Research Article

Prevalence and Pattern of Antibiotic Usage in Paediatric Patients Admitted in a Tertiary Care Hospital of Bihar: An Observational and Cross-sectional Study

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ABSTRACT

Resistance to antimicrobial drugs is a global threat now. It creates burden on the health system financially and also increases the morbidity rate in pediatric age group attributed to infectious disease. To overcome this issue, it is inevitable to have pre-set guidelines for the pediatricians at the institution level. The current study was done to have an understanding of the antibiotic use among the pediatric patients admitted in the hospital. The study has also envisaged the pattern of antibiotics use among these children. An observational study was conducted among patients admitted to the inpatient paediatric department of a referral centre of Bihar, India during the period from April 2019 to March 2020. A total of 557 children were included in our study. Out of them, majority belonged to the age group of <5 years. Overall, 60% have received antibiotic in any form. Study participants were categorized based on the predefined criteria, requiring antibiotic, can be given antibiotics and antibiotics not required are 12.93%, 38.78% and 48.29%, respectively. Patients with respiratory, gastrointestinal and systemic infections comprised the majority of the cases. Antibiotic use was most commonly among those with respiratory and systemic infectious disease. Among the prescribed antibiotics, cephalosporin, penicillin group and azithromycin constitute more than 90% of the prescriptions. Irrational use of antibiotic is a threat to the health care system, that poses monetary loss to the system and the creates microbial resistance. World health Organization has recommended to have a strict surveillance system for all the hospitals to overcome this problem.

Keywords: Antibiotic resistance, Antibiotic prescription, Infectious diseases, Total White Blood count, Haemoglobin Status.

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INTRODUCTION

Antimicrobials are lifesaving drugs for the management of bacterial infections. These are the most commonly used drugs among all medications prescribed to paediatric patients. Their indiscriminate use increases the risk of antimicrobial resistance and thus has prompted their judicious prescribing in paediatrics practice. [1-3] Antibiotics are over-prescribed worldwide, but the practice of over-prescribing is more common in low- and middle-income countries (LMICs), where standard treatment guidelines are not available or implemented, and infection rates are high. [4] Inappropriate use leads to antibiotic resistance which consequences into limited treatment options, treatment failures, increased cost of therapy, adverse drug reactions (ADRs) and increased patient mortality and morbidity. The World Health Organization (WHO) has recognized antibiotic resistance as a global public health threat and identified local prescribing surveillance studies as a crucial step to slow down the emergence of resistance.[5-7] To encounter such infectious diseases are not an uncommon phenomenon among paediatric patients in India. These infections lead to increased mortality.[8]

Antibiotics are inevitable to control such infections. But at the same time, judicial use of these drugs is also very important so as to reduce the mortality following this infectious disease. [5] In spite of this known fact, antibiotics are often found to be prescribed inappropriately, either in terms of usage or dosage to combat infections. Many previous researchers have addressed this issue across various parts of the country and they unanimously concluded that antibiotics are one of the most commonly prescribed drugs. [9, 10] These prescriptions included pediatric patients as well. Acute respiratory tract infections and diarrhoea are among the most common cause of OPD attendance among pediatric patients and most of these infections are caused by viruses, where use of antibiotics is not at all mandatory pr recommended. [10-15] According to World Health Organization, list of essential medicines must be implemented nationwide to assure quality treatment with rational use of medicines. [5] If implemented correctly, it would help to address this problem of unnecessary antibiotic use and would eventually turn down antibiotic resistance. Hence, all the practicing paediatrician are supposed to follow the guidelines led by the Indian

Academy of Paediatrics. The guideline enlists the essential medicines (IAP-LEM).[16] This list has 16 antibiotics with their dosage along with their route of administration for children.

One major challenge for pediatricians is to treat infections in neonatal intensive care units as these are extremely difficult to treat. [17, 18] Prescription audit is one step towards providing information on pattern of diagnosis specific antibiotic use, to help in appropriate use of such life saviour drugs. [19, 20] WHO also recommends documentation of this pattern of antibiotic use among admitted pediatric patients, so that it can be compared across various health facilities to identify problem areas. [21, 22] Majority of the studies in this field in India have focused their research among the out-patients of public hospital, though higher antibiotic use has been documented in private sector. [10, 11, 23, 24] These private hospitals are also the major service providers in our country. [9-11, 23, 24] Also, there is a dearth of study to address association between antibiotic use with the appropriate indication among paediatric in-patients. This creates a barrier to understand over- or under- use of antibiotics. With this view, it is inevitable to monitor usage and dosage of these drugs for every health care facility. [25]

This study was designed to know the prevalence and pattern of uses of antibiotics in admitted paediatric patients according to the disease condition and also data on indiscriminate use of antibiotic. So that the treating paediatrician of our institute could be having an insight of such findings. This would in turn made them cautious while prescribing antibiotics.

MATERIALS AND METHODS

Study site-This study was conducted in the Department of Paediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India.

Study duration- One year from April 2019 to March 2020

Study design- This was an observational study with cross-sectional design. Case sheets of 557 children belonging to age group of 2 months to 12 years who were admitted in Paediatric department of the hospital were reviewed. Necessary consent from parent or guardian was taken during admission process or during hospital stay.

Inclusion criteria:

1) Children of age group from 2 months to 12 years
2) Either gender.
3) Every child discharged on 3rd day of each week from paediatric ward

Exclusion criteria: Children who had discontinued the treatment like absconded after admission, discharged against medical advice and transferred to another centre were excluded from this study.

Sample size: Sample size was calculated using an online software taking margin of error 3%, Confidence level 95%, Population size 3000 (Approximately 3000 children below 12 years of age gets admitted in NMCH, Patna) and 80% as population proportion (this proportion or prevalence of antimicrobial prescription among admitted paediatric patients was taken from previous study). [26] In this way, bed head ticket of 557 children were studied in this study, based on inclusion and exclusion criteria.

All the bed head ticket of children discharged on every 3rd day (twice in week) from paediatric ward during the study period were analysed, scrutinized and relevant data was collected. Out of 768 such tickets, 557 were included in the study based on inclusion and exclusion criteria.

Data collection: Treatment to the study participants were given according to the standard protocol of respective unit. Following details were collected at the time of discharge:

1) Basic details of patient like age, gender
2) Chief complaints of patient
3) Provisional or confirmed diagnosis
4) Investigations performed like complete blood count (emphasis on total WBC count and Haemoglobin (Hb%)
5) Treatment given- Different class and number of Antimicrobials given during treatment

Children in this study group were divided into three groups according to requirement of antibiotics for their disease condition

1) Group 1 (Antibiotic must require): - like cellulitis, abscess, pyogenic meningitis, acute dysentery. In this category antibiotics were must require due to definite bacterial cause of the illness.
2) Group 2 (Antibiotic can be used): - Like acute watery diarrhoea, bronchopneumonia etc. In this category antibiotics can be used because causative agent of these disease may be either bacterial or another microbial agent.
3) Group 3 (Antibiotic not required): - Like acute viral bronchiolitis, bronchial asthma etc. In this category antibiotics were not required due to non-bacterial cause.

Statistical analysis: Data collected was tabulated and analysed using GraphPad Instat software and Microsoft Excel software. Association between antibiotic use and different factors were analysed by Chi-square test using both two rows, two columns and large contingency table when more rows and columns were present. Statistical significance was considered for a p value <0.05.

RESULTS

A total of 557 pediatric prescriptions were included in the final analysis. Age of children less than 2 years, 2-5 years and 5-12 years were 167 (29.98%), 186 (33.39%) and 204 (36.63%) respectively. 311 (55.83%) were males and 246 (44.17%) were females in this study group.

Table 1: Distribution of Antibiotic use in different age group and gender (n = 557)

	Frequency and Percentage	Antibiotic use		χ2 value	df@	p value
		Yes	No			
Age category (years)	< 2 years (n=167, 29.98%)	97 (58.08%)	70 (41.92%)	3.795	2	0.1499
	2-5 years (n=186, 33.39%)	122 (65.59%)	64 (34.41%)			
	>5 years (n=204, 36.63%)	115 (56.37%)	89 (43.63%)			
Gender	Male (n=311, 55.83%)	190 (61.09%)	121 (38.91%)	0.374	1	0.54
	Female (n=246, 44.17%)	144 (58.54%)	102 (41.46%)			

65% (362) of children had normal WBC count (normal range 4000 to 11000). WBC count was abnormal in 35% (195) of children. In 49.91% (278) of children had normal haemoglobin status while 50.09% (279) of children were anaemic.

Table 2: Comparison of Antibiotic use with patient's Total WBC count and Haemoglobin status (n = 557)

	Frequency and Percentage (n=557)	Antibiotic use		χ2 value	df@	p value
		Yes	No			
Total WBC count status	Normal (n=362, 64.99%)	209 (57.73%)	153 (42.27%)	2.141	1	0.1435 Not Significant
	Abnormal (n=195, 35.01%)	125 (64.10%)	70 (35.90%)			
Hemoglobin status	Normal (n=278, 49.91%)	151 (54.32%)	127 (45.68%)	7.374	1	0.0066 Very Significant
	Anemia (n=279, 50.09%)	183 (65.59%)	96 (34.41%)			

Out of 557 admitted children, 334 (59.96%) had received antibiotics (oral or parenteral). 223 (40.04%) admitted children were treated without antibiotics. Most common antibiotic used was intravenous ceftriaxone (n=94, 28.14%). Among different antibiotic groups, 85 % (n=285) of the prescription was contributed by cephalosporin, penicillin group (ampicillin, amoxycillin and amoxycillin-clavulanate) and azithromycin.

Table 3: Different antibiotics used among children admitted in paediatric ward (n=334)

	Antibiotics used (n=334)	Frequency	Percentage
1.	Ceftriaxone	94	28.14
2.	Azithromycin	53	15.87
3.	Amoxiclav	44	13.17
4.	Amoxicillin	28	8.39
5.	Cefotaxime	23	6.89
6.	Cefixime	20	5.99
7.	Ampicillin	18	5.39
8.	Metronidazole	16	4.79
9.	Amikacin	12	3.59
10.	Doxycycline	10	2.99
11.	Ciprofloxacin	7	2.09
12.	Cotrimoxazole	3	0.9
13.	Cefadroxil	2	0.6
14.	Cefpodoxime	2	0.6
15.	Gentamicin	1	0.3
16.	Linezolid	1	0.3

Out of 557, children admitted for diseases like respiratory, infectious, gastrointestinal, central nervous system, cardiovascular and renal system were 206, 145, 95, 42, 20 and 15 respectively and out of them 70.38% (n=145), 71.72% (n=104), 44.21% (n=42), 30.95% (n=13), 25% (n=5) and 80% (n=12) had received either oral or parenteral antibiotics respectively, also 46.6% (n=96), 58.62% (n=85), 28.42% (n=27), 59.52% (n=25), 80% (n=16) and 0% respectively did not required antibiotic because they had non-bacterial cause for their illness.

Table 4: Antibiotic requirement and their use according to systemic disease (n=557)

	Systemic disease in admitted paediatric patients (n=557)						
	Respiratory (n=206)	**Gastrointestinal (n=95)**	**Infectious disease (n=145)**	**Central Nervous System (n=42)**	**Cardiovascular (n=20)**	**Renal system (n=15)**	**Others (n=34)**
Antibiotic requirement (n=557)							
Must required (n=72, 12.93%)	6 (2.91%)	9 (9.47%)	51 (35.17%)	0	1 (5%)	3 (20%)	2 (5.88%)
Can be required (n=216, 38.78%)	104 (50.49%)	59 (62.11%)	9 (6.21%)	17 (40.48%)	3 (15%)	12 (80%)	12 (35.29%)
Not required (n=269, 48.29%)	96 (46.6%)	27 (28.42%)	85 (58.62%)	25 (59.52%)	16 (80%)	0	20 (58.83)
χ2 value- 174.94, df@- 12, p value- <0.0001(Very Significant)							
Antibiotic used out of total cases (n=557)							
Yes (n=334, 59.96%)	145 (70.38%)	42 (44.21%)	104 (71.72%)	13 (30.95%)	5 (25%)	12 (80%)	13 (38.24%)
No (n=223, 40.04%)	61 (29.61%)	53 (55.79%)	41 (28.28%)	29 (69.05%)	15 (75%)	3 (20%)	21 (61.76%)
χ2 value- 61.602, df@- 6, p value-<0.0001 (Very Significant)							

DISCUSSION

Out of 557 children, antibiotic was given to 334 (60%) children. Class, dose, duration and route of antibiotic given in these children was according to the type of disease. According to guidelines on antibiotic use laid by WHO in the year 2006, the average number of medicines that can be prescribed should be limited to 2 where 30% of these medicines could be antibiotics and 20% could be used in injectable form. [26] Inspite of such set guidelines, various researchers had concluded the percentage of antibiotic prescription >30%. [27] This pattern of antibiotic varies from country to country like it is 81.3% in Sudan, 71.1% in Nigeria, and 81.1% India. [28-30]

Such resistance to drugs is seen not only with bacteria, it is seen with all categories of microbes that includes virus, rickettsia, chlamydia, fungus and parasites. [31] Development of superbugs is basically due to presence of resistant microbial genes and non-judicial use of antimicrobial drugs. [32] Development of resistant genes occurs by natural selection over a long period of time. One of the factors that accelerates this process is overuse of antibiotics in clinical practices along with other industries using these drugs. [33] Though this has emerged as a global threat in past decade [32, 33], developing and economically poor countries are more at risk due to poor compliance to set guidelines and delay in diagnostic facility. [34] Another contributing factor may be developing global market with migration of communities for trade purpose. In low economic set up, patients' inability to afford investigations to confirm pathogenic organism led to over-treatment among patients with common conditions like acute respiratory illness, acute diarrheal illness. In a study done by Bharathiraja et al in Chennai nearly 80% of children with acute respiratory infection and acute diarrheal disorders' have received antibiotic therapy. [35] They also concluded that fever was one of the most prominent reasons to start antibiotic therapy among such patients. In our study, children with clinical diagnosis suggestive of acute bacterial infection are the definite candidates for either oral or parenteral appropriate antibiotic therapy. Such children constitute 13% of the study population. When those conditions with the possibility of both viral and bacterial causes are added another 38.3% of cases required antibiotics. Hence, careful analysis of the case history and definite investigations along with consideration of standard guidelines of antimicrobial use are the ways to restrict non-judicial use of such drugs. Xiayoun Liang conducted a study in China and they documented this over-use of antibiotics for respiratory illness among 43% of their study population. [36] Poland implemented health care reforms and documented 50% reduction in the cases of antibiotic use in common clinical conditions like acute watery diarrhea. [37] Apart from health-related problems, such resistance also increases the treatment cost proportionately and creates a financial burden to the health system. [38] Another problem associated with such non-judicial use is destruction of commensals that further adds to development of resistance and transfer

to pathogenic strains. [32] Hence, surveillance of judicial use of antimicrobial drugs with documentation is inevitable to overcome and hold this threat. [39]

Apart from this, decision on using appropriate group of anti-microbial drug is also equally important. The development of such resistance to antimicrobial drugs not only depends on the prevalence of use or non-judicial use but also on the end group of antibiotics being used. This depends on the type of cases being admitted in the hospital. Using broad spectrum antibiotics has been justified by the concerned authority while use of specific group of antibiotics requires diagnostic evaluation but will help to reserve the broad-spectrum antibiotics in future or in non-responding cases. In our center, injection ceftriaxone is the antibiotic most frequently used and it was prescribed among one third of the antibiotic group. This is similar to a study done in Bangalore where the major class of antibiotics used was cephalosporin group. [40] In a study done in Switzerland the inappropriate and overuse of antibiotic rate was 9-64%. [41] In European countries, Penicillin group is the most predominant group of antibiotics being used especially in pediatric outpatient departments as well as the hospitalized patients. [31, 42] In the study done in Jaffna, 54% of children received antibiotics and the most commonly used antibiotic was penicillin group. [43]

Further analysis revealed that children admitted with various types of respiratory illness and systemic infectious diseases, 145 (70.38%) and 104 (71.72%) have received antibiotics respectively. In other studies, also respiratory system involvement is the predominant condition for hospitalization and antibiotic prescription in pediatric practice. [44] In a study done by Pennie et al, majority of the cases had some or the other form of respiratory illnesses. In their study, 82.1% of children treated with antibiotic include acute otitis media, acute pharyngitis and acute bronchitis. [45] Among the infectious diseases viral infections are also given antibiotics both in developed and developing countries. This is due to diagnostic uncertainty and overlap of symptoms, as discussed above. [46] In our study, systemic infections and children with respiratory infections predominates the group of patients receiving antibiotic therapy. It has been suggested that if investigations to establish any bacterial etiology cannot be performed and the patient is not acutely ill, antimicrobial can be withdrawn. [47]

CONCLUSION

This misuse of such a lifesaving group of drugs, antimicrobials have to be contained at any cost not only in human medicine, but also in veterinary medicine, agriculture, and aquaculture along with agricultural industry. Intensive awareness programs to educate not only the physicians but only the patients are the need of the hour.

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