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STUDY OF PRESCRIBING PATTERNS OF ANTIMICROBIAL AGENTS IN THE PAEDIATRIC WARDS AT TERTIARY TEACHING CARE HOSPITAL, GUJARAT

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ABSTRACT

Keywords:

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Background: Prescription of drugs, which needs to be continuously assessed and refined according to disease progression. It not only reflects the physician's knowledge about drugs but also his/her skill in diagnose and attitude towards selecting the most appropriate cost-effective treatment. Antimicrobials are among the most commonly prescribed drugs in hospital. As per literature, they account for over 50% of total value of drugs sold in our country. Such studies have been sparse from Gujarat and hence, this study was undertaken.

Methods: Retrospective study was carried out by collecting 350 prescriptions containing antimicrobial agents in paediatric department at Sir Sayajirao General (SSG) Hospital, Vadodara to assess the prescribing patterns of antimicrobial agents. All information about the drugs details recorded in pre-tested Proforma that was finalized by our Pharmacology department.

Results: Total 350 prescriptions containing 690 antimicrobial drugs were prescribed in patients during study. Of them aminoglycosides (233; 33.77%) was frequently prescribed followed by β -lactam group (191; 27.68) and cephalosporins (176; 25.5%). Average numbers of antimicrobials per prescription was 1.97. Out of 690 antimicrobial prescribed, 576(83.48%) were prescribed by generic name, while 114(16.52%) were prescribed by trade name. Total numbers of antimicrobial prescribed by parenteral route were 599 (86.81%), while only 91(13.18%) antimicrobial agents were prescribed by oral route. Out of 350 prescriptions two or more than two antimicrobial agents were prescribed in 249(71.14%) prescriptions, while 101(28.85%) prescriptions constitute one antimicrobial agent.

Conclusion: Results indicates need for improving the prescribing pattern of drugs and minimizing the use of antimicrobial agents. It is suggested that further detail analysis to judge the rationality of the therapy is necessary.

INTRODUCTION: Prescription order is an important transaction between the physician and the patient ¹. It brings into focus the diagnostic acumen and therapeutic proficiency of the physician with instruction for palliation or restoration of the patient's

health ¹. Prescription of drugs is an important skill, which needs to be continuously assessed and refined accordingly. It not only reflects the physician's knowledge of pharmacology and pathophysiology of diseases but also his/her skill in diagnose and attitude

towards selecting the most appropriate cost effective treatment¹. It is an order for a scientific medication for a person at a particular time². Setting standards and assessing the quality of care through performance review should become part of everyday clinical practice³. Medical audits oversee the observance of standards of medical treatment at all levels of the health care delivery system. The study of prescribing patient is a component of medical audit which seeks monitoring, evaluation and necessary modifications in the prescribing practice of the prescribers to achieve the rationale and cost effective medical care.

Antimicrobials are among the most commonly prescribed drugs on worldwide basis. They account for nearly 20% of all new and repeat prescriptions each year. Hospital purchase of these drugs is thought to be about 25 to 30 % of the total annual drug budget⁴ and each tertiary care hospital in the United States typically spends more than \$1 million every year on the purchase of antimicrobial drugs alone. There is no doubt that these drugs have massive utilization that by no means can be less in India as compared to the developed countries.

Antimicrobials as a group contribute significantly to the cost of therapy. In India the prevalence of the use of antimicrobials agents varies from 24 to 67%. It is also estimated that they account for over 50% of total value of drugs sold in our country⁵. Keeping this in mind, it is not surprising that an increasing number of new antimicrobials agents are being made available regularly. With widespread use of antibiotics, the prevalence of resistance has increased⁶. The association of resistance with the use of antimicrobials agents has been documented both in patient⁷ and outpatient setting⁸.

Wide spread irrational usage of antimicrobial agents and their shortage of supply in the government hospitals, low purchasing capacity of patients and incidence of antimicrobial resistance complicates the outcome of the therapies⁹. Antimicrobial resistance among streptococcus pneumonia is rapidly increasing in several countries¹⁰ and the single most important factor in the emergence of antimicrobial resistance among respiratory bacterial pathogens is selection pressure from antimicrobial agents¹¹. It was found out in some studies, a link between rates of antimicrobial

agent's prescription and resistance in the communities^{12, 13}. In general practice antimicrobial agents usage is highest among children and approximately 70% of all the antimicrobial agents prescribed in children are for URTI¹⁴. As in other developed countries the most frequent type of misuse is prescribing antimicrobial agents for infections, which are commonly caused by virus¹⁵. Moreover there seems to be a large variation between physicians in antimicrobial prescribing¹⁶.

In the view of the emerging worldwide threat of bacterial resistance, there are increasing need to identify determinants and patterns of antimicrobial prescribing to identify where the clinical practice can be improved¹⁷. The present study was planned with the objectives;

1. To study the antimicrobial agent's utilization patterns in the different diseases and;
2. To study the existing prescribing practices of the antimicrobial agents by the physicians of paediatric department.

The data generated from this study would be helpful to communicate with the prescribers and suggest the various lacunae observed to improve the prescribing practice. The data will also be helpful in planning longitudinal studies on prescribing pattern and drug utilization patterns. Thus it will ultimately benefit the patients with fewer incidences of adverse effects with minimal rise in resistance strain of bacteria and reduction in the cost of therapy.

MATERIAL AND METHODS: This retrospective study was carried out by collecting prescriptions of the indoor patients admitted in the wards paediatric department at Sir Sayajirao General (SSG) Hospital, Vadodara to assess the prescribing patterns of antimicrobial agents. Total 350 prescriptions containing antimicrobial agents were collected from the hospital record section for the study. Prescriptions were collected irrespective of the indications. The data were collected in a proforma, containing information regarding age and sex of the patients as well as trade/generic name of antimicrobial drugs, numbers of drugs prescribed, their dosage, frequency, route of administration, duration of therapy along with the clinical diagnosis (**Annexure -1**).

Study of prescribing patterns of antimicrobial agents in the paediatric department at tertiary teaching care hospital, Gujarat

Data Acquisition Form

No.	Sex	Age	Fluroquinolones	β -lactam (Except CP) + Vancomycin	Cephalosporins	Others	Dose	Duration	Route	Diagnosis

Inclusion criteria: Patients taking other drugs for any existing diseases were not counted in the prescriptions. Only antimicrobial agents prescribed for any types of bacterial infections were included in the proforma. Also patients suffering from chronic diseases like tuberculosis were included in the study. However the antimicrobial combination containing AKT (3 or 4 drugs) were not included in the study.

The antimicrobial agents were divided into following major groups for the study;

- (1) β -lactams = β -lactams (except cephalosporins) +vancomycin
- (2) Cephalosporins,
- (3) Aminoglycosides,
- (4) Fluoroquinolones,
- (5) Sulfonamides
- (6) Metronidazole and;
- (7) Macrolides

Total numbers of the antimicrobial agents prescribed in each prescription were counted irrespective of numbers of the prescription. Basic drug indicators were selected to analyze the prescribing patterns¹⁸.The prescription data were analyzed on the basis of the following parameters.

- (1) Total numbers of the antimicrobial agents prescribed irrespective of number of prescription.
- (2) Mean numbers of the antimicrobial agents per prescriptions.
- (3) Prescribing frequency of antimicrobial agents.
- (4) Numbers of antimicrobial agents prescribed by generic vs. trade name.

(5) Numbers of antimicrobial agents administered orally or parenterally.

(6) Numbers of prescription with one or more than one antimicrobial agents.

Data were also analyzed by using prescribing patterns of antimicrobial agents for every infections involving different system like infection of Respiratory tract (RT), Gastrointestinal tract (GIT), Hepatobiliary tract (HBT), Central nervous systems(CNS), Genito urinary tract (GUT), Soft tissue and miscellaneous conditions (i.e. pyrexia of unknown origin).

Data were also analyzed by using Microsoft excel sheet. Proportions of different antimicrobial agents were calculated from the total number of antimicrobial agents prescribed. Further, proportions of the different antimicrobial agents prescribed for different systems were calculated.

RESULTS: Total 350 prescriptions of the patients admitted in the wards of paediatric department were studied during the period of October 2005 to June 2006. Total numbers of antimicrobial agents prescribed in the paediatric wards were 690. Therefore, average number of antimicrobials prescribed per prescription in the paediatric wards was 1.97 (**Table 3a**).

The results are summarized to study frequency of prescribing patterns of antimicrobial agents in different systems in accordance with diagnosis as well as prescribing frequency of antimicrobials using tables for wards.

(A) Preference of antimicrobial agents: During study period, highest numbers of antimicrobials prescribed were from aminoglycosides (233; 33.77%) while macrolides were the least (06; 0.87%) prescribed (**Table 1**). Among the total number of aminoglycosides prescribed, the highest were prescribed for respiratory tract infections (39.91%) and the lowest for soft tissue

infections (1.29%) (Table 1). Also of among the total number of aminoglycosides prescribed amikacin (73.82%) and gentamicin (21.18%) were prescribed (Table 2, Fig. 1).

Similarly, among the total numbers of antimicrobials prescribed from β -lactams group (191; 27.68%), highest numbers were prescribed for respiratory tract infections (60.20%) and the lowest for soft tissue infections (0.52%) (Table 1). From the β -lactam group, coamoxy-clav (36.65%) (Fig. 1) and ampicillin (21.47%) were prescribed more frequently, while cloxacillin (1.05%) was the least prescribed drug (Table 2).

From the cephalosporins (176; 25.51%), highest numbers were prescribed for miscellaneous conditions (34.1 %) followed by respiratory tract infection (28.98%) while the least (1.34%) was used for soft tissue infections (Table 1). Among the cephalosporins, cefotaxime (89.77%) (Fig.1) was almost prescribed consistently, while cefadroxyl (0.56%) and ceftazidime (0.56%) were not prescribed frequently (Table 2).

From the total numbers of fluoroquinolones (59; 8.55%) prescribed, highest numbers were prescribed for gastrointestinal (32.20%) and genitourinary tract (25.42%) infections, while the lowest was for soft tissue (1.69%) infections and none for either hepatobiliary diseases or for prophylactic purposes (table 1). However among fluoroquinolones,

ciprofloxacin (89.83%) (Fig. 1) was prescribed extensively, while surprisingly norfloxacin (1.69%) and gatifloxacin (1.69%) has very low preference in the prescriptions (Table 2).

Metronidazole, sulfonamides (cotrimoxazole) and macrolides (erythromycin) have very low frequency of prescription. All the three antimicrobials were prescribed for respiratory tract infections. However both metronidazole and cotrimoxazole were prescribed for gastrointestinal tract infections, while metronidazole was also prescribed for miscellaneous conditions (Table 1).

(B) Frequency of prescribing patterns of antimicrobial agents in accordance with diagnosis: Highest numbers of antimicrobial agents were prescribed for respiratory tract infections (278, 40.3%) followed by for miscellaneous conditions (182; 26.37) and the infection involving central nervous system. Among the total numbers of antimicrobial prescribed for respiratory tract infections; the highest numbers were prescribed from β -lactam group followed by aminoglycosides and cephalosporins. Similarly among the total numbers of antimicrobials prescribed for miscellaneous conditions, highest numbers were prescribed from aminoglycosides followed by cephalosporins and β -lactam group. However for soft tissue infections aminoglycoside, cephalosporin and sulfonamide were prescribed (Table 1).

TABLE 1: FREQUENCY OF PRESCRIBING PATTERNS OF ANTIMICROBIAL AGENTS IN DIFFERENT SYSTEMS IN ACCORDANCE WITH DIAGNOSIS

Antimicrobial Agents prescribed	Total Prescribed No (%)	RS No (%)	CNS No (%)	CVS No (%)	GIT No (%)	GUT No (%)	HBT No (%)	MISC No (%)	PROPH No (%)	Soft tissue No (%)
Aminoglycosides	233 (33.77)	93 (39.91)	27 (11.59)	08 (3.43)	15 (6.74)	08 (3.43)	05 (2.15)	66 (28.33)	08 (3.43)	03 (1.29)
β -lactams (except CP)+ Vancomycin	191 (27.68)	115 (60.20)	11 (5.75)	04 (2.09)	05 (2.61)	03 (1.57)	09 (4.71)	38 (19.9)	05 (2.61)	01 (0.52)
Cephalosporins	176 (25.51)	51 (28.98)	34 (19.91)	06 (3.41)	10 (5.68)	04 (2.27)	05 (2.84)	60 (34.1)	04 (2.27)	02 (1.34)
Fluoroquinolones	59 (8.55)	09 (15.25)	02 (3.39)	02 (3.39)	19 (32.20)	15 (25.42)	00 (0.0)	11 (18.64)	00 (0.0)	01 (1.69)
Metronidazole	15 (2.17)	04 (26.7)	00 (0.0)	00 (0.0)	04 (26.7)	01 (6.7)	01 (6.7)	05 (33.33)	00 (0.0)	00 (0.0)
Sulfonamides	11 (1.59)	03 (27.27)	00 (0.0)	00 (0.0)	04 (36.4)	00 (0.0)	01 (9.09)	01 (9.09)	00 (0.0)	02 (18.2)
Macrolides	06 (0.87)	03 (50)	00 (0.0)	01 (16.66)	00 (0.0)	01 (16.66)	00 (0.0)	01 (16.66)	00 (0.0)	00 (0.0)
Total	690 (100)	278 (40.3)	74 (10.72)	20 (2.89)	57 (8.26)	32 (4.63)	21 (3)	182 (26.37)	17 (2.46)	09 (1.3)

RS: - Respiratory system; CNS: - Central nervous system; CVS: - Cardiovascular system; GIT: - Gastrointestinal tract; GUT: -Genito urinary tract; HBT: - Hepatobiliary tract; PROPH: -Prophylaxis; MISC: -Miscellaneous including Pyrexia of unknown origin, Malaria, Tetanus, Septicaemia, Poisoning, Septic hip arthritis; CP-Cephalosporins

TABLE 2: PRESCRIBING FREQUENCY OF ANTIMICROBIALS

Sr. No.	Antimicrobial agents	No. (%)	Sr. No.	Antimicrobial agents	No. (%)
1)	Aminoglycosides			Cefipime	05(2.84)
	Amikacin	172(73.82)		Cefadroxyll	01(0.56)
	Gentamicin	61(21.18)		Ceftazidime	01(0.56)
2)	β -lactam (Except CP) + vancomycin		4)	Fluoroquinolones	
	Coamoxy-clav	70(36.65)		Ciprofloxacin	53(89.83)
	Amoxykid	29(15.18)		Ofloxacin	04(6.78)
	Ampicillin	41(21.47)		Gatifloxacin	01(1.69)
	Cloxacillin	2(1.05)		Norfloxacin	01(1.69)
	Tazobactam + Piperacillin	34(17.80)	5)	Metronidazole	
	Vancomycin	09(4.71)		Metronidazole	15(2.17)
	Crystalline penicillin	3(1.57)	6)	Sulfonamides	
	Meropenum	3(1.57)		Cotrimoxazole	11(1.59)
3)	Cephalosporins		7)	Macrolides	
	Cefotaxime	158(89.77)		erythromycin	6(0.87)
	Ceftriaxone	11(6.25)		Total	690(100)

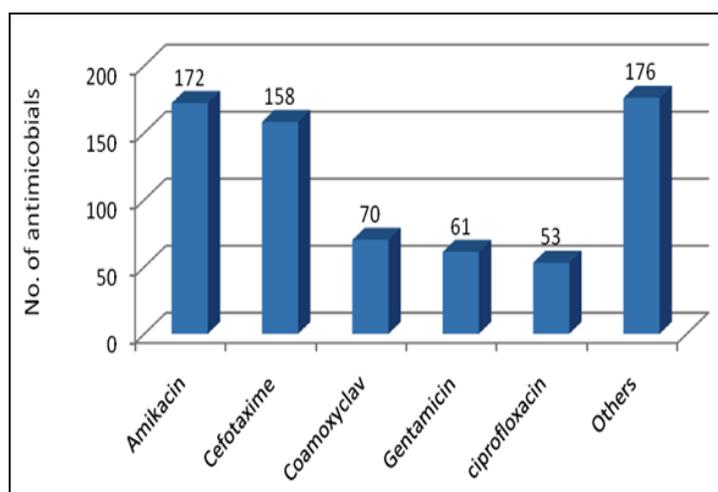


FIG. 1: FIVE MOST COMMONLY PRESCRIBED ANTIMICROBIALS

(C) **Route of administration:** Analyzing total 690 numbers of antimicrobials prescribed, it was observed that 599 (86.81%) antimicrobial agents were prescribed for parenteral administration while only 91(13.18%) were for oral route (Table 3b).

(D) **Generic vs. trade name:** Out of 690 antimicrobials agents prescribed, 576 (83.48%) were prescribed by generic name while rest 114 (16.52%) were prescribed by trade name (Table 3c).

(E) **Number of antimicrobial agents per prescription:** Among 350 prescriptions studied, it was found that only 101(28.86%) prescriptions constitute single antimicrobial agents while 249(71.14%) prescriptions contains either two or more than two antimicrobial agents (Table 3d).

TABLE 3: PRESCRIPTION ANALYSIS IN PEDIATRIC WARDS

TABLE 3a:

Total no. of prescriptions	350
Total numbers of antimicrobial agents prescribed	690
Mean numbers of the antimicrobial agents per prescriptions	1.97

TABLE 3b: ROUTE OF ADMINISTRATION

Antimicrobial administered by route	Total Number (%)
Parenteral	599(86.81)
oral	91(13.18)
Total	690(100)

TABLE 3c: ANTIMICROBIAL AGENTS PRESCRIBED BY NAME

Antimicrobial agents prescribed by Name	Total Number (%)
Generic name	576(83.48)
Trade name	114(16.52)
Total	690(100)

TABLE 3d: NO.OF PRESCRIPTION WITH ONE OR MORE THAN ONE ANTIMICROBIAL AGENTS

Number of prescription with one or more than one antimicrobial agents	Total Number (%)
More than	249(71.14)
One	101(28.86)
Total	350(100)

DISCUSSION: A prescription by a doctor may be taken as a reflection of physician's attitude to the diseases and the role of drug treatment. It also provides an insight into the nature of health care delivery system

¹⁹. Several classes of antimicrobial agents have been discovered and hundreds of them are available today. Antimicrobial agents are life saving in many conditions. With the advent of antibacterial therapy death from an incurable bacterial infection is considered a thing of past. These drugs are the most widely used category of drugs in the world accounting for over one quarter of hospital drug costs²⁰.

In our study, it was found out that aminoglycosides were commonly prescribed antimicrobials followed by β -lactam group and cephalosporins. Amikacin, coamoxy-clav and cefotaxime were frequently prescribed. Wider use of amikacin observed in our study may be due to its broad antibacterial spectrum and drug of choice for the most cases of hospital acquired gram negative sepsis, as it is effective against organisms resistant to other conventionally used aminoglycosides (i.e. gentamicin, tobramycin). Also physician's choice and easier availability in hospital pharmacy may also dictate a rather heavy use of a particular drug. Other factor contributing to the preferential uses of the above antimicrobial agents in the wards may be due to their low cost with better safety profile and ease of their availability from hospital pharmacy.

A study carried out in eastern Nepal reported that, gentamicin, ampicillin, crystalline penicillin, cefotaxime were the most commonly prescribed²¹. Same research study was carried out in a tertiary hospital; Bangladesh (2004) reported that ampicillin, gentamicin, amoxicillin, cloxacillin and ceftriaxone were prescribed frequently²². We observed the antimicrobial prescribing pattern which is in consonance with the studies carried out at these places. During study we have observed that, highest numbers of antimicrobial agents were prescribed for respiratory tract infections. Among the total numbers of antimicrobial agents prescribed for respiratory tract infections, highest numbers were prescribed from β -lactam and aminoglycosides groups.

The types of antibacterials used at each centre depend on many factors like the patient profile, type of infection, availability of antimicrobial, susceptibility patterns, the prescriber's awareness on rational antimicrobial use etc. Such statistics form an important index of ongoing antimicrobial audit as they indicate

the changes in the pattern of usage accordance with the susceptibility patterns of bacteria. They also indicate the extent of use of newer antimicrobial agents.

Data analysis in our study showed that numbers of prescription with two or more than two antimicrobial agents is quite high as compared to those with single antimicrobial agent. Mean number of drugs per prescription was 1.97. This indicates a large numbers of prescriptions in our study were for multiple drugs. This may indicate empirical nature of therapy. A study carried out in Kathmandu valley (2004) reported that, a high percentage (93%) of patients were prescribed at least one antibiotic²³. These figures are quite opposite to our study. A study carried out by Marlies *et al.*, (1998) reported that 36% of the patients were prescribed at least one antibiotic²⁴. These reports are similar to our study. Prakash *et al.*, (1989) and Ansari *et al.*, (1998) found this number to be 5.86 and 5.05 medicines per prescription respectively in their studies^{25, 26}. These figures are quite high as compared to our study.

Average number of the drugs per prescription is an important index of the scope for review and educational intervention in prescribing practices. One must remember that the benefit: risk ratio for each drug decreases when multiple drugs are given. Extreme and empirical treatment is an important cause of irrational antimicrobial use. It is preferable to keep the mean number of drug per prescription as low as possible. Since, the highest figures always lead to increased risk of drug – drug interaction²⁷.

In study, it was found out that 86.81% antimicrobial agents were prescribed for parenteral administration, while only 13.18% were for oral route in paediatric patients. A study carried out in Kathmandu valley (2004) showed that, 75% of antibiotics were given by injections²³.

These figures are somewhat similar to our study. The parenteral use of drugs in general and antibacterial in particular is important parameters to judge rationale drug use. Unnecessary use of parenteral antimicrobial adds to cost of therapy and also increases the risk of blood borne infections.

In countries where disposable needles and syringes are scarce and the sterilization facilities are unsatisfactory, the administration of drugs by injection should be kept to the minimum required. Preference to parenteral route over oral route observed in our study could be due to study conducted in the indoor patients.

In our study observed that antimicrobial agents were prescribed more frequently by generic name (83.48%) as compared to trade name (16.52%). A study carried out by Nazima *et al.*, showed that 77.61% of the drugs were prescribed by generic name, while remaining by trade name²⁸. These reports are similar to our study. These show that apparent control over the prescribing habits of the physicians for indoor patients at our hospital. The most probable reason for such prescribing may be due to easier availability of antimicrobial agents in our hospital pharmacy as well as proper communication between the prescribing physicians and the hospital authority.

Our study had a number of limitations. The study was retrospective and seasonal variations were not considered. The patient care indicators were not studied. The study was limited to only a paediatric department. Also, further studies for a longer period of time in all the clinical departments are required. The data presented here will be useful in future, long term and more extensive drug utilization studies in the hospital and in promotion of rational prescribing and drug use in hospitals.

CONCLUSION: Pooled data from this study showed that prescribing frequency of antimicrobials more frequently for respiratory tract infections. Because of wider spectrum co-amoxyclav, cefotaxime, amikacin and ciprofloxacin were commonly prescribed. Positive finding in this study is more numbers of antimicrobials are prescribed by using generic name but on the other side more numbers of multiple drug prescriptions found out and antimicrobials are administered by using parenteral route more frequently. So this result indicates a scope for improving the prescribing pattern of drugs and minimizing the use of antimicrobial agents. It is observed that further detail analysis in respect to selection of dose, frequency and duration of therapy of antimicrobial agents used in the wards is needed as per criteria's of Kunin *et al.*,²⁹ to judge the rationality of the therapy

Improvement for prescribing habit would be facilitated by providing feedback, prescriber education and various intervention strategies like introduction of hospital formulary, control by institutional regulatory authorities, and utilization of antibacterial susceptibility test. We propose to make suitable intervention in future and to assess their impact on the utilization of antibacterial drugs in our hospital.

More emphasis needs to be laid on teaching the art of writing a prescription to undergraduate and postgraduate medical students. A one week posting in clinical pharmacology and therapeutics if possible, should be taught over during internship and this period should be utilized in teaching prescription writing and rational drug therapy.

Here, it is important to incorporate local data on the hospital microbiological flora along with epidemiologic data to formulate guidelines for empirical antibiotic usage and de-escalation therapies so as to aid clinicians to make appropriate antibiotic choices for their patients.

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