SHORT COMMUNICATION

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Antibiotic Utilization in a Healthcare Resource Limited Setting of South India

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Abstract

Background: The "more-is-better" antibiotic prescribing philosophy contributes to suffering and mortality in children, along with resistance. Limited data on antibiotic usage in pediatric populations in India underscores the need for pharmaco-surveillance measures. **Aim and Objectives:** The descriptive cross-sectional study was performed in the pediatric outpatient department dispensing pharmacy of a rural secondary care referral hospital in south India, to investigate the antibiotic prescribing pattern and its utilisation. **Materials and Methods:** The six-month study approved by the ethics committee was performed in the pediatric outpatient department dispensing pharmacy and included patient prescriptions of infants and children between 1 month and 12 years of age of both genders, diagnosed with infections and prescribed antibiotics. Patient information, including health status, antibiotic details and prescription trends, was collected with consent. Antibiotic prescribing pattern and their use were investigated with the help of World Health Organisation access, watch, reserve antibiotics and core prescribing indicators. **Results:** Among 120 pediatric prescriptions, cephalosporins (48.09%) were the most prescribed antibiotic followed closely by penicillins and macrolides, among which ceftriaxone (33.59%) was highly used. Antibiotics prescribed were in line with the World Health Organisation (WHO) standards of optimal value. In addition, the access to watch index was observed to be less than 1, with 48.09% watch category of antibiotics. **Conclusion:** In conclusion, pediatric antibiotic prescribing and utilisation were adequately studied which found notable discrepancies, with the access to watch index being less than 1. Therefore, it is crucial to implement pediatric antibiotic stewardship programs to address the negative effects of improper antibiotic use.

Keywords: Access Watch Reserve, Antibiotics, Prescribing Pattern, Utilisation, WHO

Abbreviations: WHO: World Health Organization. G7: Group of Seven. OPD: Out-Patient Department. FDCs: Fixed Dose Combinations. ARPEC: Antibiotic Resistance and Prescribing in European Children. INRUD: International Network of Rational Use of Drugs.

1. Introduction

Antibiotic resistance can cause serious illnesses, longer hospital stays, higher healthcare expenses, and treatment failures[1,2]. Pediatric patients are often prescribed antibiotics[3-7] based on adult data[8-10], leading to potential misuse in newborns and young children[11,12]. This "more-is-better" approach, combined with resistance, greatly impacts suffering and mortality in children[13]. There is a lack of comprehensive data on pediatric antibiotic use worldwide[14,15], especially in India[16-19], emphasising the importance of regional surveillance and antibiotic stewardship in this population, which is crucial in promoting appropriate antibiotic use, improving patient outcomes and preventing infections[20]. In 2022, the Group of 7(G7) countries committed to setting measurable goals for human antibiotic consumption, focusing on quantity and appropriateness[21]. The WHO's 13th General Programme of Work aimed for at least 60% of national antibiotic usage to be access to antibiotics[22]. The WHO's

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Access/ Watch/ Reserve (AWaRe) system[23] provides a simple framework to group antibiotics into categories for stewardship. The WHO core prescribing indicators[24-26] assess healthcare providers' ability to promote proper medication use, identify issues, highlight facility shortcomings and guide interventions for rational drug use and antibiotic stewardship. However, there is a lack of recent data to assess the usage of AWaRe antibiotics in children, especially in southern India. Keeping this in mind, we carried out the present study at a rural children's hospital in south India to investigate pediatric antibiotic utilisation and its prescribing pattern. The current study in the pediatric Out-Patient Department (OPD) of a rural secondary care referral hospital in south India was conducted to investigate the antibiotic prescribing pattern by WHO AWaRe 2021 classification and its use as per the WHO core prescribing indicators.

2. Materials and Methods

The descriptive cross-sectional study, approved by the ethics committee was performed in the pediatric outpatient department dispensing pharmacy of a rural secondary care referral hospital in south India. Prescriptions of infants and children between 1 month and 12 years of age of both genders, diagnosed with infections and started on at least one antibiotic agent, over 3 months (October 2023 to December 2023) were included and prescriptions with incomplete data were excluded. A total of 120 prescriptions were collected for analysis. Sampling was convenient and purposive, with prescriptions randomly collected at the exit point of the pharmacy queue adjacent to the pediatric OPD at least 5 days a week. Patients' personal details, baseline conditions, laboratory investigations, antibiotic agent name, dose, dosage, therapy days, route and rate of administration, prescribed as generic or brand and Fixed-Dose Combination (FDCs), and its availability in hospital pharmacy were obtained and recorded in the data collection form, after obtaining consent from the parent or legal guardian, with a witness present if needed (when the guardian was illiterate). The antibiotic prescribing pattern and its use were investigated by using WHO AWaRe 2021[23] Classification and WHO core prescribing indicators[24-26]. Descriptive statistical analysis was carried out using MS Excel and GraphPad Prism. Absolute numbers and frequencies (%) were calculated for qualitative variables, while arithmetic means and Standard Deviations (SD) were calculated for quantitative variables respectively.

3. Results

In the study, we analysed 120 pediatric prescriptions, with 63% male and 37% female patients. The data is summarised in Table 1.

A total of 690 drugs were identified, averaging 5.75 drugs per prescription. Antibiotics were prescribed in 18.99% of encounters, with an average of 1.09% per prescription. 84.73% of antibiotics were administered through injections, 70.23% were prescribed using generic names, and all prescriptions were from the hospital formulary containing essential drugs[27], the responses of which are analysed and presented in Table 2.

Pneumonia (25%) was the most common indication for antimicrobial use, followed by urinary tract infections (15%) and lower respiratory tract infections (14%), as detailed in Figure 1.

Ceftriaxone (31.2%) was the most prescribed drug, followed by Amoxicillin + clavulanate (19.85%), and others[28] as shown in Table 3.

Upon analysing the antibiotics based on the WHO AWaRe classification, it was noted that the Watch category

Table 1. Characteristics of study participants (n = 120)

Age Group (in years)	Gender Distribution				Total	
	Male		Female			
	n	%	N	%	N	%
New Born (0-27 Days)	0	0	0	0	0	0
Infants and Toddler (1 to 23 Months)	28	60.87	18	39.13	46	38.33
Preschool (2 to 6 Years)	20	58.82	14	41.18	34	28.33
School (6 to 12 Years)	16	64	9	36	25	20.83
Adolescent (12 to 18 Years)	11	73.33	4	26.67	15	12.5
Total	75	62.5	45	37.5	120	100

Table 2. Pattern of antibiotic use

WHO core prescribing indicators.	n (%)	
Total number of prescriptions handled.	120	
Total number of drugs prescribed.	690	
Total number of antibiotic drugs used.	131	
Average number of drugs per prescription.	690:120	5.75
Average number of antibiotic drugs per prescription.	131:120	1.09
Percentage of antibiotic drugs prescribed by generics.	92:131	70.23
Percentage of antibiotic drugs prescribed as an injection.	111:131	84.73
Percentage of antibiotic drugs used as FDCs.	28:131	21.37

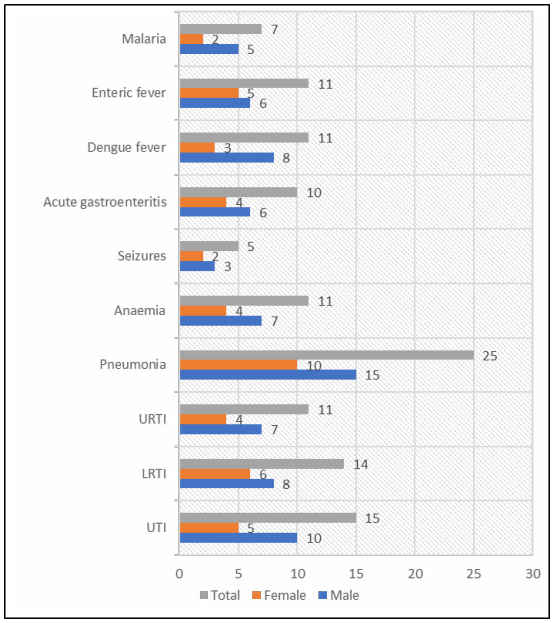


Figure 1. Distribution of diagnosis.

Table 3. Antibiotic prescribed to study participant

Class	Antibiotics (n = 131)	ATC code	n	%
Penicillins	Amoxicillin	J01CA04	10	7.63
	Ampicillin	J01CA01	5	3.82
	Amoxicillin/clavulanic-acid	J01CR02	28	21.37
Cephalosporins	Ceftriaxone	J01DD04	44	33.59
	Cefixime	J01DD08	13	9.92
	Cefotaxime	J01DD01	6	4.58
Macrolides	Azithromycin	J01FA10	8	6.11
Aminoglycosides	Amikacin	J01GB06	6	4.58
	Gentamicin	J01GB03	4	3.05
Fluoroquinolones	Ciprofloxacin	J01MA02	4	3.05
Glycopeptides	Vancomycin	J01XA01	1	0.76
Lincosamides	Clindamycin	J01FF01	1	0.76
Imidazoles	Metronidazole	J01XD01	1	0.76

comprised the highest number of prescriptions, totalling 63 or 48.09% of the overall count. The Access category closely followed with 55 prescriptions, representing 41.98% of the total. The remaining 13 prescriptions, making up 9.92, were classified as not recommended. Interestingly, no prescription contained an antibiotic from the Reserve category, the results of which are thoroughly analysed and presented in Table 4 and Table 5.

Table 4. Classification of the antibiotics as per the WHO AWaRe 2021

AWaRe Classification			Not Recommended
Access (%)	Watch (%)	Reserve (%)	
55 (41.98%)	63 (48.09%)	0	13 (9.92%)

Table 5. Frequency of prescribing of antibiotics according to WHO AWaRe 2021

WHO AWaRe category	Antibiotics (n = 131)	n	%	Total n (%)
Access	Amoxicillin	10	7.63	55 (41.98)
	Ampicillin	5	3.82	
	Amoxicillin/clavulanic-acid	28	21.37	
	Amikacin	6	4.58	
	Gentamicin	4	3.05	
	Clindamycin	1	0.76	
	Metronidazole	1	0.76	
Watch	Ceftriaxone	44	33.59	63 (48.09%)
	Cefotaxime	6	4.58	
	Azithromycin	8	6.11	
	Ciprofloxacin	4	3.05	
	Vancomycin	1	0.76	
Not Recommended	Cefixime	13	9.92	13 (9.92)

4. Discussion

In children, infections are the main cause of sudden illness[29], with antibiotics being the primary medication used in hospitals and the community[30]. However, misuse of antibiotics can lead to resistance, increasing healthcare costs and patient risks[31-35]. Healthcare providers need to use antibiotics judiciously in pediatric patients. To address this issue, the current study was performed to investigate the pediatric antibiotic prescribing pattern and its utilisation, in a rural secondary care referral hospital of south India.

The study found that 62.5% of pediatric patients were male, consistent with findings in Ethiopia[36], Nepal[37] and India[38-43]. Furthermore, 38% of patients were aged 1-23 months[44], potentially indicating higher vulnerability to infections, inadequate hygiene, nutrition deficiencies, vaccination gaps and age-related issues.

The rate of encounters with antibiotics prescribed in this study was 18.92%; a figure notably lower than those reported in the Antibiotic Resistance and Prescribing in European Children (ARPEC)[4] study (36.7%), and other previous studies from China[45], Italy[46] and India[40,41,44,47].

Out of 120 pediatric prescriptions analysed, a significant deviation was observed (5.75) in terms of the average number of drugs per prescription far from the WHO-INRUD optimal range of 1.6-1.824 and other studies conducted in India[41,47,48]. The average number of antibiotics in pediatric prescriptions (1.09) met WHO standards[25], indicating good prescribing practices consistent with other Indian studies[19,40,49,50]. Generic prescriptions are widely accepted and cost-effective globally, with usage ranging from 13.3% to 93%[51,52]. In our study, 70.33% of the prescriptions were generic, surpassing some previous studies[53,54] but lower than others[18,40,49,51].

Our study revealed that pneumonia (25%), urinary tract infections (15%) and lower respiratory tract infections (14%) accounted for the majority of antibiotic prescriptions, consistent with previous research[31,37,54-56]. This trend may be attributed to the high prevalence of communicable diseases and prescribing practices among healthcare professionals.

In our study, cephalosporins (63, 48.09%) were the most prescribed antibiotic followed closely by penicillins (43, 32.82%) and macrolides (8, 6.11%); consistent with previous studies in China[46] and India[41,43,47]. Other studies[57,58] have noted the interchangeable use of penicillins and cephalosporins. In this study, Ceftriaxone was the most commonly used antibiotic agent, consistent with previous research[59-61], followed closely by the amoxicillin-clavulanic acid combination[62-64]. Ceftriaxone is widely used in pediatric patients for treating bacterial infections, with many benefits. Its use in children is backed by numerous clinical trials[65,66].

The categorisation of antibiotics into Access, Watch, and Reserve groups (AWaRe)[67] in the 2017 update of WHO's essential medicines list for children serves as a means to promote antibiotic stewardship. The current study analysed the use of antibiotics categorised

under AWaRe 2021. Sales data in India showed higher consumption of Watch and Reserve antibiotics from 2007 to 2012, compared to access group antibiotics[68]. In our study, the Access to Watch index is less than 1 as observed in other studies[3,69-71]; with 41.98% Access, 48.09% Watch, and not recommended antibiotics making up 9.92%. This contradicts the WHO's recommendation of using Access-group antibiotics for at least 60% of cases[22].

The observation of the current study illustrates the magnitude of India's challenge in decreasing the utilisation of Watch and Not Recommended Group antibiotics as outlined in the WHO's antibiotic resistance action plan.

5. Conclusion

In conclusion, the current study observed a notable deviation from WHO standards in terms of pediatric antibiotic prescription and utilisation, with the Access to Watch index being less than 1. Therefore, it is crucial to implement pediatric antibiotic stewardship programs to address the negative effects of improper antibiotic use.

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