

## Original Investigation

# Drug Utilization Pattern in Pneumonia among Pediatric Patients at a Tertiary Care Hospital

Anita Yadav<sup>1\*</sup> | Bandana Rimal<sup>1</sup> | Anita Aryal<sup>1</sup> | Nabina Paudel<sup>1</sup><sup>1</sup>Department of Pharmacy, Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Rupandehi, Nepal

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## \*Correspondence:

AnitaYadav.

Department of Pharmacy,  
Universal College of  
Medical Sciences and  
Teaching Hospital,  
Bhairahawa, Rupandehi,  
Nepal.

## E-mail:

anita.yadav2047@gmail.com

 0000-0002-5288-3066

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## ABSTRACT

**INTRODUCTION:** Pneumonia remains the leading cause of hospitalization and mortality in young children in low and middle-income countries like Nepal. Antibiotics are commonly prescribed for pediatric pneumonia patients. To prevent antimicrobial resistance, antibiotics must be prescribed rationally. Therefore, the purpose of this study was to evaluate the drug utilization pattern in pediatric pneumonia patients at a tertiary care hospital by using World Health Organization (WHO) prescribing indicators. **MATERIALS AND METHODS:** A descriptive cross-sectional study was conducted among pediatric pneumonia patients at Universal College of Medical Sciences, Bhairahawa, Nepal from December 2022 to May 2023. Ethical approval was taken from the Institutional Review Committee (UCMS/IRC/191/22) and the purposive sampling method was used. Data were collected from pro-forma to assess WHO prescribing indicators and analyzed in Statistical Package for Social Sciences (SPSS) version 20 program and expressed as frequency and percentage for all variables. **RESULTS:** A total of 1408 drugs were prescribed to 196 prescriptions or patients. The average number of drugs per prescription was 7.18. The most common 51.5% of prescriptions contain 4-5 drugs per prescription. The percentage of prescriptions with antibiotics and injections was 100% respectively. Drugs prescribed by generic name were 44.24% and those matched to the national Essential Drugs List of Nepal were 53.19%. Cephalosporins (86.7%) were the most frequently prescribed antibiotics followed by aminoglycosides (79.1%). All the antibiotics were given parenterally (100%). **CONCLUSIONS:** The study reported inadequate compliance with WHO prescribing indicators and recommended policy formulation and application by regulatory agencies to promote the drug utilization study.

**Keywords:** Antibiotics, drug utilization, pediatrics, pneumonia, WHO prescribing indicators



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## INTRODUCTION

Pneumonia is an acute lung parenchymal inflammation and a Lower Respiratory Tract Infection (LRTI) frequently accompanied by fever, respiratory symptoms, and clinical or radiographic evidence of parenchymal involvement [1, 2]. It is a significant health issue in children; according to the World Health Organization (WHO), pneumonia affects nearly 156 million children (151 million in developing nations and 5 million in developed nations) [3]. Pneumonia in children is a difficult diagnosis since the presenting signs and symptoms are ambiguous, may be subtle (especially in newborns and young children), and vary depending on the patient's age, causative pathogen, and severity of the illness [4, 5]. Because of their low immune and nutritional state, children are the most vulnerable population to infectious diseases [6]. According to WHO, there is an increase in irrational

antibiotic use, which leads to antibiotic resistance and higher mortality [7]. The study of the marketing, distribution, prescription, and use of drugs in a society, with a focus on the associated medical and socio-economic implications, is known as the Drug Utilization Study (DUS). Because of changes in pharmacodynamics and pharmacokinetics, infants and children are especially prone to disease and suffer from the adverse effects of medications [8]. The mortality rate of pediatric pneumonia is higher in Nepal due to a lack of immunization [9]. Environmental variables such as air pollution, poor sanitation, and maternal smoking may increase a child's vulnerability to pneumonia [10]. Pediatric age groups are more susceptible to pneumonia, and pneumonia continues to be the primary cause of morbidity and mortality in this age group. Due to the irrational use of antibiotics and

polypharmacy, the morbidity is even growing. A limited study has been conducted to analyze the drug utilization pattern in pediatric pneumonia patients in Nepal. Therefore, this study was designed to analyze the drug utilization pattern among pediatric pneumonia patients by using WHO prescribing indicators.

## MATERIALS AND METHODS

### Study design and setting

A prospective, cross-sectional descriptive study was conducted in the In-patient Department of the Pediatric ward at the Universal College of Medical Sciences and Teaching Hospital (UCMS-TH), Bhairahawa, Rupandehi, Nepal. The study period was six months, commencing from December 2022 to May 2023.

### Participants, sample size and sampling technique:

The patients diagnosed with pneumonia admitted to the In-patient Department of the pediatric ward having ages less than 12 years of both sexes and who were prescribed at least one drug were included in the study. All the adult patients, out-patients, and emergency patients, patients with other respiratory diseases having similar symptoms to pediatric pneumonia and not willing to participate in the study were excluded from this study. The sample size was calculated using Cochran's formula for cross-sectional study,  $n = [z^2 * pq] / d^2$ ; where,  $p =$  prevalence of drug utilization = 0.5 [11],  $q = (1-p) = (1-0.5) = 0.5$ ,  $z =$  confidence interval level 95% = 1.96,  $d =$  acceptable error = 7%. So,  $n = z^2 * pq / d^2 = (1.96)^2 * 0.5 * 0.5 / (0.07)^2 = 196$ . The purposive sampling technique was used.

### Data collection procedure and study variables:

The ward was visited daily and the patients were enrolled based on study criteria. The data was gathered by reviewing the prescription paper and face-to-face interviews with the parents/caretakers of the patients. Data collection was performed by well-trained three pharmacy professionals, and the completeness of the collected data was checked by the supervisors. The required information was recorded in data collection form (pro-forma) [9,11] which contained information on patient demographics, clinical characteristics, drug utilization patterns, route of administration of drugs, and assessment of drug charts with WHO prescribing indicators. The data collection form was pre-tested on a 10% sample size before the data collection to reduce bias and maintain the accuracy of data in the study.

The WHO prescribing indicators were used in this study. The prescribing indicators that were measured included: the average number of drugs prescribed per

prescription (to assess the degree of polypharmacy); the percentage of drugs prescribed by generic name (to assess the tendency of prescribing by generic name); the percentage of prescriptions in which an antibiotic and an injection were prescribed (to assess the overall use of commonly overused and costly forms of drug therapy); and the percentage of drugs prescribed from an Essential Drug List (EDL) (to assess the degree to which practices conform to a national drug policy as indicated in the Essential Drug List of Nepal 2021) [12].

### Statistical analysis and data management:

The data were entered and analyzed in the latest version of SPSS (Statistical Package for the Social Sciences) version 20, after the completion of data collection. Descriptive indices, including frequency and percentage, were used to express data for all variables. The values of the indicators obtained were compared with the standard values of the WHO prescribing indicators.

### Ethical consideration:

Ethical approval was obtained from the Institutional Review Committee of UCMS-TH (UCMS/IRC/191/22). Before each interview, written consent was obtained from the parents or caretakers, and the research objectives were elucidated. Permission was taken from hospital administration to access the data of the participants and their information was kept confidential and anonymous. Data collection forms were handled appropriately.

## RESULTS

Out of 196 prescriptions, the majority of them, 134 (68.4%) were male and 62 (31.6%) were female. In the age group less than one year, 159 (81.1%) were found to suffer from a high prevalence of pneumonia. The weight of 2 kg- 4 kg patients was found to be 62 (31.6%), which is the highest in the range (Table 1).

Regarding the severity class of pneumonia, 139 (70.9%) patients were suffering from pneumonia followed by 54 (27.6%) patients suffering from severe pneumonia. The detailed clinical characteristics of the respondents are shown in Table 2.

According to this study, the most prescribed antibiotic was Cephalosporins. Among cephalosporins, the drugs prescribed were cefotaxime 117 (59.7%) and ceftriaxone 53 (27%) respectively. The least prescribed antibiotic was Meropenem 9 (4.6%). All the antibiotics were given through the parenteral route during the hospital stay of the patients. Antibiotics were the most commonly prescribed therapeutic class, followed by inhaled corticosteroids, bronchodilators, and anticholinergic

**Table 1** | Demographic characteristics of respondents (n=196)

Variables	Frequency (%)
<b>Age</b>	
<1y	159 (81.1%)
1y-<3y	25 (12.8%)
3y-<6y	3 (1.5%)
6y-<12y	9 (4.6%)
<b>Sex</b>	
Male	134 (68.4%)
Female	62 (31.6%)
<b>Weight</b>	
2kg-4kg	62 (31.6%)
4kg-6kg	60 (30.6%)
6kg-12kg	57 (29.1%)
12kg-20kg	8 (4.1%)
20kg-45kg	9 (4.6%)

drugs i.e. 158 (80.6%) which were given through the inhalation route (Table 3).

Among 196 prescriptions, 101 (51.5 %) had at least three drugs prescribed (Table 4). The average number of drugs per prescription, percentage of prescriptions with antibiotics, and percentage of prescriptions with injections were greater than the WHO standard. However, drugs prescribed by generic name and drugs prescribed from the essential drug list were lower than the WHO ideal value (Table 5).

**Table 2** | Clinical characteristics of respondents (n=196)

Clinical Variables	Frequency (%)
<b>Severity class of pneumonia</b>	
Pneumonia	139 (70.9%)
Severe pneumonia	54 (27.6%)
Very severe pneumonia	3 (1.5%)
<b>Types of pneumonia</b>	
Community-Acquired Pneumonia (CAP)	178 (90.8%)
Hospital-Acquired Pneumonia (HAP)	12 (6.1%)
Aspiration Pneumonia	5 (2.6%)
Recurrent Pneumonia	1 (0.5%)
<b>Diagnostic method</b>	
Complete blood count	48 (24.5%)
Complete blood count and chest radiography	136 (69.4%)
Culture	9 (4.6%)
Chest radiography	3 (1.5%)
<b>Patient follow-up evaluation</b>	
Improved	145 (74%)
Fair	19 (9.7%)
Discharge under request	8 (4.1%)
ICU admission	13 (6.6%)
Referred	8 (4.1%)
Death	3 (1.5%)
<b>Hospital duration (days)</b>	
<3	46 (23.5%)
4-5	109 (55.6%)
6-7	29 (14.8%)
≥8	12 (6.1%)

**Table 3** | Utilization Pattern of Drugs Prescribed

Antibiotics Prescribed			
Category of drugs	Types of antibiotics	Route of administration	Number of Prescriptions (N=196) (%)
Cephalosporins	Cefotaxime	Parenteral	117 (59.7%)
	Ceftriaxone	Parenteral	53 (27%)
Aminoglycosides	Amikacin	Parenteral	155 (79.1%)
Beta lactam antibiotics	Piperacillin+Tazobactam	Parenteral	53 (27%)
Carbapenem	Meropenem	Parenteral	9 (4.6%)
Macrolides	Vancomycin	Parenteral	51 (26%)
	Azithromycin	Parenteral	52 (26.5%)
Other drugs prescribed along with antibiotics			
NSAIDs	Paracetamol	Parenteral	135 (68.9%)
Diuretics	Frusemide	Parenteral	45 (23%)
Inhaled Corticosteroids	Budesonide Nebulizer Solution	Inhalation	158 (80.6%)
Bronchodilators	Salbutamol Nebulizer Solution	Inhalation	158 (80.6%)
Anticholinergic	Ipratropium Nebulizer Solution	Inhalation	158 (80.6%)
Nasal drops	Oxymetazoline Hydrochloride Nasal Solution	Nasal	144 (73.5%)
IV fluids	Dextrose Normal Saline (DNS)	Parenteral	196 (100%)
Anti-emetics	Ondansetron	Oral and Parenteral	6 (3.1%)
Zinc Supplements	Zinc syrup	Oral	38 (19.4%)
Anti-epileptics	Phenytoin	Oral	3 (1.5%)

## DISCUSSION

In our study, males were found to suffer more from pneumonia than females, which was similar to the studies conducted by Thapaliya et al. [13], Shrestha S et al. [14], and Ashmi et al. [15]. This is due to the humoral and cellular immune response in females making them less susceptible to lower respiratory tract infection. The

**Table 5 | Analysis of prescription indicator**

WHO Prescribing Indicators	Number	Current study	WHO ideal values (average/percentage)
Average number of drugs per prescription	1408	7.18	1.6-2.0
Percentage of prescriptions with antibiotics	196	100%	20% - 26.8%
Percentage of prescriptions with injection	196	100%	13.4% -24.1%
Percentage of drugs prescribed by generic name	623	44.24%	100%
Percentage of drugs from the essential drug list of Nepal	749	53.19%	100%

majority of the hospitalized pediatric patients were under the age of one year, which is consistent with the previous studies [13, 16, 17]. This is because the immune system of babies under the age of one year is not fully formed and matured. As a result, they are more susceptible to infections. Because this study was conducted in a tertiary care hospital with patients from surrounding villages, the prevalence of pediatric pneumonia is strongly linked to factors such as malnutrition, a lack of safe water and sanitation, indoor air pollution, and insufficient access to health care [14].

Cephalosporin was the most frequently used antibiotic in pneumonia patients in our study, which is similar to a study conducted in Chitwan, Nepal [13]. In the study conducted by Shrestha S et al. [14], Beta-lactam antibiotics were most prescribed, followed by aminoglycosides. These findings contradict our findings. The higher prescription rate of cephalosporins could be due to its broad spectrum of activity, favorable safety profile in infants, and tolerability across all age groups. [12]. In this study, parenteral and inhalational routes were more commonly prescribed drugs than the oral route, which is similar to the previous studies [14, 15, 18, 19]. It is difficult to provide medicines orally to children because of the bitter taste of the medicine. The child may refuse to take it or will throw up the medicine when taken orally. Similarly, the inhalation route is also preferred due to its easy access and well-tolerated by the child.

The average number of drugs per prescription in our study was 7.18. In contrast to this, the previous study conducted in Bharatpur, Nepal found the number of drugs per prescription was 3.2. The average number of drugs is an important indicator for assessing the

**Table 4 | Distribution of drugs per prescription**

Drugs	Number of prescriptions (196) (%)
2-3	25 (12.8%)
4-5	101 (51.5%)
6-7	56 (28.6%)
>7	14 (7.1%)

rationality of prescriptions. The WHO recommends that the average number of drugs per prescription should be lower than 2. The average number of drugs per prescription should be as low as possible to prevent the harmful consequences of poly-pharmacy, such as increased risk of drug interactions, increased expense of therapy, non-compliance, and antimicrobial resistance [12].

The percentage of prescriptions with an antibiotic prescribed was higher than the WHO criteria (20.0%-26.8%), which is similar to Ashmi et al. [14] and Pokharel et al. [20]. The study conducted by Shamsy et al. [21] found that 54.29% of antibiotics, which is less in our study. The use of antibiotics is important to kill the bacteria causing pneumonia. The hospital has developed the practice of administering antibiotics without sensitivity studies and did not have the hospital's policy on antibiotic utilization. This method may have promoted greater usage of antibiotics, which ultimately fostered bacterial resistance and elevated the demand to use expensive antibiotics. Research in a tertiary care hospital in Mangalore revealed that 19.44% of the antibiotics were lower than the WHO guideline range. The antibiotic policy was attributed to the low rate of antibiotic prescribing [12]. The evidence-based appropriate antibiotic policy is a contemporary necessity for healthcare facilities to decrease improper antibiotic use and related impacts.

The percentage of injectables prescribed in the study was greater compared to the studies done by Alemnew G. et al. in 2015 [16] and Palikhe N. in 2004 [17]. The injectables were prescribed more because the study was primarily focused on inpatients. The excessive use of injectables is frequent in many developing countries. Excessive use of parenteral can lead to pain and



discomfort in pediatric patients. It seems necessary for the pediatric patient to be treated by the parenteral route of administration, but special consideration should be taken. Some infections like CNS infections or patient groups like neonates and infants require parenteral use. [12].

According to the study conducted by Naik et al. [22], the number of drugs prescribed by generic names is also low, similar to our study. Prescribing the drugs by a generic name helps the hospital pharmacy to have better inventory control because generic drugs are typically more affordable than branded drugs.

In this study, the percentage of drugs prescribed from the essential drug list is less than the WHO standard value, which is similar to the study conducted by

Chavda et al. [23]. Medications that satisfy the priority healthcare needs of the population and that are chosen based on their efficacy, safety, and cost-effectiveness are known as essential medicines. So, essential drugs are needed to cure the diseases of the patients and should be available in the required time.

The study was conducted at a single center and on a specific disease. Therefore, a multi-centered study should be conducted as it provides a better scenario for different hospitals. It was a cross-sectional one with a small sample size. Hence, the study should be carried out with a larger sample size in the future, which helps to bring variation to the study. The study was conducted for six months and seasonal variations could also impact the drug utilization study.

## CONCLUSIONS

The findings from our study concluded that brand-name drugs were prescribed more than generic-name drugs. Antibiotics prescribed were 100% among hospitalized pneumonia patients. Essential drugs were prescribed more than non-essential. The Cephalosporin group of antibiotics was prescribed more frequently

than other antibiotics. This study suggests educational initiatives should be undertaken to strengthen the rational prescription among the doctors of pediatric in-patient ward wards, which ultimately improves drug utilization in pediatric pneumonia patients.

## ADDITIONAL INFORMATION AND DECLARATIONS

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**Data Availability:** Data will be available upon request to corresponding authors after valid reason.

*Note: This article undergoes expedited fast-track publication*

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