An Approach to Study and Evaluate Antibiotic Drug Use Pattern among Paediatric Patients: A Prospective Observational Drug Utilisation Study

[1]Mili Bulsari, [2]Shlok Malusare, [3]Vatsal Mehta, [4]Akash Paghadal

[1,2,3,4]*Student, Shree Dhanvantary Pharmacy College, Kim , Surat*
Corresponding Author: Dr. Shwetha Swaminath M. (Pharm.D), Dr. Alpesh Singhvi (M.D. Paediatrics)

ABSTRACT: The strategic use of antibiotics is pivotal for health outcomes and patient care quality. Contributing factors to irrational antibiotic use, such as self-medication, polypharmacy, inappropriate usage, overuse of injectables, and prescription deviations, pose a significant challenge. This surge in antibiotic consumption has led to a critical global issue—antibiotic resistance, jeopardizing our ability to combat infectious diseases. A comprehensive assessment of irrational antibiotic use is imperative. Our study aimed to evaluate antibiotic prescribing patterns using WHO indicators and Defined Daily Dose (DDD) for drug utilization under the Anatomical Therapeutic Chemical (ATC) classification. Primary objectives included assessing therapy rationality and determining differences between weight-adjusted and DDD-based drug doses. Secondary goals involved identifying infection prevalence among pediatric patients and evaluating major antibiotics for common infections. In a prospective observational study, data from 200 patients at SDA Diamond Hospital were collected over six months. Patients meeting inclusion/exclusion criteria had their data recorded in a Case Report Form (CRF), which was then assessed for variations between ATC-DDD and weight-based prescribed doses. WHO prescribing indicators were considered. Results showed 50% of admissions were inpatient, 25% outpatient, and 25% in the neonatal intensive care unit. The most prescribed antibiotics were amoxicillin with potassium clavulanate (35.29%) and azithromycin (33.33%). Among inpatients, 67% were male, with ceftriaxone (43.55%) and azithromycin (10.22%) dominating prescriptions. Neonatal intensive care unit patients, mainly aged 0–1 month, commonly received gentamicin (14.50%) and cefixime (14.50%). Polypharmacy prevailed across departments, urging further review and medical reconciliation for improved therapy quality. Establishing a comprehensive DDD-based system facilitates pediatric dosing assessments, providing a nuanced understanding of antibiotic use in children beyond traditional DDD metrics.

KEYWORDS: Drug Utilization Evaluation (DUE), Antibiotic resistance, Defined daily dose (DDD), anatomical therapeutic chemical (ATC), classification, WHO Indicators, Pediatric patients, prescribing patterns, polypharmacy, therapy quality, antibiotic consumption, infection prevalence, weight-adjusted doses, medication reconciliation.

I. INTRODUCTION:

The pediatric population, which includes children under the age of 15 years, accounts for around 25.69% of the total population in India and is considered the most vulnerable group to any kind of infection.[1] Consequently, the administration of antibiotics has become a prevalent approach in the pediatric population. The overuse of antibiotics without culture sensitivity tests can lead to antibiotic resistance, resulting in ineffective treatments and prolonged hospital stays.[2] Governmental bodies have formulated various guidelines such as the National Guidelines for Antimicrobial Use in Infectious Diseases developed by the Ministry of Health and Family Welfare, Indian Council of Medical Research (ICMR) guidelines, All India Institute of Medical Sciences (AIIMS) guidelines, and National Centre for Disease Control (NCDC) guidelines which are periodically revised and updated. These guidelines assist physicians in rationally prescribing medication.[3]

The basis of effective pediatric medical treatment is a thorough diagnosis and the appropriate course of drug therapy of antibiotics, which generally involves a drug regimen. Rational medication therapy is the first step in the regulation of the proper drug dose regimen. Drug utilization evaluation (DUE) is one such approach that helps

the researcher to evaluate and analyze the rationality of the therapy.

Drug utilization research was defined by WHO in 1977 as the marketing, distribution, prescription, and use of drugs in a society, with special emphasis on the resulting medical, social, and economic consequences.[4] Numerous indicators have been evolved through the global community for the rational use of medication in collaboration with WHO which enables the evaluation of drug use practices and remedial measures. These indicators include the prescribing indicators, the patient care indicators, and the facility indicators.[5] The DUE studies mainly use the prescription indicators for appropriate review of the drugs in a hospital setting.

Prescription indicators allow the therapeutic actions taken in similar institutions to be ascertained, enabling subsequent comparison of parameters between them, evaluating the population's medication needs, and determining the most frequently used medications in a given place. These indicators allow the investigator to identify the prescription profile and quality of services offered to the population.

The core prescribing indicators suggested by the WHO are as follows:
1. The average number of drugs per encounter
2. Percentage of drugs prescribed by generic names
3. Percentage of encounters with an antibiotic prescribed
4. Percentage of encounters with an injection prescribed
5. Percentage of drugs from the Essential Drug List

Another approach is the use of WHO-ATC classification, ATC gives a unique code to all the drugs according to their Anatomic, Therapeutic, and Chemical Class, WHO has suggested a standard method for evaluating drug usage quantitatively by using the ATC/DDD index. The ATC/DDD methodology aims to serve as a tool for drug utilization studies to improve the quality of drug use.[4] Therefore, this study might assist us to monitor the prescribing pattern of antibiotics so that those may be used judiciously. This information is expected to help in an intervention that would improve the prescribing patterns and rational use of drugs in the pediatric population.

So, in the present study, prescribing patterns in the pediatric population were observed, antibiotics dosage and frequency were analyzed and daily dose was compared to the prescribed dose and variation ATC-DDD and weight accordingly adjusted dose was evaluated.

II. OBJECTIVES:
Pediatric population is one of the most vulnerable groups in patient society. In order to be rational, the therapy should be safe, efficacious and affordable and drug utilization studies are tools to facilitate rational prescribing of drugs. The current study was designed with the objective of assessing drug utilization in the pediatric department, to apply the WHO core indicators and to assess the appropriateness of prescribed medicines in a pediatric unit.

1. PRIMARY OBJECTIVES :
● To assess the rationality of therapy.
● To ascertain the difference between weight-adjusted dose of medications and drug dose according to Defined Daily Dose of ATC/DDD Index.

2. SECONDARY OBJECTIVES :
● To determine the prevalence of infection among the pediatric population.
● To assess major antibiotics used to treat common infections.

III. MATERIALS AND METHOD:
STUDY DESIGN :
A prospective observational study was conducted at SDA Diamond Hospital and Medical Research Centre from October 2022 to January 2023. The ethics committee approved the study and the requirement of informed consent was waived.

STUDY DURATION :
The duration of the study was 6 months.

STUDY SUBJECTS :
A total of 200 pediatric patients were enrolled in the study.

STUDY SITE:
This study was conducted in SDA Diamond Hospital And Medical Research Centre.

INCLUSION CRITERIA:
All pediatric patients aged 0-14 years, at least on one antibiotic, born healthy and full-term patients admitted to OPD, IPD and NICU were included in the study.

EXCLUSION CRITERIA:
Patients above the age of 14 with missing prescription orders were excluded from the study. Moreover, the patients who were receiving the

treatment outside along with hospital treatment and patients born preterm were also excluded from the study. The study also excluded patients' discharge medication orders.

METHODOLOGY:

The study was conducted in accordance with ICH-GCP guidelines. Documents like the protocol and data collection forms (CRF and ICF) were presented to the ethics committee for approval of the study. The study proceeded after the ethics committee's approval.

Data was collected from respective patient files using a CRF approved by the ethics committee. Data collected included the parameters such as patient demographics, chief complaints, diagnosis, name and class of antibiotics as well as other drugs, and finally duration, dose, and frequency of the drugs prescribed. Antibiotic indications were classified as empiric, definitive, and prophylactic therapy.

The data was collected for the duration of 6 months for 200 patients fulfilling inclusion and exclusion criteria. The data from the physician validated CRF was analyzed using WHO prescribing indicators; statistical analysis was carried out by finding the mean and a percentage of various parameters and criteria on the basis of the same. Moreover, antibiotics were classified according to ATC classification, and DDD was obtained, which was compared with weight and accordingly adjusted dose was calculated to check the variation. A result was obtained, and the study was concluded. All the statistical calculations were done using MS Excel.

## IV.   RESULT AND STATISTICS:

A total of 200 samples were collected over the course of six months, from August 22 to February 23, based on inclusion and exclusion criteria. Out of the 200 samples taken, 50 (25%) were collected from the outpatient department (OPD), while the remaining 150 (75%) were collected from the inpatient department (IPD). Out of the 150 samples collected from the IPD, 50 (25%) were obtained from the NICU, while the remaining 100 (50%) were obtained from the general ward.
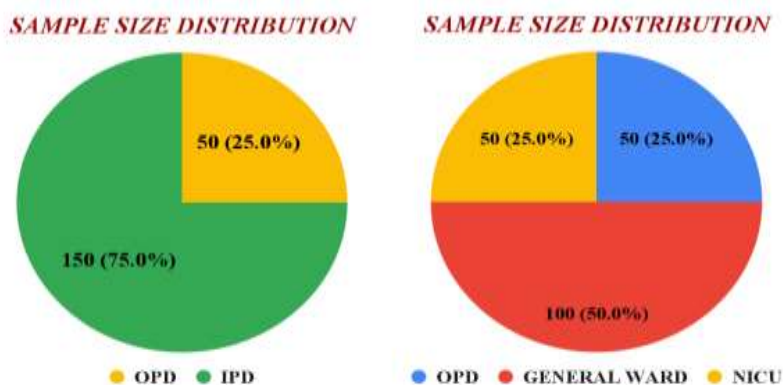
FIGURE 1: DISTRIBUTION OF SAMPLE SIZE BETWEEN OPD AND IPD (NICU AND GENERAL WARD)

1.   ANALYSIS OF THE OUTPATIENT DEPARTMENT
1.1 GENDER WISE DISTRIBUTION
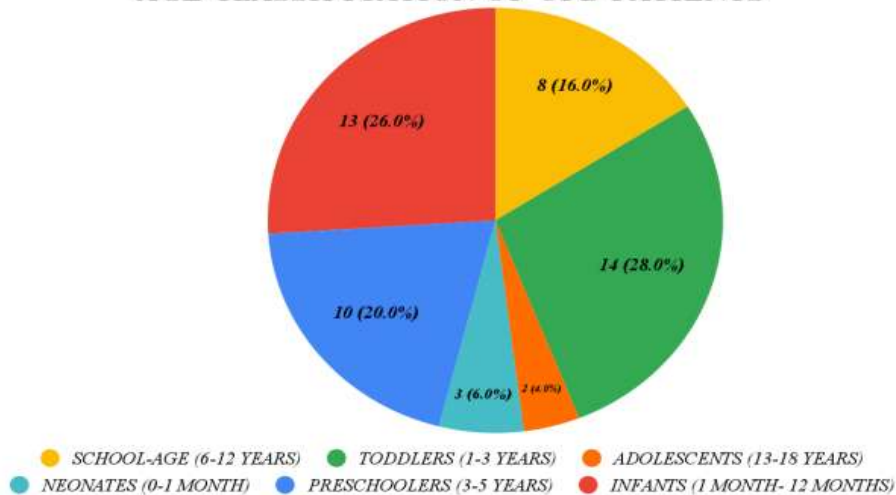
GENDER DISTRIBUTION IN OPD
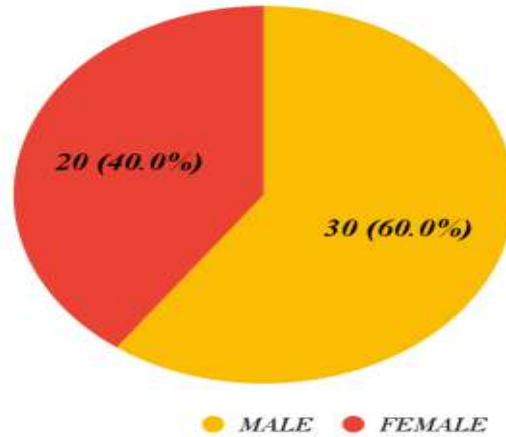
FIGURE 2: DISTRIBUTION OF GENDER (OPD)

A total of 50 outpatients were assessed for this study. The gender split among these 50 patients was 30 (60%) were male while 20 (40%) were female.

1.2 AGE WISE DISTRIBUTION IN OPD

AGE CLASSIFICATION OF OPD PATIENTS

SCHOOL-AGE (6-12 YEARS)   TODDLERS (1-3 YEARS)   ADOLESCENTS (13-18 YEARS)
NEONATES (0-1 MONTH)   PRESCHOOLERS (3-5 YEARS)   INFANTS (1 MONTH- 12 MONTHS)

FIGURE 3 : DISTRIBUTION OF OUT-PATIENTS ACCORDING TO WHO AGE

CLASSIFICATION

As presented in FIGURE 3, it was found that the most patients were Toddlers (1-3 years) i.e. 28% followed by Infants (1 month - 12 months) i.e. 26% and the least patients were Adolescents (13-18 years) i.e. 4%.

TABLE 1: AGE WISE DISTRIBUTION OF PATIENTS ACCORDING TO GENDER		
	NUMBER OF PATIENTS	AVERAGE AGE ± SEM
TOTAL	50	3.034 ± 0.473
MALE	30	2.590 ± 0.599
FEMALE	20	3.712 ± 0.762

TABLE 2: AGE WISE DISTRIBUTION OF PATIENTS ACCORDING TO WHO AGE CLASSIFICATION		
	NUMBER OF PATIENTS	AVERAGE AGE ± SEM
NEONATES	03	0.047 ± 0.020
INFANTS	13	0.506 ± 0.087
TODDLERS	14	1.642 ± 0.119
PRESCHOOLERS	10	3.625 ± 0.455
SCHOOL AGE	08	7.375 ± 0.532
ADOLESCENTS	02	13.5 ± 0.5

The mean age of outpatients was 3.034 ± 0.473 years. The mean age for male patients was 2.590 ± 0.599 years while the mean age for female patients was 3.712 ± 0.762 years as shown in TABLE 1. Moreover, the age wise distribution of patients according to WHO classification is depicted in TABLE 2 and FIGURE 4.

1.3 MAJOR COMPLAINTS IN OPD PATIENTS

Cough (26.61%) was the major complaint of the patients in the outpatient department, followed by fever (25.69%) and cold (25.69%).
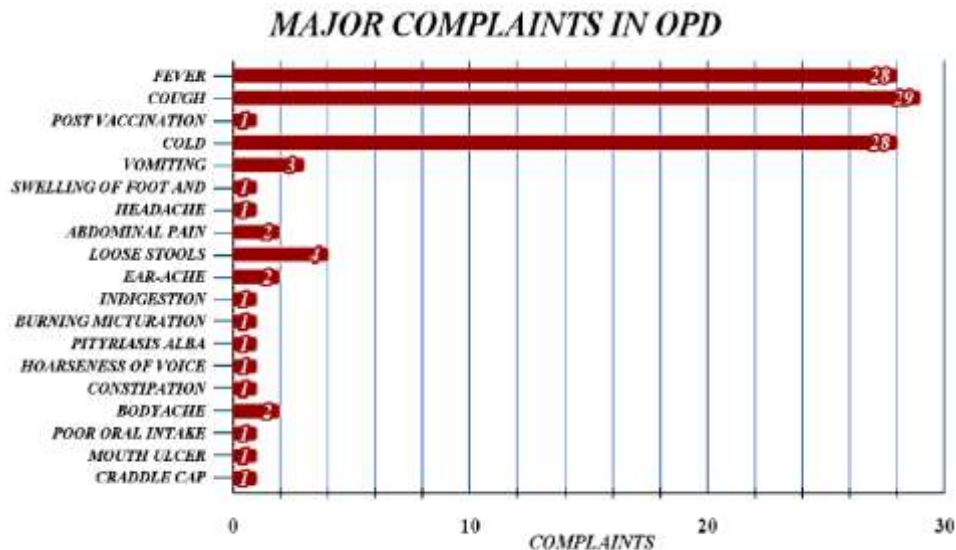

FIGURE 4: MAJOR COMPLAINTS OF PATIENTS IN OUTPATIENT DEPARTMENT

TABLE 3: MAJOR COMPLAINTS OF PATIENTS IN OUTPATIENT DEPARTMENT		
COMPLAINTS	**COUNT**	**PERCENTAGE**
COUGH	29	26.61%
FEVER	28	25.69%
COLD	28	25.69%
LOOSE STOOLS	4	3.67%
VOMITING	3	2.75%
EAR-ACHE	2	1.83%
BODYACHE	2	1.83%
ABDOMINAL PAIN	2	1.83%
SWELLING OF FOOT AND ITCHING	1	0.92%
POST VACCINATION CELLULITIS	1	0.92%
POOR ORAL INTAKE	1	0.92%
PITYRIASIS ALBA	1	0.92%
MOUTH ULCER	1	0.92%
INDIGESTION	1	0.92%
HOARSENESS OF VOICE	1	0.92%
HEADACHE	1	0.92%
CRADLE CAP	1	0.92%
CONSTIPATION	1	0.92%
BURNING MICTURITION	1	0.92%
Grand Total	109	100.00%

1.4 PRESCRIPTION ANALYSIS IN OUT-PATIENT DEPARTMENT

Out of 50 sample sizes collected from the OPD department it was found that 42.7% of the patients were prescribed with 4 drugs followed by 21.8% of the patients were prescribed with 5 drugs at a time and 20.4% of the patients were prescribed with 3 drugs at a time.
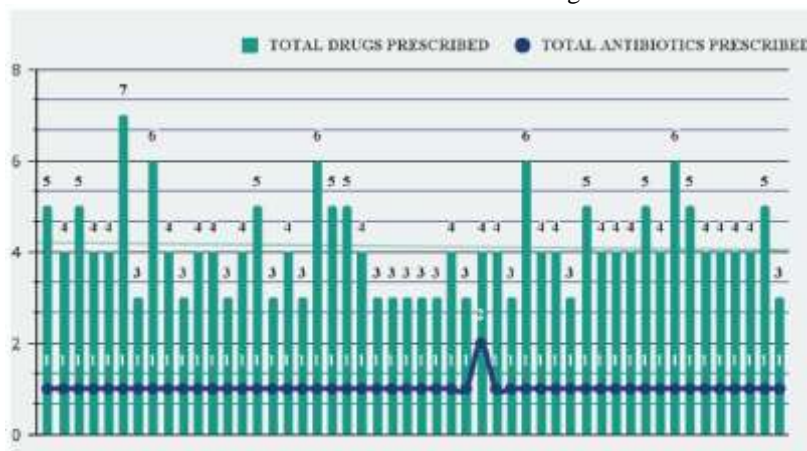
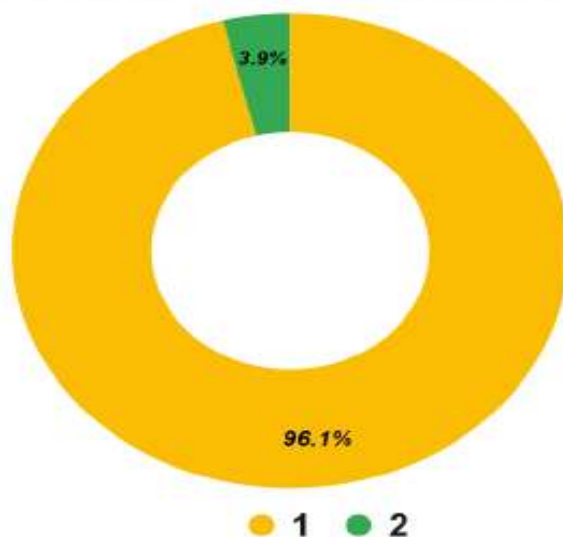FIGURE 5: TOTAL NUMBER OF DRUGS AND ANTIBIOTICS PRESCRIBED

FIGURE 6: NUMBER OF ANTIBIOTICS PRESCRIBED IN OPD

Of the 50 cases that were gathered from the OPD, it was discovered that 96.1% of the patients received one antibiotic at a time, and only 3.9% of the patients, received two antibiotics at once.

After analysing 50 prescriptions from OPD it was found that 34.4% percent of the patients were taking 3 drugs other than antibiotics at a time and 24.4% of the patients were prescribed 2 drugs at a time other than antibiotics.

1.5 ANALYSIS OF ANTIBIOTICS

In this study, combination of amoxicillin and potassium clavulanate (35.29%) and azithromycin (33.33%) were mostly prescribed, followed by cefixime and combination of cefixime and ofloxacin which were 11.76% and 7.84% respectively.

TABLE 4: ANTIBIOTICS USED IN OUT-PATIENT DEPARTMENT

GENERIC NAME	COUNT	PERCENTAGE
AMOXICILLIN AND POTASSIUM CLAVULANATE	18	35.29%
AZITHROMYCIN	17	33.33%
CEFIXIME	6	11.76%
CEFIXIME + OFLOXACIN	4	7.84%
SATRONIDAZOLE AND OFLOXACIN	2	3.92%
LEVOFLOXACIN	1	1.96%
CHLORAMPHENICOL	1	1.96%
CEFPODOXIME	1	1.96%
AMOXICILLIN	1	1.96%
Grand Total	**51**	**100.00%**

Out of 18 patients were prescribed amoxicillin and clavulanic acid. Out of which 8 patients were prescribed with AUGMENTIN 228, 5 patients with AUGMENTIN 457, 2 patients with AUGMENTIN 375 and AUGMENTIN 625 while remaining 2 patients were prescribed with AUGPEN 475 and AUGPEN 228.

Similarly, 17 Azithromycin prescribed, 8 patients (16%) were prescribed AZEE-200, 7 patients (14%) were prescribed with AZEE-100 while 1 patient (2%) was prescribed with AZEE-500 and AZEE-250.

TABLE 5: ANALYSIS OF USE OF BRANDED ANTIBIOTICS IN OUT-PATIENT DEPARTMENT		
BRAND NAME	**COUNT**	**PERCENTAGE**
AZEE 200	8	15.69%
AUGMENTIN 228	8	15.69%
AZEE 100	7	13.73%
ZIFI 100	5	9.80%
AUGMENTIN 457	5	9.80%
OFFICE 50	3	5.88%
SATROGYL-O	2	3.92%
AUGPEN 228	2	3.92%
ZIFI O	1	1.96%
ZIFI 50	1	1.96%
OPOX 100	1	1.96%
NOVAMOX	1	1.96%
LEVOFLOX	1	1.96%
CANDIBIOTIC EAR DROPS	1	1.96%
AZEE 500	1	1.96%
AZEE 250	1	1.96%
AUGPEN 475	1	1.96%

AUGMENTIN 625	1	1.96%
AUGMENTIN 375	1	1.96%
Grand Total	**51**	**100.00%**

Out of 51 antibiotics prescribed, the most commonly prescribed class was combination of penicillins and beta-lactamase inhibitors (35.29%), followed by macrolides and fluoroquinolones which were 31.37% and 13.73% respectively.

TABLE 6: ANALYSIS OF ANTIBIOTIC CLASS IN OUT-PATIENT DEPARTMENT		
CLASS	**COUNT**	**PERCENTAGE**
PENICILLINS + BETA LACTAMASE INHIBITORS	18	35.29%
MACROLIDES	16	31.37%
FLUOROQUINOLONES	7	13.73%
CEPHALOSPORINS	6	11.76%
ANTIPROTOZOAL AGENTS + FLUOROQUINOLONES	2	3.92%
PENICILLINS	1	1.96%
CHLORAMPHENICOL	1	1.96%
Grand Total	51	100.00%

The most commonly used formulation of antibiotics in the outpatient department was syrup (86.27%) followed by tablet (9.80%).

TABLE 7: ANALYSIS OF FORMULATION OF ANTIBIOTICS USED IN OUT-PATIENT DEPARTMENT		
FORMULATION	**COUNT**	**PERCENTAGE**
SYRUP	44	86.27%
TABLET	5	9.80%
ORAL SUSPENSION	1	1.96%
EAR DROPS	1	1.96%
Grand Total	**51**	**100.00%**

1.6 ANALYSIS OF OTHER DRUGS

Apart from the antibiotics prescribed, most commonly prescribed other drugs were a combination of nimesulide and paracetamol (18.12%), followed by xylometazoline (10.74%).

Out of 28 nimesulide and paracetamol combinations prescribed, 17 patients (34%) were prescribed MINIDOL-P, 9 patients (18%) were prescribed MONTINA-L KID while 5 patients were prescribed with NIMESON-P.

TABLE 8: OTHER DRUGS USED IN OUT-PATIENT DEPARTMENT		
GENERIC NAMES	**COUNT**	**PERCENTAGE**
Nimesulide + Paracetamol	28	15.38%
Xylometazoline	17	9.34%
Guaifenesin + Chlorpheniramine Maleate + Dextromethorphan Hydrobromide + Menthol	14	7.69%
Phenylephrine + Chlorpheniramine Maleate + Dextromethorphan Hydrobromide	12	6.59%
Paracetamol	10	5.49%
Levocetirizine + Montelukast	9	4.95%
Chlorpheniramine Maleate + Paracetamol + Phenylephrine + Sodium Citrate + Menthol	9	4.95%
Prednisolone	7	3.85%
Paracetamol + Chlorpheniramine Maleate & Phenylephrine Hydrochloride	7	3.85%
Sodium Ascorbate Zinc	6	3.30%
Ibuprofen + Paracetamol	6	3.30%
Ambroxol	5	2.75%
Phenylephrine + Chlorpheniramine Maleate	4	2.20%
Levosalbutamol + Ipratropium bromide + Budesonide	4	2.20%
Lactobacillus	4	2.20%
Granisetron	4	2.20%

Chlorpheniramine + Codeine	4	2.20%
Levosalbutamol + Ipratropium bromide	3	1.65%
Folic Acid	3	1.65%
Domperidone + Pantoprazole	3	1.65%
Albendazole + Ivermectin	3	1.65%
Zinc drops	2	1.10%
Vitamin A	2	1.10%
Sodium Picosulfate Liquid Paraffin + Milk of Magnesia	2	1.10%
Racecadotril sachet	2	1.10%
Naproxen	2	1.10%
Levosalbutamol + Ambroxol + Guaifenesin	2	1.10%
Hydroxyzine Hydrochloride	2	1.10%
Fexofenadine HCl + Montelukast sodium	2	1.10%
Dicyclomine Hydrochloride + Simethicone	2	1.10%
Desonide cream	2	1.10%
Grand Total	**182**	100.00%

The most commonly used formulation of other drugs in the outpatient department was syrup (64.71%) followed by tablets (15.03%) and nasal drops(10.46%).

| FORMULATION	COUNT	PERCENTAGE
TABLE 9: FORMULATION OF OTHER DRUGS USED IN OUT-PATIENT DEPARTMENT		
SYRUP	99	64.71%
TABLET	23	15.03%
NASAL DROPS	16	10.46%
NEBULISER	5	3.27%
POWDER GRANULES	3	1.96%
ORAL DROPS	3	1.96%
TOPICAL	2	1.31%
EAR DROPS	2	1.31%
Grand Total	**153**	100.00%

1.7 RATIONALITY OF DOSE
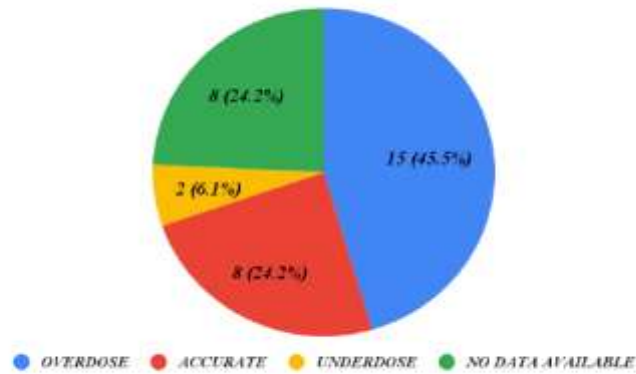
FIGURE 7 : RATIONALITY OF DOSE IN OPD ACCORDING TO DDD AND cDDD

After calculating and analysing the prescribed doses according to defined daily doses it was found that 45.5% of the patients received doses that were overdose, only 6.1% patients were underdosed while 24.2% of the patients received doses which were accurate. 24.2% data were not available according to the WHO ATC/DDD criteria.
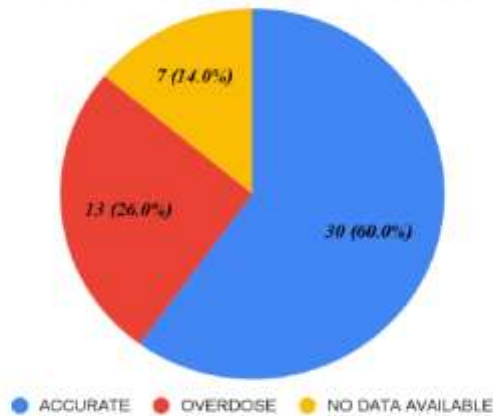
FIGURE 8: RATIONALITY OF DOSE ACCORDING TO WEIGHT OF OUT-PATIENTS

After calculating and analysing the prescribed doses according to weight it was found that 60% of the patients received doses that were accurate while 26% of the patients received doses which were overdose. Moreover, 14% patients were those whose data was not available.

**2.	ANALYSIS OF THE INPATIENT DEPARTMENT (GENERAL WARD)**
**2.1	GENDER WISE DISTRIBUTION IN GENERAL WARD**
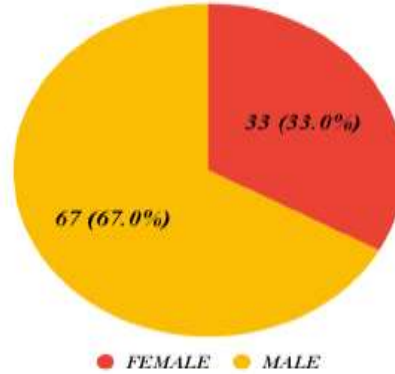
FIGURE 9: DISTRIBUTION OF GENDER (GENERAL WARD)

The study evaluated 100 outpatients in total, among which 33% were female and 67% were male patients.

2.2 AGE-WISE DISTRIBUTION IN GENERAL WARD

TABLE 10: AGE WISE DISTRIBUTION OF PATIENTS ACCORDING TO GENDER IN GENERAL WARD

	NUMBER OF PATIENTS	AVERAGE AGE ± SEM
TOTAL	100	1.846 ± 0.470
MALE	67	4.949 ± 0.583
FEMALE	33	4.919 ± 0.805

TABLE 11: AGE WISE DISTRIBUTION OF PATIENTS ACCORDING TO WHO AGE CLASSIFICATION IN GENERAL WARD

	NUMBER OF PATIENTS	AVERAGE AGE ± SEM
NEONATES	03	0.083 ± 0
INFANTS	23	0.637 ± 0.061
TODDLERS	26	1.846 ± 0.156
PRESCHOOLERS	09	4 ± 0.333
SCHOOL AGE	26	8.5 ± 0.478
ADOLESCENTS	13	13.384 ± 0.180

The mean age of inpatients was 1.846 ± 0.470 years. The mean age for male patients was 4.949 ± 0.583 years while the mean age for female patients was 4.919 ± 0.805 years as shown in TABLE 10. Moreover, the age-wise distribution of patients according to WHO classification is depicted in the TABLE 11 and FIGURE 10.

AGE CLASSIFICATION OF GENERAL WARD PATIENTS
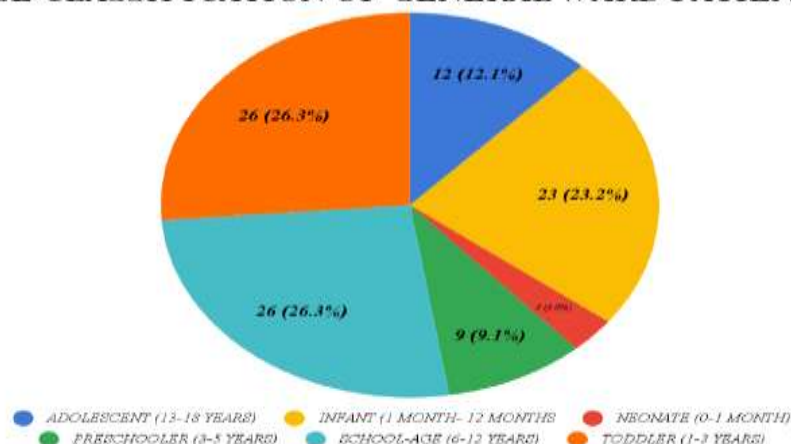
FIGURE 10 : DISTRIBUTION OF GENERAL WARD PATIENTS ACCORDING TO WHO AGE CLASSIFICATION

2.3 MAJOR COMPLAINTS IN GENERAL WARD PATIENTS

Fever (23.83%) and vomiting (13.62%) were the major complaints of the patients in the general ward, followed by cough (11.49%) and cold (10.21%). Other common complaints reported by patients in the general ward included loose stools (8.51%).

TABLE 12: MAJOR COMPLAINTS OF PATIENTS IN GENERAL WARD		
COMPLAINTS	**COUNT**	**PERCENTAGE**
FEVER	56	23.83%
VOMITING	32	13.62%
COUGH	27	11.49%
COLD	24	10.21%
LOOSE STOOLS	20	8.51%
DECREASED ORAL INTAKE	9	3.83%
EPILEPTICAL SYMPTOMS	8	3.40%
ABDOMINAL PAIN	8	3.40%
SWELLING	6	2.55%
DIFFICULTY IN MICTURITION	6	2.55%
CHILLS	5	2.13%
REDNESS	4	1.70%
NAUSEA	4	1.70%
FAST BREATHING	4	1.70%
PAIN	3	1.28%
THROAT CONGESTION	2	0.85%
RASHES	2	0.85%
NECK SWELLING	2	0.85%
CHEST PAIN	2	0.85%
BACKACHE	2	0.85%
YELLOWISH URINE	1	0.43%
WEAKNESS	1	0.43%
INCONTINENCE OF URINE SINCE BIRTH	1	0.43%
ICTERUS	1	0.43%
HEADACHE	1	0.43%
FLANK PAIN	1	0.43%
FACIAL PUFFINESS	1	0.43%

DIFFICULTY IN MOVEMENT	1	0.43%
BURNING MICTURITION	1	0.43%
Grand Total	**235**	**100.00%**

2.4 DIAGNOSIS OF PATIENTS IN GENERAL WARD

Out of the 100 samples collected in the general ward, 22 (22%) patients were diagnosed with AGE, followed by LRTI 13 (13%) and viral fever 7 (7%). There were also patients with rare diseases such as acute lymphoblastic leukaemia 1 (1%). It was also found that the most prevalent infection was AGE.

TABLE 13: DIAGNOSIS OF PATIENTS IN GENERAL WARD		
DIAGNOSIS	**COUNT**	**PERCENTAGE**
AGE	22	22.00%
LRTI	13	13.00%
VIRAL FEVER	7	7.00%
URTI	6	6.00%
PHIMOSIS	5	5.00%
HEPATITIS A	4	4.00%
TYPHOID	3	3.00%
FEBRILE SEIZURES	3	3.00%
ACUTE SEPSIS	3	3.00%
UTI	2	2.00%
TONSILLITIS	2	2.00%
GASTROENTERITIS	2	2.00%
FALL DOWN	2	2.00%
ENTERIC FEVER	2	2.00%
STATUS EPILEPTICUS	1	1.00%
SEPTICEMIA WITH CYSTITIS	1	1.00%
SEIZURES	1	1.00%
RIGHT LEG MEDIAL MALLEOLUS	1	1.00%
RIGHT LEG CELLULITIS	1	1.00%
RIGHT HAND RADIUS FRACTURE	1	1.00%
PYELONEPHRITIS	1	1.00%
PNEUMONIA	1	1.00%

2.5 TYPE OF THERAPY IN PATIENTS IN GENERAL WARD

80% patients in the IPD received empirical therapy followed by 17% of them receiving prophylactic therapy and a mere 3% receiving definitive therapy.
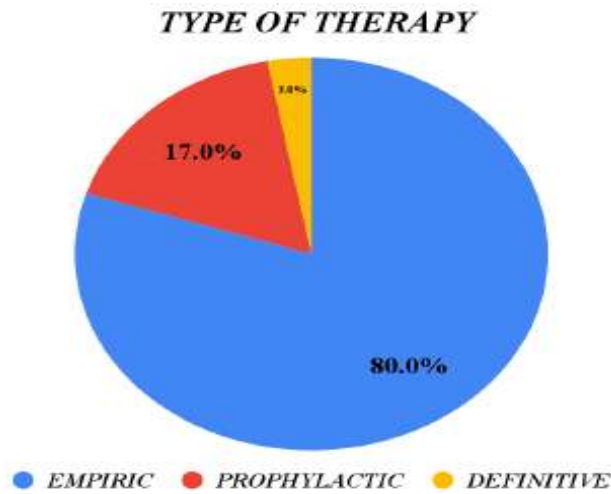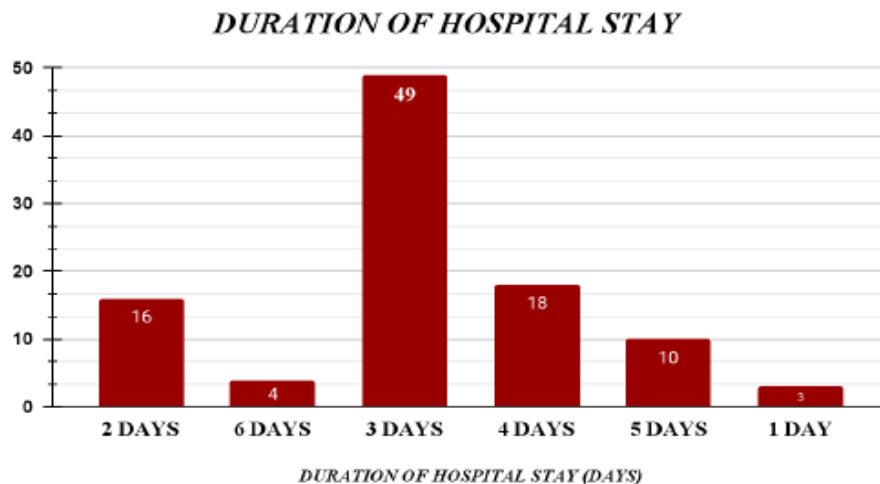
FIGURE 11 : TYPE OF THERAPY IN GENERAL WARD PATIENTS

2.6 DURATION OF HOSPITAL STAY OF IPD PATIENTS

Of the 100 IPD cases recorded, most patients were admitted for 3 days (49 patients), followed by 4 days (18 patients), and the fewest patients were admitted for 1 day (3 patients).

FIGURE 12 : DURATION OF HOSPITAL STAY OF PATIENTS IN GENERAL WARD

PRESCRIPTION ANALYSIS IN INPATIENT DEPARTMENT
2.7 ANALYSIS OF ANTIBIOTICS

Ceftriaxone (43.55%) was the most commonly prescribed antibiotic in the general ward, followed by azithromycin (10.22%) and amikacin (10.22%).

The third most commonly prescribed antibiotics were amoxicillin + clavulanate (5.38%) and satronidazole + ofloxacin (5.38%).

Out of the 81 ceftriaxone prescribed, 70 (86%) were prescribed under the brand name MONOCEF and 11 (13%) were prescribed under the brand name OFRAMAX.

A total of 19 patients (10.22%) were prescribed amikacin and azithromycin with the brand names AMIKA and AZEE, respectively.

TABLE 14: ANTIBIOTICS USED IN GENERAL WARD		
GENERIC NAME	COUNT	PERCENTAGE
CEFTRIAXONE	81	43.55%
AZITHROMYCIN	19	10.22%
AMIKACIN	19	10.22%
SATRONIDAZOLE + OFLOXACIN	10	5.38%
AMOXICILLIN + CLAVULANATE	10	5.38%
OFLOXACIN	7	3.76%
PIPERACILLIN + TAZOBACTAM	6	3.23%
LEVOFLOXACIN	6	3.23%
METRONIDAZOLE	5	2.69%
DOXYCYCLINE	3	1.61%
CEFOPERAZONE + SULBACTAM	3	1.61%
CEFIXIME	3	1.61%
SATRONIDAZOLE	2	1.08%
MEROPENEM	2	1.08%
VANCOMYCIN	1	0.54%
RIFAMPICIN	1	0.54%
PYRAZINAMIDE	1	0.54%
PRIMAQUINE	1	0.54%
ISONIAZID	1	0.54%
ETHAMBUTOL	1	0.54%
COTRIMOXAZOLE	1	0.54%
CLINDAMYCIN	1	0.54%
CEFTAZIDIME	1	0.54%
ARTESUNATE	1	0.54%
Grand Total	**186**	**100.00%**

TABLE 15: ANALYSIS OF BRANDS OF ANTIBIOTICS USED IN GENERAL WARD		
BRAND NAME	COUNT	PERCENTAGE
MONOCEF	70	37.63%
AZEE	19	10.22%
AMIKA	19	10.22%
OFRAMAX	11	5.91%
SATROGYL O	10	5.38%
AUGMENTIN	8	4.30%
OFLOX	7	3.76%
PIPTAZ	5	2.69%
METRO	5	2.69%
AKT4	4	2.15%
ZOSTUM	3	1.61%
LEVOFLOX	3	1.61%

LEVO	3	1.61%
SATROGYL	2	1.08%
MERO	2	1.08%
DOXY	2	1.08%
ARICEF	2	1.08%
ZIFI	1	0.54%
VANCOMYCIN	1	0.54%
SEPTRAN	1	0.54%
PRIMAQUINE	1	0.54%
PIPZO	1	0.54%
FALCIGO	1	0.54%
DOXYCYCLINE	1	0.54%
CLINDA	1	0.54%
CEFTAZIDIME	1	0.54%
AVENT	1	0.54%
ADVENT 457	1	0.54%
Grand Total	**186**	**100.00%**

Among the 100 IPD cases collected, it was found that the most commonly prescribed antibiotic class was cephalosporins (47.85%), followed by macrolides and aminoglycosides (10.22%).

TABLE 16: ANALYSIS OF ANTIBIOTIC CLASS IN GENERAL WARD		
CLASS	**COUNT**	**PERCENTAGE**
CEPHALOSPORINS	89	47.85%
MACROLIDES	19	10.22%
AMINOGLYCOSIDES	19	10.22%
NITROIMIDAZOLE	17	9.14%
PENICILLINS	16	8.60%
FLUOROQUINOLONES	13	6.99%
ANTI-TB	4	2.15%
TETRACYCLINE	3	1.61%
CARBAPENEMS	2	1.08%
SULPHONAMIDE	1	0.54%
LINCOSAMIDE	1	0.54%
GLYCOPEPTIDE ANTIBIOTIC	1	0.54%
ARTEMISININ DERIVATIVE	1	0.54%
Grand Total	**186**	**100.00%**

Out of the 100 samples from the IPD, most drugs were prescribed in the form of injections (73.66%), followed by syrup (13.44%).

The least prescribed dosage form was capsule (1.08%).

TABLE 17: ANALYSIS OF FORMULATION OF ANTIBIOTICS USED IN GENERAL WARD		
FORMULATION	**COUNT**	**PERCENTAGE**
INJECTION	137	73.66%
SYRUP	25	13.44%
TABLET	22	11.83%
CAPSULE	2	1.08%
Grand Total	186	100.00%

Among the 100 IPD cases, it was found that the majority of patients were prescribed 2 antibiotics, 48.4%, followed by patients who received 1 antibiotic, 21%. Finally, only 3.2% of patients received 6 antibiotics.
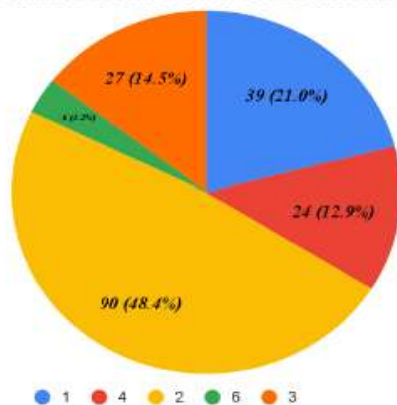
FIGURE 13: TOTAL NUMBER OF ANTIBIOTICS PRESCRIBED IN GENERAL WARD

2.8 ANALYSIS OF OTHER DRUGS

Among the 100 samples collected from the general ward, a total of 572 drugs were prescribed other than antibiotics. The most commonly prescribed drug was ondansetron (16.96%), followed by ranitidine (16.61%) and PCM (15.38%).

TABLE 18: OTHER DRUGS USED IN GENERAL WARD		
GENERIC NAME	COUNT	PERCENTAGE
ONDANSETRON	97	16.96%
RANITIDINE	95	16.61%
PCM	88	15.38%
IPRATROPIUM BROMIDE + LEVOSALBUTAMOL	16	2.80%
MONTELUKAST + LEVOCETIRIZINE	15	2.62%
XYLOMETAZOLINE HCL	14	2.45%
BUDESONIDE	14	2.45%
RACECADOTRIL	12	2.10%
DEXTROMETHORPHAN + CHLORPHENIRAMINE + PHENYLEPHRINE	12	2.10%
ZINC ACETATE	10	1.75%
MULTIVITAMIN	9	1.57%
CHLORPHENIRAMINE + GUAIFENESIN + DEXTROMETHORPHAN + MENTHOL	9	1.57%
SACCHAROMYCES BOULARDII	8	1.40%
DICYCLOMINE	8	1.40%
DICLOFENAC SODIUM + PCM	8	1.40%
ZINC OXIDE	6	1.05%
TRAMADOL	6	1.05%
SODIUM PICOSULFATE+LIQUID PARAFFIN+MILK OF MAGNESIA	6	1.05%
PREDNISOLONE	6	1.05%
IBUPROFEN + PCM	6	1.05%

DICLOFENAC	6	1.05%
LACTOBACILLUS BACTERIA	6	1.05%
PROTEIN POWDER	5	0.87%
PROBIOTIC	5	0.87%
CLOBAZAM	5	0.87%
URSODEOXYCHOLIC ACID	4	0.70%
TRYPSIN BROMELAIN AND RUTOSIDE TRIHYDRATE	4	0.70%
SIMETHICONE	4	0.70%
L ORNITHINE L ASPARTATE	4	0.70%
HIMALAYA HERBAL	4	0.70%
PHENYTOIN	4	0.70%
PHENYLEPHRINE & CHLORPHENIRAMINE MALEATE + DEXTROMETHORPHAN HYDROBROMIDE	3	0.52%
PHENYLEPHRINE HYDROCHLORIDE + CHLORPHENIRAMINE MALEATE	3	0.52%
PANTOPRAZOLE	3	0.52%
MIDAZOLAM	3	0.52%
FAVIPIRAVIR	3	0.52%
VITAMIN C	2	0.35%
VITAMIN B6 + B12 + NIACINAMIDE + FOLIC ACID	2	0.35%
TRYPSIN + CHYMOTRYPSIN	2	0.35%
METOCLOPRAMIDE	2	0.35%
LEVETIRACETAM	2	0.35%

LACTULOSE SOLUTION	2	0.35%
HYDROXYZINE HCL	2	0.35%
HEPARIN	2	0.35%
DISODIUM HYDROGEN CITRATE	2	0.35%
DICYCLOMINE+PARACETAMOL	2	0.35%
AMBROXOL	2	0.35%
LEVOSALBUTAMOL + AMBROXOL HCL +GUAIPHENESIN	2	0.35%
VITAMIN D	1	0.17%
TORSEMIDE+SPIRONOLACTONE	1	0.17%
SODIUM VALPROATE	1	0.17%
SODIUM BICARBONATE	1	0.17%
RISPERIDONE	1	0.17%
RIFAXIMIN	1	0.17%
RENALKA	1	0.17%
PREDNISOLONE SODIUM PHOSPHATE	1	0.17%
PCM + CHLORPHENIRAMINE MALEATE + PHENYLEPHRINE ACETATE	1	0.17%
OSELTAMIVIR	1	0.17%
NIFEDIPINE	1	0.17%
MUCAINE GEL	1	0.17%
MIDAZOLAM	1	0.17%
METRONIDAZOLE	1	0.17%
MECOBALAMIN	1	0.17%
LORAZEPAM	1	0.17%
LIGNOCAINE GEL	1	0.17%
LEVOCETIRIZINE	1	0.17%

LACTOBACILLUS + SACCHAROMYCES + ZINC	1	0.17%
KETAMIN	1	0.17%
IVERMECTIN+ALBENDAZOLE	1	0.17%
IMMUNOGLOBULIN	1	0.17%
HYOSCINE+SIMETHICONE	1	0.17%
GRANISETRON	1	0.17%
GLY	1	0.17%
GLUCOSE POWDER	1	0.17%
FUROSEMIDE	1	0.17%
FERROUS ASCORBATE & FOLIC ACID	1	0.17%
DICYCLOMINE+SIMETHICONE	1	0.17%
DEXAMETHASONE	1	0.17%
DEFLAZACORT	1	0.17%
CODEINE PHOSPHATE	1	0.17%
CLONIDINE	1	0.17%
CHLORHEXIDINE	1	0.17%
CARBOXYMETHYLCELLULOSE SODIUM	1	0.17%
CALCIUM + VIT D3	1	0.17%
BROMHEXINE + CHLORPHENIRAMINE	1	0.17%
Grand Total	**572**	100.00%

Out of the 572 drugs prescribed, the most commonly prescribed formulation was injection (55.07%), followed by syrup (16.61%).

TABLE 19: FORMULATION OF OTHER DRUGS USED IN GENERAL WARD		
FORMULATION	**COUNT**	**PERCENTAGE**
INJECTION	315	55.07%
SYRUP	95	16.61%
TABLET	57	9.96%
GRANULES	31	6.29%
NEBULIZER	30	5.24%
DROPS	23	4.02%
CREAM	6	1.05%
POWDER	6	1.05%
PATCH	4	0.70%
SPRAY	2	0.35%
OIL	2	0.35%
GARGLE	1	0.17%
Grand Total	**572**	**100.00%**

2.9 ANALYSIS OF DRUGS USING WHO PRESCRIBING INDICATORS

TABLE 20: WHO PRESCRIBING INDICATORS IN GENERAL WARD	
INDICATORS	**LABEL**
AVERAGE NUMBER OF DRUGS PER ENCOUNTER	7.75
PERCENTAGE OF DRUGS PRESCRIBED BY GENERIC NAMES	2.97%
PERCENTAGE OF ENCOUNTER WITH AN ANTIBIOTIC PRESCRIBED	58.97%
PERCENTAGE OF ENCOUNTER WITH AN INJECTION PRESCRIBED	24.92%
PERCENTAGE OF DRUGS FROM THE ESSENTIAL DRUG LIST	20.52%

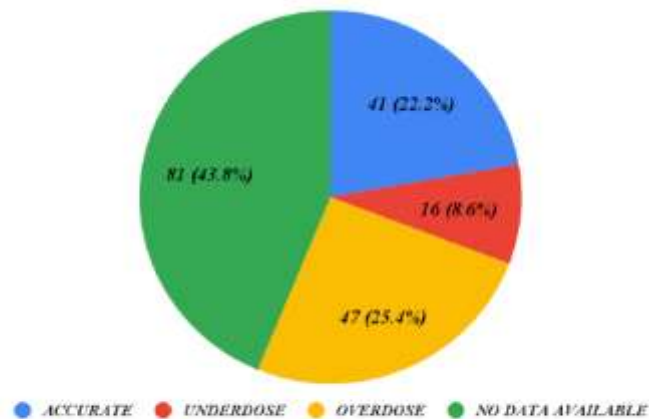**2.10 RATIONALITY OF DOSE**

RATIONALITY ACCORDING TO DDD AND cDDD
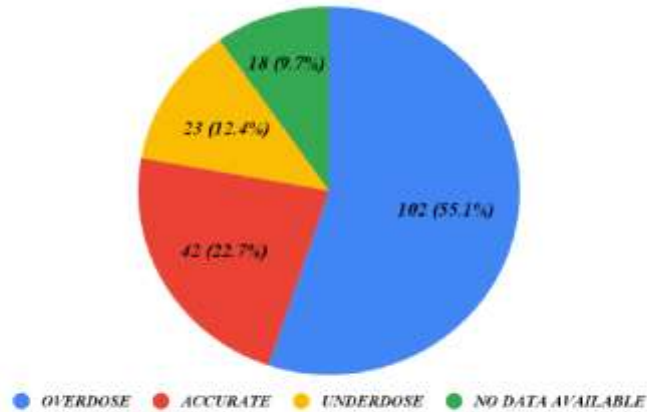
FIGURE 14: RATIONALITY OF DOSE IN GENERAL WARD ACCORDING TO DDD

AND cDDD

After calculating and analysing the prescribed doses according to Defined Daily Doses (DDD) it was found that 44.9% of the patients received doses that were overdosed and only 22.7% of patients received accurate doses.

RATIONALITY OF THERAPY ACCORDING TO WEIGHT

FIGURE 16: RATIONALITY OF DOSE ACCORDING TO WEIGHT OF GENERAL

WARD PATIENTS

After calculating and analysing the prescribed doses according to weight, it was found that only 22.2% of patients received accurate doses and 14.6% of the patients received excessive doses. 43.8% of patients were patients whose data was not available.

3. ANALYSIS OF THE INPATIENT DEPARTMENT (NICU)
3.1 GENDER WISE DISTRIBUTION IN NICU
After analysing 50 patients in the neonatal intensive care unit (NICU), it was found that 24 patients were female (48%) and 26 patients were male (52%).
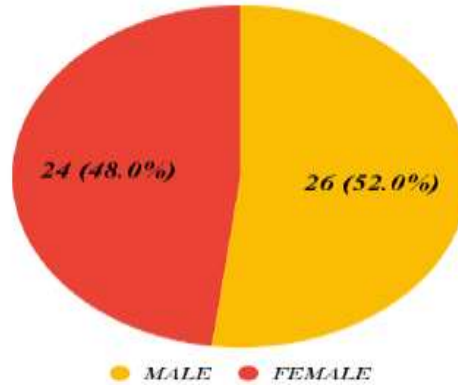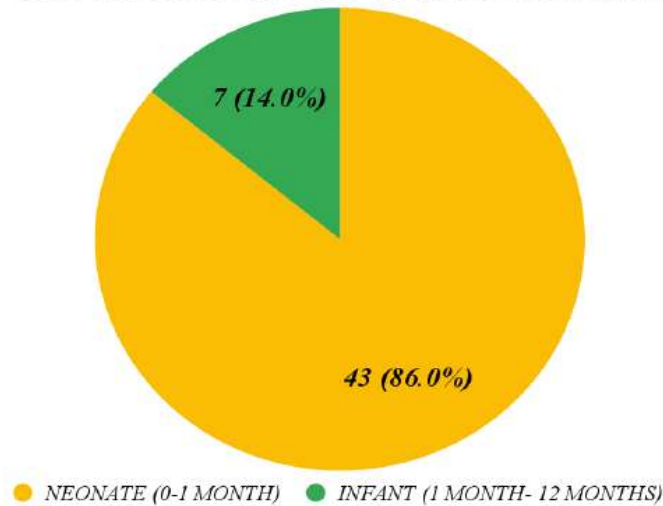
FIGURE 17 : DISTRIBUTION OF GENDER (NICU)

3.2 AGE-WISE DISTRIBUTION IN NICU

After analysing 50 patients in NICU 43 patients (86%) were neonates and 7 patients (14%), were infants. The mean age of inpatients was 23.28 ± 10.21 days. The mean age for male patients was 24.65 ± 14.18 days while the mean age for female patients was 21.79 ± 15.04 days as shown in TABLE 20. Moreover, the age wise distribution of patients according to WHO classification is depicted in TABLE 21 and FIGURE 8.

FIGURE 18: DISTRIBUTION OF NICU PATIENTS ACCORDING TO WHO AGE CLASSIFICATION

TABLE 21: AGE WISE DISTRIBUTION OF PATIENTS ACCORDING TO GENDER IN NICU

	NUMBER OF PATIENTS	AVERAGE AGE ± SEM
MALE	26	24.65 ± 14.18 DAYS
FEMALE	24	21.79 ± 15.04 DAYS
TOTAL	50	23.28 ± 10.21 DAYS

TABLE 22: AGE WISE DISTRIBUTION OF NICU PATIENTS ACCORDING TO WHO AGE CLASSIFICATION

	NUMBER OF PATIENTS	AVERAGE AGE ± SEM
NEONATES	43	4.83 ± 0.64 DAYS
INFANTS	7	136.57 ± 59.86 DAYS

3.3 REASON FOR ADMISSION OF PATIENTS IN NICU

After analysing 50 patients there were numerous reasons for admission which were reported by the parents the majority were Icterus (16.85%) followed by respiratory distress (11.24) the most rare sign was brain sparing effect (1.12%).

TABLE 23 : REASON FOR ADMISSION OF PATIENTS IN NICU

REASON FOR ADMISSION	COUNT	PERCENTAGE
ICTERIC	19	21.34%
RESPIRATORY DISTRESS	12	13.49%
GRUNTING	9	10.12%
LOW BIRTH WEIGHT	6	6.74%
TACHYPNOEA	6	6.74%
FEVER	4	4.49%
COUGH	4	4.49%
LETHARGIC	4	4.49%

SEVERE BIRTH ASPHYXIA	3	3.37%
COLD	4	4.49%
DEHYDRATION	2	2.25%
CONVULSION	3	3.37%
BIRTH ASPHYXIA	2	2.25%
SEPSIS	1	1.12%
MECONIUM ASPIRATION	1	1.12%
ICTERIC UPTO SOLE	1	1.12%
HYPOXIA	1	1.12%
HYPOGLYCEMIA	1	1.12%
GRASPING BREATHING	1	1.12%
FETO-PLACENTAL INSUFFICIENCY	1	1.12%
FEEDING INTOLERANCE	1	1.12%
CYANOSIS	1	1.12%
BROWNISH VOMITING	1	1.12%
BRAIN SPARING EFFECT	1	1.12%
Grand Total	**89**	100.00%

3.4 DIAGNOSIS OF PATIENTS IN NICU

There were variety of disease and conditions which were observed in NICU in 50 patients majority of the diagnosis were neonatal hyperbilirubinemia (17.35%), RDS (15.31%), early onset sepsis (11.22%) and late onset sepsis (5.10%). The most prevalent infection in NICU was early onset sepsis 14.31%.

TABLE 24 : DIAGNOSIS OF PATIENTS IN NICU		
DIAGNOSIS	COUNT	PERCENTAGE
NEONATAL HYPERBILIRUBINEMIA	18	18.37%
RESPIRATORY DISTRESS SYNDROME	15	15.31%
EARLY ONSET SEPSIS	14	14.31%
LATE ONSET SEPSIS	5	5.10%
MENINGITIS	5	5.1%
LOW BIRTH WEIGHT	5	5.10%
SEVERE BIRTH ASPHYXIA	3	3.06%
VIRAL PNEUMONITIS	2	2.04%
PERSISTENT PULMONARY HYPERTENSION OF NEWBORN	2	2.04%
MODERATE RESPIRATORY DISTRESS SYNDROME	2	2.04%
HIE GRADE III	2	2.04%
HIE GRADE I	2	2.04%
MECONIUM ASPIRATION SYNDROME	2	2.04%
SEIZURES	1	1.02%
Rh INCOMPATIBILITY	1	1.02%
RETROGNATHIA	1	1.02%
PNEUMONIA	1	1.02%
PLEURAL EFFUSION	1	1.02%
NEONATAL ENCEPHALOPATHY	1	1.02%
NECROTIZING ENTEROCOLITIS	1	1.02%
MECONIUM STAINED LIQUOR	1	1.02%
KERNICTERUS	1	1.02%
HIE GRADE II	1	1.02%
GESTATIONAL DIABETES MELLITUS	1	1.02%
G6PD DEFICIENCY	1	1.02%
FETO-PLACENTAL INSUFFICIENCY	1	1.02%
DENGUE ENCEPHALOPATHY	1	1.02%
CORONARY SINUS TAPVC	1	1.02%

CLEFT PALATE	1	1.02%
BRAIN SPARING EFFECT	1	1.02%
AV MALFORMATION IVH-III	1	1.02%
ASYMMETRICAL INTRAUTERINE GROWTH RESTRICTION	1	1.02%
ASPIRATION PNEUMONIA	1	1.02%
ABO INCOMPATIBILITY	1	1.02%
Grand Total	**98**	100.00%

3.5 TYPE OF THERAPY IN PATIENTS IN GENERAL WARD

TYPE OF THERAPY IN NICU PATIENTS

8 (16.0%)

41 (82.0%)

● DEFINITIVE THERAPY ● PROPHYLACTIC THERAPY ● EMPIRICAL THERAPY
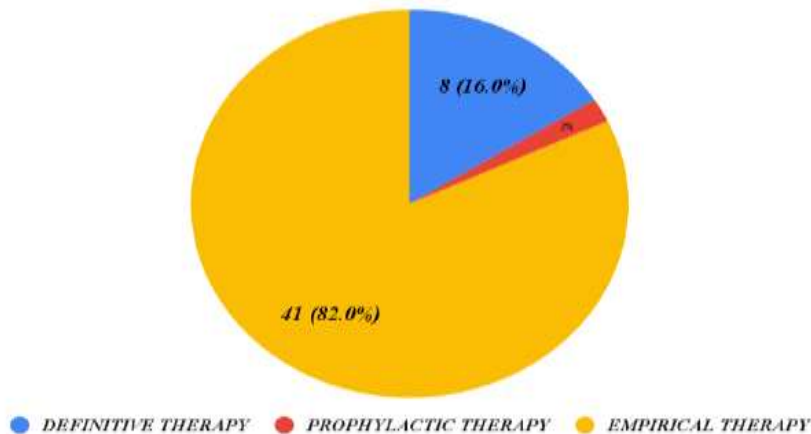
FIGURE 19: TYPE OF THERAPY IN NICU PATIENTS

TABLE 25 : ISOLATED ORGANISM IN NICU		
CULTURE SENSITIVITY TEST	**COUNT**	**PERCENTAGE**
CST NOT DONE	42	84.00%
KLEBSIELLA PNEUMONIAE	5	10.00%
PSEUDOMONAS	3	6.00%
Grand Total	**50**	100.00%

Out of 50 sample sizes collected from the NICU department only 8 patients were performed with CST out of which 5 patients (10%) had infection caused with Klebsiella pneumoniae and 3 patients (6%) had infection caused with Pseudomonas. 42 patients (82%) were not performed with CST.

3.6 DURATION OF HOSPITAL STAY IN NICU
The average duration of stay in the hospital for NICU patients was 5.06 ± 0.504 days.

3.7 ANALYSIS OF ANTIBIOTICS
The most frequently prescribed antibiotics in NICU were gentamicin (14.50%), cefixime

(14.50%), and cefotaxime (13.74%). meropenem (9.16%) was the third most frequently prescribed antibiotic.

TABLE 26 : ANALYSIS OF ANTIBIOTICS IN NICU		
GENERIC NAME	**COUNT**	**PERCENTAGE**
GENTAMICIN	19	14.50%
CEFIXIME	19	14.50%
CEFOTAXIME	18	13.74%
MEROPENEM	12	9.16%
CO-TRIMOXAZOLE	11	8.40%
AMIKACIN	9	6.87%
PIPERACILLIN + TAZOBACTAM	8	6.11%
COLISTIN	8	6.11%
POLYMYXIN-B	6	4.58%
LEVOFLOXACIN	5	3.82%
CLINDAMYCIN	4	3.05%
VANCOMYCIN	2	1.53%
NETILMICIN	2	1.53%
LINEZOLID	2	1.53%
CIPROFLOXACIN	2	1.53%
AMOXICILLIN + POTASSIUM CLAVULANATE	2	1.53%
CEFTRIAXONE	1	0.76%
AZITHROMYCIN	1	0.76%
Grand Total	**131**	100.00%

TAXIM (15.83%), GENTA (15.83%) and ZIFI (15%) were the mostly prescribed antibiotic brands.

TABLE 27 : BRANDS PRESCRIBED IN NICU		
BRAND NAME	**COUNT**	**PERCENTAGE**
TAXIM	19	15.83%
GENTA	19	15.83%
ZIFI	18	15.00%
MERO	12	8.33%
SEPTRAN	11	7.50%
AMIKAR	9	6.67%
PIPTAZ	8	5.83%
COLI	8	5.00%
POLY-B	6	4.17%
LEVOFLOX	5	3.33%
CLINDA	4	2.50%
VANCO	2	1.67%
NETIL	2	1.67%
LINOSPAN	2	1.67%
CIPLOX	2	1.67%
OFRAMAX	1	0.83%
MEGA CV	1	0.83%
AZEE	1	0.83%
ADVENT	1	0.83%
Grand Total	**131**	100.00%

The majority of the formulation of drugs prescribed for the 50 samples in the NICU were injections (79.39%), followed by oral drops (10.69%). Eye drops were the least frequently prescribed dosage type (0.76%).

TABLE 28 :FORMULATION OF ANTIBIOTICS PRESCRIBED IN NICU		
FORMULATION	**COUNT**	**PERCENTAGE**
INJECTION	104	79.39%
ORAL DROPS	14	10.69%
SYRUP	12	9.16%
EYE DROPS	1	0.76%
Grand Total	**131**	**100.00%**

The most frequently prescribed antibiotic class among the 50 NICU cases was cephalosporins (29.01%), followed by aminoglycosides (22.90%) and polymyxins (10.69%).

TABLE 29 : CLASS OF ANTIBIOTICS PRESCRIBED IN NICU		
CLASS	**COUNT**	**PERCENTAGE**
CEPHALOSPORINS	38	29.01%
AMINOGLYCOSIDES	30	22.90%
POLYMYXINS	14	10.69%
CARBAPENEMS	12	9.16%
SULFONAMIDES + DHFR INHIBITORS	11	8.40%
PENICILLINS + BETA LACTAMASE INHIBITOR	10	7.63%
FLUOROQUINOLONES	7	5.34%
LINCOSAMIDES	4	3.05%
OXAZOLIDINONES	2	1.53%
GLYCOPEPTIDES	2	1.53%
MACROLIDES	1	0.76%
Grand Total	**131**	**100.00%**

3.8 ANALYSIS OF OTHER DRUGS
Out of the 50 samples collected in the NICU department, a total of 313 drugs were prescribed other than antibiotics. Multivitamins were most commonly prescribed (9.86%) by the brand name ONVITA, followed by the combination of calcium carbonate and vitamin D 3 (8.39%) by the brand name CCD3.

TABLE 30 : OTHER DRUGS PRESCRIBED IN NICU		
GENERIC NAME	COUNT	PERCENTAGE
MULTIVITAMINS	30	9.68%
CALCIUM CARBONATE + VIT.D$_3$	26	8.39%
LEVETIRACETAM	18	5.81%
CALCIUM GLUCONATE	14	4.52%
ADRENALINE + ACETYLCYSTEINE	14	4.52%
GRANISETRON	13	4.19%
VITAMIN K	12	3.87%
FUROSEMIDE	11	3.55%
DEXAMETHASONE	11	3.55%
METOCLOPRAMIDE	10	3.23%
DOBUTAMINE	10	3.23%
FLUCONAZOLE	9	2.90%
CAFFEINE	9	2.90%
RANITIDINE	8	2.58%
PHENOBARBITONE	8	2.58%
PARACETAMOL	8	2.58%
LORAZEPAM	6	1.94%
SILDENAFIL	4	1.29%
PHENYTOIN	4	1.29%
MEDIUM CHAIN TRIGLYCERIDES	4	1.29%
HYDROCORTISONE	4	1.29%
GLYCERINE ENEMA	4	1.29%
ADRENALINE	4	1.29%
XYLOMETAZOLINE	3	0.97%

SODIUM BICARBONATE	3	0.97%
OSELTAMIVIR	3	0.97%
ONDANSETRON	3	0.97%
MUPIROCIN + HEPARIN & BENZYL NICOTINATE	3	0.97%
KANGAROO MOTHER CARE	3	0.97%
IPRATROPIUM BROMIDE + LEVOSALBUTAMOL	3	0.97%
BUDESONIDE	3	0.97%
ZINC OXIDE CREAM	2	0.65%
MOSAPRIDE CITRATE	2	0.65%
MILRINONE	2	0.65%
MIDAZOLAM	2	0.65%
LANSOPRAZOLE	2	0.65%
LACOSAMIDE	2	0.65%
DOMPERIDONE	2	0.65%
DILL OIL + FENNEL OIL + SIMETHICONE	2	0.65%
COLLOIDAL IRON + FOLIC ACID + VITAMIN B12	2	0.65%
CITICOLINE SODIUM	2	0.65%
AMPHOTERICIN-B	2	0.65%
AMBROXOL	2	0.65%
VACCINE	1	0.32%
URSODEOXYCHOLIC ACID	1	0.32%
TRANEXAMIC ACID	1	0.32%
SIMETHICONE	1	0.32%

SALBUTAMOL	1	0.32%
PREDNISOLONE	1	0.32%
MUPIROCIN	1	0.32%
LACTASE ENZYME	1	0.32%
INTRAVENOUS IMMUNOGLOBULIN	1	0.32%
HUMAN MILK FORTIFIERS	1	0.32%
GLYCOPYRROLATE	1	0.32%
FOLIC ACID	1	0.32%
FLUTICASONE FUROATE	1	0.32%
FENTANYL	1	0.32%
DICYCLOMINE	1	0.32%
DEFLAZACORT	1	0.32%
BROMHEXINE + PHENYLEPHRINE + CPM + PCM	1	0.32%
BISACODYL	1	0.32%
BACILLUS CLAUSII	1	0.32%
AMINOPHYLLINE	1	0.32%
AMINO ACIDS	1	0.32%
Grand Total	**310**	100.00%

TABLE 31 : BRANDS OF OTHER DRUGS PRESCRIBED IN NICU		
BRAND NAMES	COUNT	PERCENTAGE
ONVITA	28	8.95%
CCD3	26	8.31%
LEVERA	18	5.75%
CALARC	14	4.79%

ADRENALINE + MUCOMIX	14	4.47%
GRANDEM	13	4.15%
VITAMIN K	12	3.83%
LASIX	11	3.51%
DEXONA	11	3.51%
PERINORM	10	3.19%
DOBUTA	10	3.19%
FLUCON	9	2.88%
CAPNEA	9	2.88%
RANTAC	8	2.56%
LOPEZ	6	1.92%
FEBRINIL	5	1.60%
T.BACT + THROMBOPHOB	4	1.28%
PHENOBARB	4	1.28%
MCT OIL	4	1.28%
HYDROCORT	4	1.28%
GLYCERINE ENEMA	4	1.28%
GARDINAL	4	1.28%
EPSOLIN	4	1.28%
ADRENALINE	4	1.28%
TONOFERON	3	0.96%
SILDENAFIL	3	0.96%
NASTROZ	3	0.96%
KMC	3	0.96%
EMSET	3	0.96%
DUOLIN	3	0.96%
COLICAID	3	0.96%

BUDECORT	3	0.96%
BICARB	3	0.96%
SOFIRASH	2	0.64%
PCM	2	0.64%
OSELTAMIVIR	2	0.64%
NEOSMILE	2	0.64%
MOZA	2	0.64%
MIDAZ	2	0.64%
LACOSAMIDE	2	0.64%
JUNIOR LANZOL	2	0.64%
ENTEROGERMINA	2	0.64%
DOMSTAL	2	0.64%
CITICOLINE	2	0.64%
AMPHO B	2	0.64%
A VENT	2	0.64%
WYSOLONE	1	0.32%
VAC	1	0.32%
UDCAMENT	1	0.32%
TRANEXA	1	0.32%
TAMIFLU	1	0.32%
PULMOSIL	1	0.32%
MILIRINONE	1	0.32%
MILICORE	1	0.32%
MEGAHEEL	1	0.32%
IVIG	1	0.32%
HMF SACHET	1	0.32%
GLYCO	1	0.32%

FOLVITE	1	0.32%
FENTANYL	1	0.32%
DULCOLAX	1	0.32%
DEFLASTAR	1	0.32%
CALPOL	1	0.32%
AUROFACTS	1	0.32%
ASTHALIN	1	0.32%
ANC	1	0.32%
AMINOVEN	1	0.32%
AMINOPHYLLINE	1	0.32%
ALLEGRA	1	0.32%
Grand Total	**313**	100.00%

Out of the 623 drugs prescribed, the most commonly prescribed formulation was injection (50.65%), followed by oral drops (17.64%).

TABLE 32 : FORMULATION OF OTHER DRUGS PRESCRIBED IN NICU		
FORMULATION	**COUNT**	**PERCENTAGE**
INJECTION	155	50.65%
ORAL DROPS	54	17.64%
SYRUP	50	16.34%
NEBULISER	21	6.86%
TABLET	8	2.61%
OINTMENT	5	1.63%
ENEMA	4	1.31%
NASAL DROPS	3	0.98%
SUPPOSITORY	1	0.33%
GRANULES	1	0.33%
NASAL SPRAY	1	0.33%
GEL	1	0.33%
CREAM	1	0.33%
CAPSULE	1	0.33%
Grand Total	**306**	100.00%

3.9 WHO PRESCRIBING INDICATORS

TABLE 33 : WHO PRESCRIBING INDICATORS IN NICU	
INDICATOR	**LABEL**
AVERAGE NUMBER OF DRUGS PER ENCOUNTER	8.89
PERCENTAGE OF DRUGS PRESCRIBED BY GENERIC NAMES	11.94%
PERCENTAGE OF ENCOUNTER WITH AN ANTIBIOTIC PRESCRIBED	27.87%
PERCENTAGE OF ENCOUNTER WITH AN INJECTION PRESCRIBED	56.21%
PERCENTAGE OF DRUGS FROM THE ESSENTIAL DRUG LIST	25.06%

3.10 RATIONALITY OF THERAPY

Defined Daily Doses (DDD) were used to calculate and analyse the prescribed doses, and it was found that 33.6% of patients received accurate doses while overdoses were reported in 11.5% of patients.
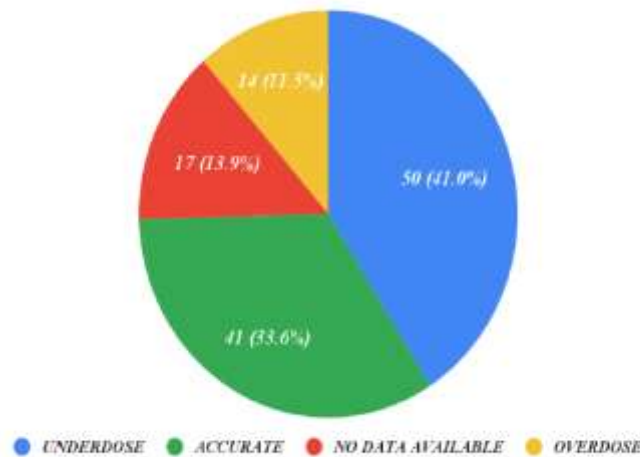
FIGURE 20 : RATIONALITY OF DOSE ACCORDING TO DDD IN NICU PATIENTS

Only 41% of patients received accurate doses, and only 33.6% of patients received excessive doses, according to calculations and analysis of the prescribed doses based on weight. Data was unavailable for 4% of the patients.

RATIONALITY OF DOSE ACCORDING TO WEIGHT
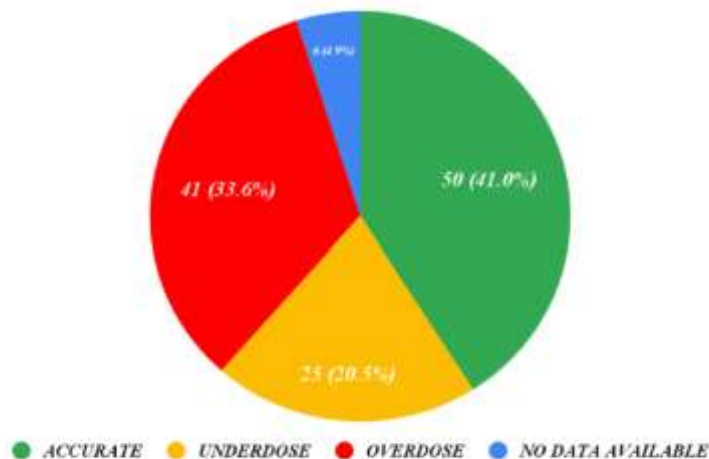
FIGURE 21 : RATIONALITY OF DOSE IN NICU PATIENTS ACCORDING TO

WEIGHT

V. DISCUSSION:

Drug utilization studies are found to be a useful tool to facilitate rational use of drugs in health care delivery systems. It truly reflects the status of the health care system. In order to be rational, use of a drug must be effective, safe, prescribed for the proper therapeutic indication and the correct dosage in an appropriate formulation, easily available and of a reasonable cost.[20]

In OPD, the total percentage of male pediatric patients was 60%, and of female patients was 40%. Similar findings were found in a study performed by A. Najmi et. al which suggested that the male patients were 60% and female patients were 40%[21].

After analyzing 50 patients in OPD, the majority of the patients belonged to the age group of 1-3 years i.e Toddlers 28% followed by infants 1-12 months i.e 26% which were similar to the study performed by A. Najmi et.al which showed that the patients in the age group of 1-3 years were 30.22%[21]. The major complaints of the patients presented in OPD included Fever 26.61% followed by cough and cold 25.69% this can be attributed to a sudden change in climate from October to March this was supported by a study performed by S.Bunyavanich et.al which suggested that Children may be an especially vulnerable subpopulation because of their developing physiology and anticipated long-term exposure. Internationally, two thirds of all preventable ill health due to the environment occurs in children[22].

In the study, it was found that the majority of the antibiotics prescribed were Azithromycin and a combination of amoxicillin and potassium clavulanate (34.69%) divergent results were found in the study performed by H. Amane said that the majority of the antibiotics prescribed were combinations of norfloxacin and tinidazole 35% [23]. Apart from these, the majority of the drugs were prescribed from the class Penicillin+Beta Lactamase Inhibitor 35.29% followed by Macrolides 31.37% which were also supported by the study performed by J. Kumar et.al, this study suggested that the majority of the antibiotics were prescribed from macrolides and fluoroquinolones [24]. The majority of the formulation which was prescribed was Syrup 86.27% this might be because the syrup is easy to administer in pediatric patients and adherence is easy to achieve[25]. After analysis of 50 patients it was found that 96.1% of the patients were prescribed with 1 antibiotic and 3.9% of the patients were prescribed with 2 antibiotics. 42.7% of the patients were prescribed with a total of 4 drugs followed by 21.8% of the patients were prescribed with 5 drugs. This was supported by the study performed by J. Kumar et.al suggested that average drugs per prescription were 2.81 [24].

Defined daily dose (DDD) is one of the established metrics used in the assessment of antimicrobial consumption.The aim of the ATC/DDD methodology is to serve as a tool for drug utilization study in order to improve the quality of drug use. One component of this is the

presentation and comparison of drug consumption statistics at international and other levels[26]. After calculating cDDD of 50 patients it was found that 48% of the patients were prescribed by the dose which Overdose, 30% of the patients were prescribed with Accurate dose, 16% of the patients were the ones whose data was not available.

After analyzing the prescribed doses to the 50 pediatric patients it was found that 60% of the patients were given Accurate dose, 26% of the patients were prescribed doses that were Overdose and 14% of the patients were given doses that were Underdose. The variance in OPD between cDDD and weight based adjusted dose regimen was 0.0287.

The main purpose of our study was to analyze the prescriptions for effective and rational drug prescribing. The ultimate aim was to make the healthcare system safer.

In IPD, the total percentage of male pediatric patients was 67% which was comparatively more than female pediatric patients, which was 33%. Similar findings were found in Gauhati Hospital (Choudhary DK and Bezbaruah BK, 2013)[27]. The pediatric patients included were from the age category of 0-14 years, out of 100 cases collected from IPD it was found that the patients of age group 1-3 years were 26% this can be attributed to the low immunity of the patients familiar results were found in a study performed by A.k Malpani, M. Waggi and 26% percent of the patients were from the age group of 6-12 years. Fewer percentages were observed in patients in the age group of 0-1 month (3%) and 3-5 years (9.1%) [28].

After analyzing 100 IPD patients it was found that the majority of the patients presented with complaints of fever (23.83%), vomiting (13.62%), cough (11.49%), and cold (10.21) which were supported by the study performed by S George, A K. Thomas,J. Jacob,et.al which stated that the majority of the patients were admitted with chief complaints of fever and cough[29]. Among the IPD patients, it was found that most of the patients had a diagnosis of AGE (22%) supporting this data, a study performed by E. Elliot suggests that Worldwide, 3-5 billion cases of acute gastroenteritis and nearly 2 million deaths occur each year in children under 5 years[30]. A study performed by M. Khan showed that 20% of the patients suffered from AGE[31]. In this study, it was found that 80% of the patients were receiving empirical therapy, a study performed by E. Bruzzese suggested that empiric therapy should be started while awaiting such results. Empiric therapy

may be started with oral co-trimoxazole or metronidazole, but in severe cases parenteral treatment with ceftriaxone or ciprofloxacin might be considered[32]. The second most diagnosed infection was LRTI 13% this finding was supported by a study performed by P. Sitthikarnkh et.al which suggested that LRTIs had a high incidence rate of hospitalization and mortality, especially in children under 5 years old [33]. Among the IPD patients, 17% of the patients were receiving prophylactic therapy and 3% of the patients were receiving definitive therapy. This was supported by a study performed by K. N. S. Karthik* and K.R. Kumar stated that The majority of prescriptions were therefore made on an empirical basis[34]. Out of 100 patients collected from IPD, it was found that the use of antibiotics has become a routine practice for the treatment of pediatric infections and majorly prescribed antibiotic was ceftriaxone (43.55%) followed by amikacin and azithromycin 10.22%. These results were supported by a similar study conducted in Erode, Tamil Nadu by K Shamshy, I Mufida Begum, and P Perumal[35]. It was also found that 5.38% of the patients received the satronidazole + ofloxacin combination. Satronidazole (SAT), is a novel nitroimidazole derivative. Ofloxacin is official in USP3 and BP4 whereas satranidazole is not official in any Pharmacopoeia[36] therefore the DDD and cDDD was not calculated. The highest prescribed class was cephalosporins (47.85%) followed by aminoglycoside and macrolide (10.22%) respectively; similar findings were found in a study performed by K Shamshy, I Mufida Begum, and P Perumal it suggested that Cephalosporins (38.83%), Aminoglycoside (22.78%) and penicillin derivatives (18.87%) were choice of antibiotics for pediatric patients [35]. Moreover, it was also found that the majority of the patients were given parenteral dosage forms i.e injections (73.7%) which was supported by a study performed in Pune hospital by R. Mathew, H.Sayyed et.al in which use of injections was high[37]. After analyzing 100 IPD cases it was found that 48.4% of the patients were prescribed 2 antibiotics and 21% of the patients were prescribed 1 antibiotic. Similar findings were from reviewing a study which suggested that A high percentage of patients 54.58% were prescribed at least one antibiotic, two antibiotics were prescribed in 28.57%, three antibiotics were prescribed in 15.02% and four antibiotics were prescribed in only 1.83% cases [35].

WHO recommends an optimal value of 100% in prescribing drugs by generic name, while our study presented only 2.97%. Generic

prescribing has been recognized to be much simpler, minimize dispensing errors, facilitate coordination and transparency between healthcare providers and clients, as well as being comparatively cheaper than branded drugs[37]. The percentage of antimicrobials prescribed from the National Drug List was 20.52%, and the proposed optimal value by the WHO is 100%. According to the WHO, DDD is the average daily dose for adult indications, so it cannot be directly used as the basis for prescribing children's medication. In the absence of specific medication standards, some hospitals directly reduce the adult dose by half to obtain the children's medication standard. However, this method has no scientific clinical basis, and it leads to the deviation of medication results. In the present study, cDDD was introduced to analyze the drug use status amongst children by dividing them into different age groups and preliminarily establishing a rational evaluation method of antimicrobial drug use in children[38].

The cDDD was calculated in various age groups by newborns (1–28 days): cDDD = 1/10 − 1/8DDD; infants (28 days-1 year): cDDD = 1/8 − 1/ 4 DDD; toddlers (1–3 years): CDDD = 1/4 − 1/3DDD; preschool (4–5 years): cDDD = 1/3 − 1/2DDD; school age (6– 14 years): cDDD = 1/2– 2/3DDD, after calculating the doses it was found that the 44.9% of the patients received overdose, 22.7% of patients received accurate doses and 12.4% of the patients received underdose these findings were supported by [39]. The variance in IPD between cDDD and weight based adjusted dose regimen was 0.40415.

The study was carried out in 50 patients in NICU, it was found that the total male patients were 52% and female patients were 48% which were supported by the study performed by A. Kumari et.al showed that the number of male patients were 66% and the number of female patients were 35%[40]. The study also showed that 86% of the patients were between the age group of 0-1 month and 14% of the patients were in the age group of 1-12 months; these findings were supported by a research performed by S. Patel et.al. stated that Neonates, particularly from high-risk pregnancies, often present with multiple comorbidities due to immature organs, which may necessitate intensive and complex medical care with high exposure to drugs[41]. The majority of the patients were presented with icterus 21.34% followed by respiratory distress 13.49% familiar study performed by K.Undela et.al suggested that most reasons for admission were jaundice 23.2% and respiratory distress 17.3%. The study also

suggested that the majority of the pediatric patients were diagnosed with neonatal hyperbilirubinemia and respiratory distress syndrome the same study stated that Unconjugated hyperbilirubinemia (17.35%), respiratory distress syndrome (15.31%) were the major diagnosis in NICU [42]. The type of therapy mostly administered was empiric 82% and 16% of the patients received definitive therapy this finding was supported by a study performed by S. patel et.al showed that 66% received empiric therapy and only 5% of the patients received definitive therapy [41]. The organisms isolated were Klebsiella pneumoniae and Pseudomonas; Multidrug-resistant (MDR) Gram-negative organisms are a major health concern due to lack of effective therapy; these organisms include Klebsiella pneumoniae and Pseudomonas []. The study was supported by research done by W. Du which suggested that majority of the organism isolated were Klebsiella pneumoniae and Pseudomonas and cephalosporins are most active against a broad antimicrobial spectrum of activity that includes both gram-positive and gram-negative bacteria, as well as organisms[43]. The average duration of stay in the hospital for NICU patients was 5.06 ± 0.504 days similarly it was found in a study performed by A. Kumari et.al showed that the mean duration of their hospital stay was 6 days[40]. Among the 50 patients the most commonly prescribed antibiotic was gentamicin (14.50%), cefixime (14.50%), and cefotaxime (13.74%) these findings were supported by a study performed by S. Chatterjee et.al suggested that the majority of the antibiotic prescribed was gentamicin, cefotaxime[44]. The majority of the formulation of drugs prescribed for the 50 samples in the NICU were injections (79.39%), followed by oral drops (10.69%) ; this was supported by the study performed by S. Chatterjee et.al which stated that The intravenous route (92.1%) was the commonest route of drug administration[44]. The most commonly prescribed class was cephalosporins (29.01%), followed by aminoglycosides (22.90%).

WHO recommends an optimal value of 100% in prescribing drugs by generic name, while our study presented only 11.94%. Generic prescribing has been recognized to be much simpler, minimize dispensing errors, facilitate coordination and transparency between healthcare providers and clients, as well as being comparatively cheaper than branded drugs[38] The percentage of antimicrobials prescribed from the National Drug List was 20.06%, and the proposed optimal value by the WHO is 100%. The cDDD was calculated in various age groups by newborns

(1–28 days): cDDD = 1/10 − 1/8DDD; infants (28 days-1 year): cDDD = 1/8 − 1/4 DDD after calculating the doses it was found that the 11.5% of the patients received overdose, 33.6% of patients received accurate doses and 41% of the patients received underdose these findings were supported by [39].The variance in NICU between cDDD and weight based adjusted dose regimen was 0.1463.

VI. CONCLUSION:

This study showed the utilisation of antibiotics in paediatrics patients of SDA diamond hospital and medical research centre. This study concludes that the treatment regimen implemented in most of the cases is empirical which has a potential for antimicrobial resistance. Our study also highlighted some common prescribing trends in the hospital, which were polypharmacy and prescribing by brand name.

Regulation of dose in paediatrics has an important role in improving medical quality in paediatrics. Developing an evaluation method for medical therapy in paediatrics is a substantial challenge for the research community.[1]

Antimicrobial resistance is life threatening conditions and patient education along with adherence to the guidelines is the requirement of the hour and should be practised widely to decrease the global burden of such infections.

The present study reveals that the pattern of prescriptions in terms of rationality of antimicrobial FDCs remains poor. There is an urgent need to develop standards of antimicrobial drug prescriptions to avoid drug resistance.

Educational intervention to promote rational use of antimicrobial agents and awareness of the deleterious impact of irrational prescribing habits on the community and all members of the health care system are needed.

VII. LIMITATIONS:

● The study consists of a limited sample size, based on the patient flow and study duration.
● The study focused on the analysis of drug use amongst children in different age groups but did not consider the effects of weight and combined medications, which might influence the results.
● There were many aspects where data was available which led to data insufficiency.
● Lastly, cDUI and PDD/cDDD are not commonly used to evaluate the appropriateness of pediatric drug use, and the evaluation system needs further improvement

and should be jointly discussed by more scholars.

ABBREVIATIONS:
1. AGE- ACUTE GASTROENTERITIS
2. ATC- ANATOMICAL THERAPEUTIC CHEMICAL
3. AV- ANTERIOR-VENTRICULAR
4. cDDD- CALCULATED DEFINED DAILY DOSE
5. cDUI- CALCULATED DRUG UTILIZATION INDEX
6. CPM- CHLORPHENIRAMINE UI
7. CRF- CASE REPORT FORM
8. CST- CULTURE SENSITIVITY TEST
9. CVDs- CARDIOVASCULAR DISEASE
10. DDD- DEFINED DAILY DOSE
11. DUE- DRUG UTILIZATION EVALUATION
12. G6PD- GLUCOSE-6-PHOSPHATE DEFICIENCY
13. GBS- GUILLAIN BARRE SYNDROME
14. GCP- GOOD CLINICAL PRACTICES
15. HCL- HYDROCHLORIC ACID
16. HCPs- HEALTHCARE PRACTITIONER
17. HIE- HYPOXIC ISCHEMIC ENCEPHALOPATHY
18. ICF- INFORMED CONSENT FORM
19. ICH- INTERNATIONAL CONFERENCE OF HARMONIZATION
20. IPD- IN-PATIENT DEPARTMENT
21. IVH- INTRAVENTRICULAR HEMORRHAGE
22. LRTI- LOWER RESPIRATORY TRACT INFECTION
23. NICU- NEONATAL INTENSIVE CARE UNIT
24. OPD- OUT- PATIENT DEPARTMENT
25. PCM- PARACETAMOL
26. PD- PHARMACODYNAMIC
27. PDD- PEDIATRIC DAILY DOSE

AUTHOR'S CONTRIBUTION:
Mili Bulsari, Shlok Malusare, Vatsal Mehta and Akash Paghadal for designing and conducting the study, analyzing data, interpreting the results and drafting the manuscript.
Dr. Shwetha Swaminath and Dr. Alpesh Singhvi supervised the study and its critical review. All the authors gave the final approval of the version to be published.

AUTHOR DETAILS:
[1,2,3,.4]Pharm.D 6th year students, Department of Pharmacy Practice, Shree Dhanvantary Pharmacy College, Kim, Surat, Gujarat – 394110. [5]Assistant Professor, Department of Pharmacy Practice, Shree Dhanvantary Pharmacy College, Kim, Surat, Gujarat – 394110. [6]Pediatric Physician, M.D (Pediatrics), SDA Diamond Hospital and Medical Research Center, Surat, Gujarat- 395006.

REFERENCES:

[1].   India - age distribution 2021, Statista.
[2].   Ahmed S, Khan S, Khawaja A, et al. Impact of Missing Culture Sensitivity Tests on Antibiotic Resistance in Pediatric Patients. Pediatr Infect Dis J. 2022;41(2):e67-e71.
[3].   Guidelines: Indian Council of Medical Research: Government of India Guidelines | Indian Council of Medical Research | Government of India.
[4].   Introduction to drug utilization research. World Health Organization. World Health Organization; cited 2023Mar20.
[5].   Kumar SA, Latha VV, Chaitanya J, et al. Medication Utilization & Evaluation In Tertiary Care Hospital Using Who Core Prescribing Indicators.
[6].   Trinh NTH, Chahwakilian P, Bruckner TA, et al. Discrepancies in national time trends of outpatient antibiotic utilization using different measures: a population-based study in France. J AntimicrobChemother. 2018;73(5):1395–401.
[7].   Hu X, Zhang X, Wang Y, et al. Cross-sectional study on the drug utilization and evaluation indicator of antibiotics used in the pediatric population. BMC Health Services Brian J AndersonResearch. 2021 Dec;21:1-0.
[8].   Anderson BJ, Holford NHG. Understanding dosing: children are small adults, neonates are immature children. Archives of Disease in Childhood 2013;98:737-744.
[9].   Antibiotic intake in India rises by 30% in a decade, says report. Hindustan Times. 2021.
[10].   Ranjalkar J, Chandy S. India's National Action Plan for antimicrobial resistance – An overview of the context, status, and way ahead. Journal of Family Medicine and Primary Care. 2019;8(6):1828.et
[11].   CDC. Core elements of hospital antibiotic stewardship programs. Centers for Disease Control and Prevention. 2019.
[12].   C. Lee Ventola. The Antibiotic Resistance Crisis. 2015;40.
[13].   Lee CR, Cho IH, Jeong BC, et al. Strategies to minimize antibiotic resistance. Int J Environ Res Public Health. 2013 Sep 12;10(9):4274-305.
[14].   WHO Collaborating Center for Drug Statistics Methodology, Oslo Guidelines for ATC Classification and DDD Assignment; 2022.
[15].   Dahlén E, Kindblom JM, Kimland EE. Defined daily doses in pediatric dosing- a theoretical example. Pharmacol Res Perspect. 2023 Apr;11(2):e01061.
[16].   Maqbool M. Evaluation of drug utilization pattern in the pediatric department of a tertiary care hospital In Srinagar, Jammu & Kashmir, India. Journal of Applied Pharmaceutical Sciences and Research. 2020 Jun 13;6–9.
[17].   Potocki M, Goette J, Szucs TD, et al. Prospective Survey of Antibiotic Utilization in Pediatric Hospitalized Patients to Identify Targets for Improvement of Prescription. Infection. 2003 Dec;31(6):398–403.
[18].   Mohajer KA, Al-Yami SM, Al-Jeraisy MI et al. Antibiotic prescribing in a pediatric emergency setting in central Saudi Arabia. Saudi Med J. 2011 Feb 1;32(2):197-8.
[19].   Kanish R, Gupta K, Juneja S et al. Prescribing pattern of antibiotics in the department of pediatrics in a tertiary care medical college hospital in Northern India. Asian Journal of Medical Sciences. 2014 May 17;5(4):69–72.
[20].   Kazzaz YM, AlTurki H, Aleisa L et al. Evaluating antimicrobial appropriateness in a tertiary care pediatric ICU in Saudi Arabia: a retrospective cohort study. Antimicrobial Resistance & Infection Control. 2020 Nov 3;9(1).
[21].   Sharma S, Bowman C, Alladin-Karan B et al. Antibiotic prescribing patterns in the

pediatric emergency department at Georgetown Public Hospital Corporation: a retrospective chart review. BMC Infectious Diseases. 2016 Apr 19;16(1).

[22]. Labi AK, Obeng-Nkrumah N, Sunkwa-Mills G, et al. Antibiotic prescribing in paediatric inpatients in Ghana: a multi-centre point prevalence survey. BMC Pediatrics. 2018 Dec;18(1).

[23]. Zuppa AF, Adamson PC, Mondick JT, et al. Drug Utilization in the Pediatric Intensive Care Unit: Monitoring Prescribing Trends and Establishing Prioritization of Pharmacotherapeutic Evaluation of Critically Ill Children. The Journal of Clinical Pharmacology. 2005 Nov;45(11):1305–12.

[24]. Erbay A, Bodur H, Akıncı E, et al. Evaluation of antibiotic use in intensive care units of a tertiary care hospital in Turkey. Journal of Hospital Infection. 2005 Jan;59(1):53–61.

[25]. Gujar A, Gulecha DV, Zalte DA. Drug utilization studies using WHO prescribing indicators from India: A systematic review. Health Policy and Technology. 2021 Sep;10(3):100547.

[26]. Kumar P, Walker JK, Hurt KM, et al. Medication Use in the Neonatal Intensive Care Unit: Current Patterns and Off-Label Use of Parenteral Medications. The Journal of Pediatrics. 2008 Mar;152(3):412-415.e1.

[27]. Smith MJ, Gerber JS, Hersh AL. Inpatient Antimicrobial Stewardship in Pediatrics: A Systematic Review. Journal of the 28.