed antibiotics were syp ceftriaxone, syp cefotaxime and tab ceftriaxone [35]. The least prescribed antibiotics were found to be inj amikacin and ceftriaxone of 2nd generation cephalosporin and aminoglycosides followed by syp azithromycin, inj cefotaxime and inj amoxicillin, inj moxifloxacin + ketorolac of macrolide, 3rd generation cephalosporin and penicillin group, Fluoroquinolones respectively. Similar findings were found in the study conducted on prescribing pattern of antibiotics in pediatric hospital in Chitwan district in Nepal. They state that third generation cephalosporin; ceftriaxone (49.3%) was the leading antibiotic prescribed.

Drug interactions with antibiotics based on severity

As per the Table 9 and Figure 5,the drug interaction with antibiotics based on severity were analyzed statically. The result shows 5 major interaction with the antibiotics prescribed including ondansetron and doxycycline as an interacting drugs [36]. Similar findings were found in the study conducted on prescribing pattern of antibiotics in a pediatric out-patient department in a tertiary care teaching and non-teaching hospital published in Indian Journal of pharmacy practice. In this study the interaction with antibiotics was found to be around 85%.

Frequency including both monotherapy and combination therapy

As per the Table 10 and Figure 6, Sample distribution according to frequency was studied and it shows that the monotherapy of BD is more with frequency of 68 with 45.3% and monotherapy of SOS is less

ANTIBIOTICS	TOTAL COST	TOTAL	
Beclomethasone + Clotrimazole	49.25	1	49.25
	Total	1	49.25
Inj. Amikacin	92.52	1	92.52
	Total	1	92.52
Inj. Amikacin & Inj. Linezolid	168 & 3790	1	3958
	Total	1	3958
Inj. Amikacin & Inj. Ofloxacin	37.12 & 40.96	1	78.08
	47.88 & 30.84	1	78.72
	72 & 769.44	1	841.44
	80 & 31	1	111
	Total	4	1108.72
Inj. Amikacin & Ceftriaxone	1260 & 320	1	1580
	1457.4 & 576	1	2033.4
	164.64 & 72	1	236.64
	18.64 & 51.1	1	69.74
	201.36 & 123.36	1	324.96
	201.36 & 48	1	249.36
	439 & 120	1	559
	45.12 & 193.8	1	238.92
	526.8 & 144	1	536.814
	992 & 96	1	1088
	Total	10	6357.834
Inj. Amoxicillin & Clavulanic Acid	102	2	204
	136	1	136
	274.8	1	274.8
	294	1	294
	362.25	1	362.25
	383.44	1	383.44
	384.72	1	384.72
	464.13	1	464.13
	478.4	1	478.4
	687	1	687
	717.6	1	717.6
	862.74	1	862.74
	96	1	96
	Total	14	5249.08
Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	100.32 & 201.36	1	301.68
	204 & 288	1	492
	2748 & 180.48	1	2928.48
	343.5 & 120.46	1	463.96
	Total	4	4186.12
Inj. Cefixime	38.4	1	38.4
	53.4	1	53.4
	71.2	1	71.2
	8.9	2	17.8
	Total	5	180.8
Inj. Cefixime & Inj. Cefuroxime	35.6 & 2025	1	2060.6
	468.16, 215.88 & 224.28	1	908.32
	86.32 & 536	1	622.32
	Total	3	3591.24

Inj. Ceftriaxone	110	1	110
	114.09	1	114.09
	118.12	2	236.24
	124	1	124
	153	1	153
	176	1	176
	176.6	1	176.6
	177.18	1	177.18
	201.36	1	201.36
	233.04	1	233.04
	250	1	250
	263.4	4	1053.6
	264.19	1	264.19
	264.9	1	264.9
	274.4	1	274.4
	285.2	1	285.2
	295.3	1	295.3
	302.04	2	604.08
	31.8	1	31.8
	330	2	660
	353.2	1	353.2
	364.35	1	364.35
	384.72	1	384.72
	395.1	1	395.1
	441.5	1	441.5
	503.4	1	503.4
	620	1	620
	63.6	1	63.6
	744	1	744
	Total	35	10568.05
Inj. Ceftriaxone & Syp. Cefixime	100.68 & 89.54	1	190.22
	109.76 & 89	1	198.76
	1240 & 87.76	1	1327.76
	263.4 & 155.48	1	418.88
	264.9 & 62.69	1	327.59
	353.2 & 62.69	1	415.89
	440 & 51.84	1	491.84
	55.50 & 330	1	385.5
	Total	8	3756.44
Inj. Ceftriaxone & Syp. Cephalexin	57.6 & 110	1	167.6
	Total	1	167.6
Inj. Ceftriaxone & Syp. Azithromycin	364.35 & 66	1	430.35
	Total	1	430.35
Inj. Ceftriaxone, Inj. Ofloxacin & Inj. Cefotaxime	219.5, 46.4 & 440	1	705.9
	Total	1	705.9
Inj. Ceftriaxone & Inj. Cefpodoxime	201.4 & 201.36	1	402.76
	263.4 & 104	1	367.4
	264.9 & 62.4	1	327.3
	Total	3	1097.46
Inj. Ceftriaxone & Inj. Amoxicillin + Clavulanic Acid	1214.5 & 170	1	1384.5
	1240 & 169.7	1	1409.7
	Total	2	2794.2
Inj. Cetriaxone & Syp. Cefuroxime	176.6 & 135	1	311.6
	Total	1	311.6
Inj. Cetriaxone & Inj. Gentamycin	168 & 120	1	288
	940.86 & 190.8	1	1131.66
	Total	2	1419.66

Inj. Cefotaxime	116.52	1	116.52
	174.78	1	174.78
	177.36	1	177.36
	223.04	1	223.04
	267.52	1	267.52
	401.28	1	401.28
	65.6	1	65.6
	68	1	68
	Total	8	1494.1
Inj. Cefotaxime & Syp. Cephalexin	204 & 58	1	262
	Total	1	262
Inj. Cefuroxime	1340	1	1340
	536	1	536
	Total	2	1876
Inj. Cefuroxime & Syp. Cefuroxime + Clavulanic Acid	190 & 68	1	258
	Total	1	258
Inj. Cefuroxime & Syp. Cefpodoxime	68.8 & 134	1	202.8
	Total	1	202.8
Inj. Cefuroxime & Tab. Cefpodoxime	536 & 378	1	914
	Total	1	914
Inj. Cefpodoxime	263.4	1	263.4
	55.2	1	55.2
	Total	2	318.6
Inj. Cefpodoxime, Syp. Moxifloxacin & Syp. Cefixime	1000, 53.17 & 96.5	1	1149.67
	Total	1	1149.67
Inj. Cefoperazone & Inj. Amikacin	240 & 61.68	1	301.68
	4340 & 168	1	4508
	4386.08	1	4386.08
	832 & 120	1	952
	Total	4	10147.76
Cephalexin Drop	10.4	1	10.4
	1785 & 72	1	1857
	30	1	30
	81	1	81
	Total	4	1978.4
Fusidic Acid Ointment	52.47	1	52.47
	Total	1	52.47
Inj. Cefotaxime & Inj. Amoxicillin	200.64 & 90	1	290.64
	Total	1	290.64
Inj. Clindamycin & Inj. Amikacin	1062, 123.36 & 1650	1	2835.36
	Total	1	2835.36
Inj. Doxycycline & Inj. Ceftriaxone	399 & 58.26	1	457.26
	940.86	1	940.86
	Total	2	1398.12
Inj. Moxifloxacin + Ketorolac	98.72	1	98.72
	Total	1	98.72
Inj. Moxifloxacin & Inj. Amoxicillin + Clavulanic Acid	380 & 74.04	1	454.04
	Total	1	454.04
Inj. Penicillin	43.2	1	43.2
	Total	1	43.2
Inj. Piperacillin + Tazobactum	1218	1	1218
	Total	1	1218
Inj. Piperacillin + Tazobactum, Inj. Doxycycline & Syp. Azithromycin	1634.4, 2400 & 45.10	1	4079.5
	171.5, 136.92 & 26740	1	27048.42
	Total	2	31127.92
Inj. Vancomycin	552	1	552
	Total	1	552

Inj. Vancomycin & Syp. Linezolid	361 & 290	1	651
	544.92 & 61	1	605.92
	Total	2	1256.92
Inj. Tazobactum	6415	1	6415
	Total	1	6415
Moxifloxacin Drop	246	1	246
	Total	1	246
Moxifloxacin Ointment	24.68 & 64.12	1	88.8
	Total	1	88.8
Syp. Cefixime	44	1	44
	44.4	1	44.4
	57	1	57
	Total	3	145.4
Syp. Ceftriaxone	121.45	1	121.45
	Total	1	121.45
Syp. Cefotaxime	34	1	34
	55.5	1	55.5
	Total	2	89.5
Syp. Cefpodoxime	64	1	64
	Total	1	64
Syp. Cefprozil	124	1	124
	Total	1	124
Tab. Ceftriaxone	236.24	1	236.24
	Total	1	17.8
Tab. Cefotaxime	17.8	1	89
	89	1	106.8
	Total	2	
	Total	**150**	

Table 7: Analysis of total cost based on prescribed antibiotics**.**

Class of antibiotics	Antibiotics	Total
1st Gen. Cephalosporin	Cephalexin Drop	3
	Total	3
1st Gen. Cephalosporin & Fusidane Class	Cephalexin Drop	1
	Total	1
2nd Gen. Cephalosporin	Inj. Cefuroxime	2
	Syp. Cefprozil	1
	Total	3
2nd Gen. & 3rd Gen. Cephalosporin	Inj. Cefuroxime & Syp. Cefpodoxime	1
	Inj. Cefuroxime & Tab. Cefpodoxime	1
	Total	2
2nd Gen. & 2nd Gen. Cephalosporin	Inj. Cefuroxime & Syp. Cefuroxime + Clavulanic Acid	1
	Total	1
2nd Gen. Cephalosporin & Aminoglycoside	Inj. Amikacin & Ceftriaxone	1
	Total	1
3rd Gen. Cephalosporin	Inj. Cefixime	5
	Inj. Ceftriaxone	35
	Inj. Cefotaxime	8
	Inj. Cefpodoxime	2
	Inj. Cefoperazone & Inj. Amikacin	1
	Syp. Cefixime	3
	Syp. Ceftriaxone	1
	Syp. Cefotaxime	2
	Syp. Cefpodoxime	1
	Tab. Ceftriaxone	1
	Tab. Cefotaxime	2
	Total	61
3rd Gen. & 3rd Gen. Cephalosporin	Inj. Ceftriaxone & Syp. Cefixime	8
	Inj. Ceftriaxone & Inj. Cefpodoxime	3
	Inj. Cefpodoxime, Syp. Moxifloxacin & Syp. Cefixime	1
	Total	12
3rd Gen. & 1st Gen. Cephalosporin	Inj. Ceftriaxone & Syp. Cephalexin	1
	Inj. Cefotaxime & Syp. Cephalexin	1
	Total	2
3rd Gen. Cephalosporin & Aminoglycoside	Inj. Amikacin & Ceftriaxone	9
	Inj. Cefixime & Inj. Cefuroxime	1
	Inj. Cetriaxone & Inj. Gentamycin	1
	Inj. Cefoperazone & Inj. Amikacin	3
	Total	14
3rd Gen. Cephalosporin & Macrolide	Inj. Ceftriaxone & Syp. Azithromycin	1
	Total	1
3rd Gen. & 2nd Gen. Cephalosporin	Inj. Cefixime & Inj. Cefuroxime	2
	Inj. Cetriaxone & Syp. Cefuroxime	1
	Total	3
3rd Gen. Cephalosporin & Penicillin Group	Inj. Ceftriaxone & Inj. Amoxicillin + Clavulanic Acid	2
	Inj. Cefotaxime & Inj. Amoxicillin	1
	Total	3
3rd. Cephalosporin, Fluoroquinolones & 3rd Gen. Cephalosporin	Inj. Ceftriaxone, Inj. Ofloxacin & Inj. Cefotaxime	1
	Total	1
Aminoglycoside	Inj. Amikacin	1
	Total	1
Aminoglycoside & Oxazolidinones	Inj. Amikacin & Inj. Linezolid	1
	Total	1
Aminoglycoside & Fluoroquinolones	Inj. Amikacin & Inj. Ofloxacin	4
	Total	4
Fluoroquinolones	Inj. Moxifloxacin + Ketorolac	1
	Moxifloxacin Drop	1
	Total	2
Fluoroquinolones & Penicillin Group	Inj. Moxifloxacin & Inj. Amoxicillin + Clavulanic Acid	1
	Total	1
1st Gen. Cephalosporin & Fluoroquinolones	Moxifloxacin Ointment	1
	Total	1
Antifungal Agent	Beclomethasone + Clotrimazole	1
	Total	1
Antineoplastic Antibiotic	Inj. Doxycycline & Inj. Ceftriaxone	1
	Total	1
Fusidane Class	Fusidic Acid Ointment	1
	Total	1
Glycopeptide & Oxazolidinones	Inj. Vancomycin & Syp. Linezolid	2
	Total	2

Glycopeptide	Inj. Vancomycin	1
	Total	1
Penicillin Group	Inj. Amoxicillin & Clavulanic Acid	14
	Inj. Penicillin	1
	Inj. Piperacillin + Tazobactum	1
	Inj. Tazobactum	1
	Total	17
Penicillin Group & Aminoglycoside	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	2
	Total	2
Penicillin Group & Macrolide	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	1
	Inj. Piperacillin + Tazobactum, Inj. Doxycycline & Syp. Azithromycin	1
	Total	2
Penicillin group & 3rd Gen. Cephalosporin	Inj. Amoxicillin + Clavulanic Aicd & Inj. Amikacin	1
	Total	1
Tetracycline & 3rd Gen. Cephalosporin	Inj. Doxycycline & Inj. Ceftriaxone	1
	Total	1
Lincosamide, Aminoglycoside & 1st Gen. Cephalosporin	Inj. Clindamycin & Inj. Amikacin	1
	Total	1
Polypeptide & 3rd Gen. Cephalosporin	Inj. Cetriaxone & Inj. Gentamycin	1
	Total	1
Macrolide, Tetracycline & Glycopeptide	Inj. Piperacillin + Tazobactum, Inj. Doxycycline & Syp. Azithromycin	1
	Total	1
	Total	**150**

Table 8: Distribution of sample according to class of antibiotics and antibiotics prescribed.

Severity	Interacting drug		Total
	Ondansetron	Doxycycline	
Major	4	1	5
	100.0%	100.0%	100.0%
Total	**4**	**1**	**5**
	100.0%	**100.0%**	**100.0%**

Table 9: Drug interaction with antibiotics based on severity.

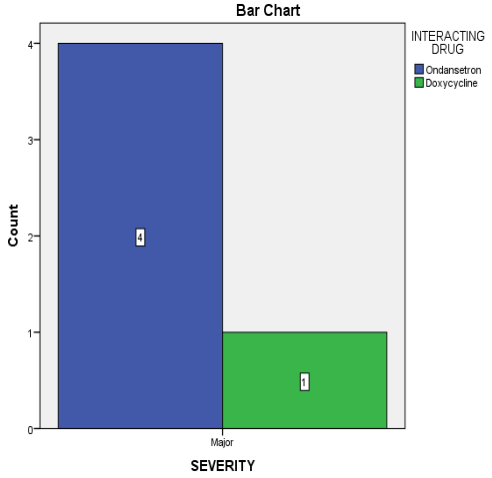

Figure 5: Drug interaction with antibiotics based on severity.

Frequency	Frequency	Percent
ATD	2	1.3
BD	68	45.3
BD & BD	20	13.3
BD & OD	12	8.0
BD & TID	2	1.3
BD, OD & TID	1	.7
BD & QID	2	1.3
BD, BD, & TID	1	.7
OD	9	6.0
OD & OD	3	2.0
OD & TID	4	2.7
OD & BD	5	3.3
OD, BD & BD	1	.7
QID	2	1.3
QID, BD & OD	1	.7
OD, OD & BD	1	.7
TID	11	7.3
TID & TID	1	.7
TID, OD & BD	1	.7
TID & BD	2	1.3
SOS	1	.7
Total	**150**	**100.0**

Table 10: Sample distribution according to combination of antibiotics prescribed.

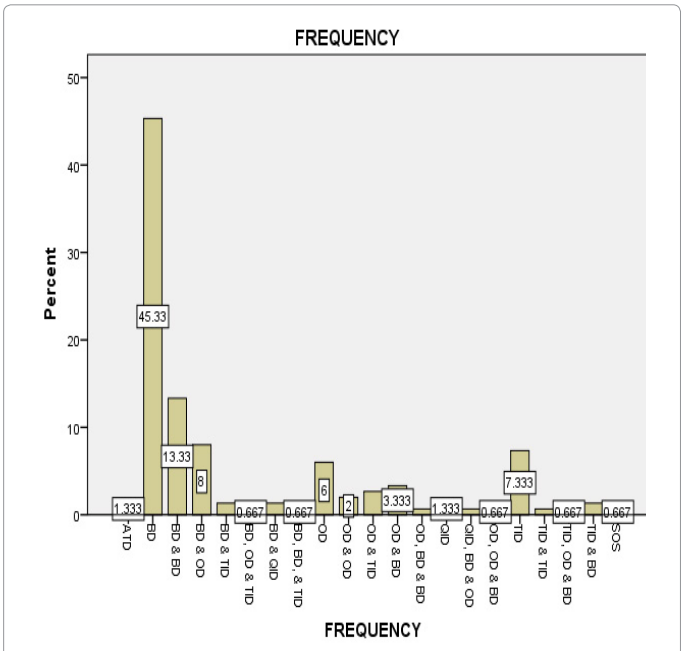

Figure 6: Sample distribution according to frequency.

with frequency of 1 with 0.7%. Whereas in case of combined frequency, BD and BD therapy is more with a frequency of 20 accounting for 13.3% and less in BD,OD and TID, BD, BD and TID, OD,BD and BD, QID, BD and OD, OD, OD and BD, TID and TID, TID, OD and BID with the frequency of 1 accounting for 1% respectively [37].

Duration of prescribed antibiotics distribution

As per the Table 11 and Figure 7, sample distribution according to duration of prescribed antibiotics were studied. The highest prescribed

Prescribed duration	Frequency	Percent
1 Day	23	10.6
2 Days	43	19.9
3 Days	57	26.4
4 Days	35	16.2
5 Days	34	15.7
6 Days	10	4.6
7 Days	13	6.0
13 Days	1	0.5
Total	**216**	**100.0**

Table 11: Sample distribution according to duration of prescribed antibiotics.

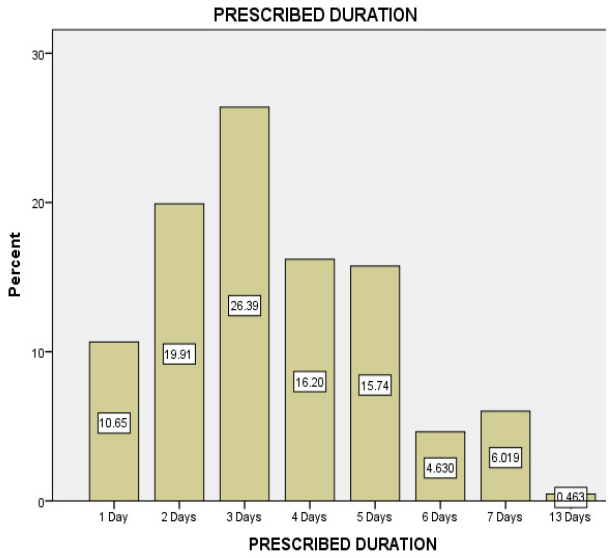

Figure 7: Sample distribution according to duration of prescribed antibiotics.

duration were 3 days with a frequency of 57 accounting for 26.4%. The least prescribed duration were 13 days with a frequency of 1 accounting for 0.5%. Similar findings were found in the study conducted on antibiotic prescribing patterns in the pediatric emergency department at George town public hospital corporation. In this study the most prescribed duration for antibiotics was found to be 3.53 days which were similar to our study [38].

Antibiotics with interaction of drug

As per the Table 12 and Figure 8, the frequent interacting drug was found to be Ondansetron with the frequency of 1 accounting for 25% respectively. Similar findings were found in the study conducted on prescribing pattern of antibiotics in a pediatric out-patient department in a tertiary care teaching and non-teaching hospital published in Indian Journal of pharmacy practice. In this study the interactions with antibiotics accounting for 85% and found to be interacted with ceftriaxone, cefotaxime, azithromycin [39].

Frequency of antibiotics prescribed in monotherapy

As per the Table 13 and Figure 9, In patients prescribed as monotherapy, the distribution according to frequency of prescribed antibiotics were found to be more in patients with BD therapy with the frequency of 141 accounting for 65.3% and least in patients with ATD and SOS therapy with the frequency of 2 accounting for 0.9% [40].

Antibiotics	Interacting drug	Total
	Ondansetron	
Inj. Amikacin & Inj. Ofloxacin	1	1
	25.00%	25.00%
Inj. Ceftriaxone, Inj. Ofloxacin & Inj. Cefotaxime	1	1
	25.00%	25.00%
Inj. Moxifloxacin & Inj. Amoxicillin + Clavulanic Acid	1	1
	25.00%	25.00%
Inj. Piperacillin + Tazobactum, Inj. Doxycycline & Syp. Azithromycin	1	1
Total	**4 100%**	**4 100%**

Table 12: Distribution of antibiotics with interacting drugs.

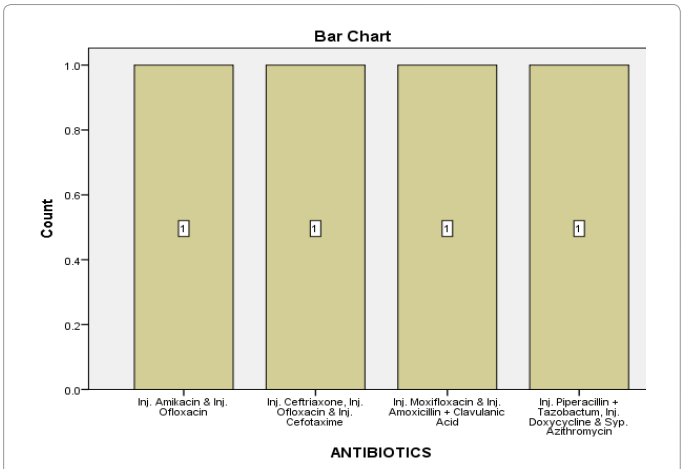

Figure 8: Distribution of antibiotics with interacting drugs.

Frequency	Frequency	Percent
ATD	2	.9
BD	141	65.3
OD	44	20.4
QID	3	1.4
SOS	2	.9
TID	20	9.3
TDS	4	1.9
Total	**216**	**100.0**

Table 13: Distribution according to frequency of prescribed antibiotics of monofrequency.

Conclusion

The total patients included in the study were 150, among which number of male and female patients were found to be 94 and 56 accounting for 62.67% and 37.33% respectively. The age distribution of patients was studied from the day of birth to14 yrs in which the highest and lowest age distribution were found in the age group between 1-5 yrs and 13-14 yrs with frequency of 51 and 3 patients accounting for 34% and 2% respectively of the total study as the age group between 1-5 years of children have variable pharmacokinetic parameter along with weak developed organs [41]. Based on final diagnosis, the maximum number of antibiotics prescribed was found to be in acute gastroenteritis in which total 17 antibiotics were prescribed and the least number of antibiotics were prescribed to acute appendicitis, acute appendicitis with obscess, acute bacillary dysentery, acute laryngo tonsillitis with gastritis, acute left pyelonephritis, acute pharyngitis, displaced radius, jaundice, gonu valgum, grade 4 adenoid hypertrophy, Hodgkins lymphoma, hand foot mouth disease, osteofibrous dysplaria and proximal penile,

pypopadias with chordac in which only one antibiotics were prescribed respectively. The maximum number of class of antibiotics prescribed were 3rd generation cephalosporin with a frequency of 61 accounting for 40.7%. It was found to be low in the combination of 1st generation cephalosporin with fusidane class, combination of two 2nd generation cephalosporin, combination of 2nd generation cephalosporin with aminoglycosides, combination of 3rd generation cephalosporins with macrolides, combination of Fluoroquinolones with 3rd generation Cephalosporin, Aminoglycosides, combination of Aminoglycoside with Oxazolidinones, combination of Fluoroquinolones with Penicillin Group, combination of 1st generation Cephalosporin & Fluoroquinolones, Antifungal Agents, Antineoplastic Antibiotics, Fusidane Class, Glycopeptide antibiotics, combination of Penicillin group with 3rd generation Cephalosporins, combination of Tetracycline with 3rd generation Cephalosporin, Lincosamide, combination of Aminoglycoside with 1st generation Cephalosporin, combination of Polypeptide with 3rd generation Cephalosporin, Macrolide antibiotics, combination of Tetracycline with Glycopeptide antibiotics with a frequency of 1 accounting for 0.7% respectively [42]. In a monotherapy, inj ceftriaxone was found to be the costliest drug with total cost of Rs. 10568.05 and the least costliest drugs were inj penicillin with total cost of Rs. 43.2. In a combinational therapy, inj piperacillin + Tazobactum, inj Doxycycline and syp Azithromycin were found to be the costliest drug with total cost of Rs. 31,127.92 and the least costliest drug was Beclomethasone + clotrimazole with total cost of Rs. 49.25. The maximum prescribed class of antibiotics were found to be 3rd generation cephalosporin in which the most prescribed antibiotics was Inj. ceftriaxone and the least prescribed antibiotics were syp ceftriaxone, syp cefotaxime and tab ceftriaxone. The least prescribed class of antibiotics were found to be 2nd generation cephalosporin and aminoglycosides which include inj amikacin and ceftriaxone respectively followed by syp azithromycin, inj cefotaxime and inj amoxicillin, inj moxifloxacin + ketorolac of antibiotic classes macrolide, 3rd generation cephalosporin and penicillin group, Fluoroquinolones respectively. The study shows that the monotherapy of BD was more with frequency of 68 with 45.3% and monotherapy of SOS was less with frequency of 1 with 0.7% [43]. Whereas in case of combined frequency, BD and BD therapy was more with a frequency of 20 accounting for 13.3% and less in BD,OD and TID, BD, BD and TID, OD,BD and BD, QID, BD and OD, OD, OD and BD, TID and TID, TID, OD and BID with the frequency of 1 accounting for 1% respectively. The highest prescribed duration were 3 days with a frequency of 57 accounting for 26.4%. The least prescribed duration were 13 days with a frequency of 1 accounting for 0.5%. The study shows 4 major interactions with the antibiotics prescribed including ondansetron and doxycycline as an interacting drugs in which ondansetron was found to be more frequent [44]. Thus, those antibiotics should be avoided or used with caution. In patients prescribed as monofrequency, the distribution according to frequency of prescribed antibiotics were found to be more in patients with BD therapy with the frequency of 141 accounting for 65.3% and least in patients with ATD and SOS therapy with the frequency of 2 accounting for 0.9%. Hence, this represents Pediatrics were more frequently prescribed with antibiotics given twice a day as those antibiotics were most effective in the treatment of diagnosed diseases.

Summary

This was a prospective and observational study based on utilization of antibiotics in pediatric patient carried out for 6 months in Pediatric department. The general objective was to study the utilization of antibiotics in Pediatric patients. Main purpose of the study was to study the age distribution of study population, to assess the prescribing pattern of antibiotic, evaluate the cost analysis of prescribed antibiotics and assess and evaluate the severity of drug interaction. Among 150 total patients, the study shows highest sample distributed between the age group of 1-5 yrs with 51 patients (34%) which includes 29 male patients(30.9%) and 22 female patients (39.3%) and less distributed in the age group 13-14 yrs including 3 patients (2%) which contribute 2 male (2.1%) and 1 female patients (1.8%). The maximum number of class of antibiotics prescribed were 3rd generation cephalosporin with a frequency of 61 accounting for 40.7%. In a Monotherapy, Inj. ceftriaxone was found to be the costliest drug with total cost of Rs 10568.05 and the least costliest drugs were inj penicillin with total cost of Rs. 43.2. In a combinational therapy, inj piperacillin + Tazobactum, inj Doxycycline and syp Azithromycin were found to be the costliest drug with total cost of Rs. 31,127.92 and the least costliest drugs were Beclomethasone + clotrimazole with total cost of Rs. 49.25. The maximum prescribed class of antibiotics were found to be 3rd generation cephalosporin in which the most prescribed antibiotics were Inj. ceftriaxone and the least prescribed antibiotics were syp ceftriaxone, syp cefotaxime and tab ceftriaxone [45]. The least prescribed antibiotics were found to be inj amikacin and ceftriaxone of class 2nd generation cephalosporin and aminoglycosides followed by syp azithromycin, inj cefotaxime and inj amoxicillin, inj moxifloxacin+ketorolac of antibiotic classes macrolide, 3rd generation cephalosporin and penicillin group, Fluoroquinolones respectively. The study shows that the monotherapy of BD was more with frequency of 68 with 45.3% and monotherapy of SOS was less with frequency of 1 with 0.7%. Whereas in case of combined frequency, BD and BD therapy was more with a frequency of 20 accounting for 13.3% and less in BD,OD and TID, BD, BD and TID, OD,BD and BD, QID, BD and OD, OD, OD and BD, TID and TID, TID, OD and BID with the frequency of 1 accounting for 1% respectively. The highest prescribed duration were 3 days with a frequency of 57 accounting for 26.4%. The least prescribed duration were 13 days with a frequency of 1 accounting for 0.5%. The result shows 5 major interaction with the antibiotics prescribed including ondansetron and doxycycline as an interacting drugs. The frequent interacting drug was found to be ondansetron with the frequency of 1 accounting for 25% respectively. In patients prescribed as monotherapy, the distribution according to frequency of prescribed antibiotics were found to be more in patients with BD therapy with the frequency of 141 accounting for 65.3% and least in patients [46] with ATD and SOS therapy with the frequency of 2 accounting for 0.9%. The limitation of the study was that it was conducted for a short duration and the sample size included was less. The future direction was implementation and establishment of study treatment guidelines and more studies on utilization of antibiotics should be conducted. Health care systems should give more focus on least costly and more effective monotherapy antibiotics prescription. Clinical pharmacy should aim to meet this demand through the proper cost effective utilization of antibiotics training programs and improved didactic education in pharmacy school that reflects the increased need for treatment in Pediatric patients [47].

Limitations

- The study was conducted only in pediatric In-patients
- Only antibiotics agents study were conducted
- Study period was 6 months only which was very less
- Pediatric Out-patients should have been taken for study

Future Directions

- Implementation and establishment of study treatment guidelines

- More studies on utilization of antibiotics should be conducted
- If we conduct evidence based treatment, the quality of life can be provided to the patient

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