

Study of Antibacterial Prescription Pattern and Adverse Drug Reactions in Childhood PneumoniaBrajesh Kumar¹, Jeetendra Kumar²¹Tutor, Department of Pharmacology, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar.²Professor and HOD, Department of Pharmacology, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar.

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Abstract**Background:** Antibacterial medications are crucial in the treatment of pneumonia, a major cause of death for children worldwide. to ascertain the antibacterials used for pneumonia, including their class, dosage schedule, adverse drug reactions (ADRs), selection criteria, and World Health Organization (WHO) prescription indicators.**Methods:** From October 2025 to December 2025 this study was conducted among 432 pediatric patients admitted with Pneumonia in JLNCH, Bhagalpur, and Bihar. Details on antibacterial prescription with selection criteria and associated ADRs were collected. Causality, preventability and severity of ADRs were assessed. WHO prescribing indicators were calculated. Data analysed using SPSS software.**Results:** Ampicillin (34.6%) with a dosing regimen of 32-66 mg/kg intravenously four times a day (34.4%) and a mean treatment duration of 3.6±1.26 days was the most commonly prescribed antibacterial class, followed by aminopenicillins (61.2%). 57% of patients were administered intravenously, and 99% of patients were treated empirically. Vancomycin-induced Redman Syndrome and gentamicin and ampicillin-induced hypersensitivity reactions were the observed adverse drug events. WHO prescription indicators: 2.42 antibacterials on average per contact, 96.56% of antibacterials administered under generic names, 98.37% of encounters involving injections, and 90.9% of antibacterials from the Essential Medicines List (EML).**Conclusion:** The most prevalent dose regimen recommended was intravenous ampicillin 32–66 mg/kg four times a day for a mean length of 3.6±1.26 days. Aminopenicillins were the primary antibacterial class. The majority of antibacterials came from EML, were given intravenously, prescribed under generic names, and were chosen experimentally. There were three documented ADRs. Calculations were made for prescribing indicators.**Keywords:** Antibacterial drugs, Childhood pneumonia, Prescription pattern.**DOI:** 10.25258/ijcpr.18.2.278

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Introduction

Pneumonia is the most common infectious cause of death for children under five worldwide, accounting for 740180 fatalities in 2019 (WHO), or 14% of deaths in children under five and 22% of deaths in children between the ages of one and five.[1] With morbidity rates of 0.2–0.5 episodes per child-year and 10–20% being severe, India is one of the top 15 nations with a high illness burden.[2] The WHO's revised guidelines divide pneumonia into two categories: "Pneumonia" (fast breathing and/or chest indrawing; requires home therapy with oral amoxicillin) and "Severe pneumonia" (with any danger sign; requires referral and injectable therapy). Danger signs include stridor, fast breathing, difficulty breathing, and chest wall indrawing.[3,4] Fast breathing is

indicated by a respiratory rate of ≥ 50 breaths/min (ages 2–12 months) and ≥ 40 breaths/min (ages 12–59 months).[5] The WHO recommends beta-lactam antibacterials (benzyl penicillin, ampicillin, amoxicillin, and ceftriaxone) that interfere with the cross-linking of bacterial cell walls, aminoglycosides (gentamicin) that interfere with the synthesis of bacterial proteins, and cotrimoxazole that blocks the metabolism of bacterial folate (used in immunocompromised patients).[3,6-8] The antibiotic prescription pattern for childhood pneumonia, adverse drug reactions, selection criteria, and WHO prescribing indicators are all described in this study.

Material and Methods

This descriptive study was conducted in Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar from October 2025 to December 2025 among the in-patients diagnosed with pneumonia (revised WHO criteria). 762.9 children between the ages of 2 months and 12 years (the age group under 12 years is included in department admissions) were recruited. 432 in-patients participated in the trial.

The youngster and a legally recognized guardian provided written informed consent or informed assent. Antibacterial prescriptions and demographic information were gathered using the proforma and case records. Additionally, selection criteria for antibacterials were established.

Direct communication with the patient was used to gather information about ADRs, which were then reported to the closest ADR monitoring center (AMC) and submitted into the CDSCO (Central Drugs Standard Control Organization) suspected ADR reporting form. The WHO-UMC (Uppsala Monitoring Centre) scale, the Schumock-Thornton scale, and the Modified Hartwig-Seigel scale were

used to evaluate causality, preventability, and severity of ADR, respectively. WHO prescribing indicators were computed. Version 24 of the Statistical Package of Social Science (SPSS) program was used to analyze data that had been imported into Microsoft Excel. Every quantitative variable was expressed as mean±standard deviation, whereas every qualitative variable was expressed as frequency and percentages.

Results

288 (66.7%) of the sample were between two months and two years old, with a mean age of 2.16±2.27 years. The male to female ratio was 3:2. Of the 432 cases, 401 (93%) had "pneumonia," while 31 (7%) had "severe pneumonia." The average length of stay in the hospital was 5.12±3 days (minimum 2 days, maximum 26 days) for "Pneumonia" and 9.68±6.12 days (minimum 4 days, maximum 30 days) for severe pneumonia. 875 (83.5%) of the 1048 antibacterials from ten different groups that were prescribed were β -lactams. Aminopenicillins, cephalosporins, and aminoglycosides were the most often prescribed antibacterials (Table 1).

Table 1: Class of anti-bacterial

Class of anti-bacterials	No. of anti-bacteria used	Percentage
Aminoglycoside	84	8.0%
Aminopenicillins	641	61.2%
Carbapenams	17	1.6%
Cephalosporins	207	19.8%
Glycopeptide	14	1.3%
Lincosamide	16	1.5%
Macrolides	45	4.3%
Oxazolidinones	14	1.3%
Penicillins	1	0.1%
Ureidopenicillins	9	0.9%
Total	1048	100.0%

Ampicillin was the most common antibiotic among the 19 different antibacterials provided to 432 individuals (Table 2). Ampicillin 32-66 mg/kg QID in 360 (34.4%), amoxicillin 30-42 mg/kg BD in 245 (23.4%), cefpodoxime 4.7-13 mg/kg BD in 75 (7.2%), and gentamicin 4-10 mg/kg OD in 57 (5.4%) were the most frequently used dose regimens. The least often prescribed was Crystalline Penicillin 1 (0.1%).

Amoxicillin+Clavulanic acid 10 (1%) and Piperacillin+Tazobactam 9 (0.9%) were examples of fixed dose combinations (FDC).

Ampicillin 21 (20.6%) was the most common antibacterial administered for those 31 patients with severe pneumonia, followed by Cefpodoxime 13 (12.7%), Ceftriaxone 11 (10.8%), and Amoxicillin 11 (10.8%).

Table 2: Anti-bacterial prescribed

Anti-bacterial prescribed	No. of anti-bacterial provided	Percentage
Amikacin	10	1.0%
Amoxicillin	268	25.6%
Amoxicillin+clavulanicacid	10	1.0%
Ampicillin	363	34.6%
Azithromycin	45	4.3%
Cefixime	8	0.8%
Cefotaxime	49	4.7%

Cefpodoxime	78	7.4%
Ceftriaxone	56	5.3%
Cefuroxime	14	1.3%
Cephalexin	2	0.2%
Clindamycin	16	1.5%
Crystallinepenicillin	1	0.1%
Faropenam	7	0.7%
Gentamicin	74	7.1%
Linezolid	14	1.3%
Meropenam	10	1.0%
Piperacillin+tazobactam	9	0.9%
Vancomycin	14	1.3%
Total	1048	100.0%

Three antibacterials were most frequently used to treat patients with "severe pneumonia" (17, or 54.8%), with intravenous ampicillin with gentamicin and oral amoxicillin being the most frequently utilized. Intravenous ampicillin and oral amoxicillin were the most often utilized antibacterials among patients classified as having "pneumonia" (282, or 70.3%). Of the 1048 antibacterials, 597 (57%) were administered intravenously and 451 (43%) were administered orally.

The most common intravenous antibacterial was ampicillin (357, 34.06%), while the most common oral antibacterial was amoxicillin (268, 25.6%). There were 1012 (97%) generic prescriptions. The average length of treatment was 3.6±1.26 days for ampicillin, 6.5±0.8 days for amoxicillin, 5.8±0.9 days for cefpodoxime, and 4.36±1.5 days for gentamicin. For severe pneumonia, the longest course of treatment was 25 days with clindamycin and 15 days with meropenam.

The average number of days that each medication was used to treat pneumonia (5.01±1.8) and severe pneumonia (5.01±1.8). 89±3.06, in that order. The EML contained 953 (91%) of the 1048

antibacterials.10 Of the 432 patients, 43 (10%) underwent Culture and Sensitivity (C&S), using blood as the material. Thirty-five (81.3%) of the forty-three culture reports were "Sterile," whereas six (13.9%) were positive. Three (6.9%) of the most frequently cultured organisms were methicillin-resistant *Staphylococcus aureus* (MRSA). All of the cultivated species were susceptible to linezolid and vancomycin. Six (1%) of the 432 patients were treated in accordance with C&S reports, while 426 (99%) received empirical treatment. At the time of discharge, every patient (100%) had improved symptoms. There have been three reported adverse drug reactions (ADRs). When gentamicin and ampicillin caused hypersensitivity reactions, the suspected medication was stopped in the first instance and replaced with cefotaxime in the second. Vancomycin caused Redman syndrome, which went away when the dosage was lowered. In three cases, the severity was "mild" in the first and second, "moderate" in the third, and causality was "probable." WHO prescribing indicators: As this study involves antibacterial prescription pattern, in prescribing indicators the word 'drug' is replaced by 'antibacterials'.

Table 3: WHO prescribing indicators

Average no. of anti-bacterials per encounter	Total no. of different Anti-bacterials prescribed ÷ No. of encounters surveyed	1048/432=2.42
Percentage of anti-bacterials prescribed by genericname	(No. of anti-bacterials prescribed by genericname ÷ No. of anti-bacterials prescribed) × 100	1012×100/1048 =96.56%
Percentage encounters with injection prescribed	No. of patient encounters With injection ÷ No. of encounters surveyed) ×100	425×100/432 =98.37%
Percentage of anti-bacterials prescribed from EML	(No. of anti-bacterialsPrescribed from EML ÷ Total no. of anti-bacterials prescribed) ×100	953×100/1048 =90.9%

Discussion

Similar to other research, the age group most frequently impacted in this study was 2 months to 2 years; this could be because of the lower immunity level.[11–13] Due to their inconsistent prescription patterns, children less than two months were not included. Males made up the majority, which is

consistent with earlier research.[11–16] According to WHO criteria, the patients were divided into two categories: pneumonia and severe pneumonia.[3] Of the total patients, 93% had "Pneumonia" (admitted because of vulnerable risk factors that could lead to severe pneumonia or cause inconvenience for follow-up; most patients treated as outpatients were not included in this study), and

7% had "Severe Pneumonia," which is consistent with other studies.[15]

Other guidelines may exhibit variability.[15] In our study, there were no recorded deaths. The age group with "severe pneumonia" in this study was 4 months, whereas the age group with "pneumonia" was 1 year. Severe pneumonia is linked to non-exclusive breastfeeding, undernutrition, low maternal education, passive smoking, lack of immunization, and low socioeconomic position.[15,17] Patients with "severe-pneumonia" spent more time in the hospital and were admitted to the intensive care unit (ICU).[11,15,18]

In the current study, 432 patients were prescribed 1048 antibacterials from 10 distinct classes, of which 83.5% were β -lactams. The primary cause of juvenile pneumonia, *Streptococcus pneumoniae*, is a gram-positive bacterium that responds well to β -lactams.[6,19] A beta lactam medication called aminopenicillins also responds better to some gram-negative bacteria, namely *H influenzae*, which is another important cause of pneumonia in children.[6,20] Aminopenicillins made up 61.2% of all antibacterials in this study, which is comparable to another study that found that aminopenicillins (46.25%) were the most commonly prescribed antibacterial, followed by macrolides (42%). In contrast, another study found that macrolide monotherapy (43.2%) was the most commonly used regimen.[14]

Ampicillin was the most common antibacterial, followed by Amoxicillin, among the 1048 prescribed antibacterials that were classified into 19 different antibacterials in our study (Table 2). Ampicillin is an extended-spectrum penicillin that works against both gram-positive and gram-negative bacteria, including *H influenzae*. It is also more effective against *Listeria*, which causes pneumonia in children.[21] In this study, oral amoxicillin (as recommended by the WHO) was quickly substituted for ampicillin in "pneumonia" cases.[3] These antibacterials' most popular dosing schedules were largely consistent with earlier research.[16] In line with earlier research, the FDCs recommended were amoxicillin plus clavulanic acid and piperacillin plus tazobactam.[15,16] Vilas-Boas et al. discovered that the oral amoxicillin BD dose was just as effective as the TID dose in a randomized controlled experiment.[22] Ampicillin was the most common antibiotic prescribed for "severe pneumonia" in the current study, followed by cefpodoxime, ceftriaxone, and amoxicillin, in that order. Ceftriaxone (55%) and azithromycin (42.5%) were the most often recommended antibacterials for "severe pneumonia" in the Albuhaire et al. study.[15]

In contrast to Baby et al., where it was cefpodoxime (8.3%), crystalline penicillin was the least prescribed antibacterial in this study.[13] Similar to our analysis, another study by Khaja et al. found that penicillin (0.9%) was the least recommended antimicrobial, followed by gentamicin, vancomycin, and piperacillin+tazobactam (0.9% each).[11]

In the current study, three antimicrobial treatments were most frequently administered to patients with "severe pneumonia," with intravenous Ampicillin+Gentamicin (as recommended by the WHO) and oral Amoxicillin being the most popular. The majority of patients with "pneumonia" were given at least two medications; the most prevalent combination was intravenous ampicillin and oral amoxicillin. The wider coverage of typical-atypical etiological pathogens and the synergistic impact may be the reasons why combination antibacterial therapy was shown to be superior to monotherapy in research by Caballero et al.[23] Antimicrobial resistance is also avoided as a result.[24]

According to Lipsett et al., the main combination treatment was macrolide plus a narrow/broad spectrum antibiotic.[14] According to Di Pietro et al., the most popular combination treatment was macrolide and aminopenicillins plus an enzyme inhibitor (80.4%).[16] Khaja et al. report that the majority of pneumonia patients (73%) were treated with single antibacterials, with cephalosporin derivatives and amikacin being the most common combination.

According to Lipsett et al., the main combination therapy was macrolide plus a narrow/broad spectrum antibiotic.[14] According to Di Pietro et al., the most popular combination therapy was macrolide and aminopenicillins plus an enzyme inhibitor (80.4%).[16] Khaja et al. report that the majority of pneumonia patients (73%) were treated with single antibacterials, with amikacin and cephalosporin derivatives being the most common combination.[11]

Cost-effective and WHO-rational drug usage standards are supported by adherence to generic medication prescriptions. In this survey, 96.56% of prescriptions were generic, which is much higher than the 16.7% in Spain and comparable to more than 60% in the UK and Denmark.[25]

The EML contained the bulk of the antibacterials used in this investigation. The WHO states that the essential medications should be accessible locally at a fair price and updated on a regular basis in accordance with the recommendations of specialists in the relevant field, depending on each nation's health needs and health care system.[26] Ten percent of the patients in our sample had C&S.

Vancomycin and linezolid were the sensitive antibacterials, while MRSA was the frequent pathogen cultivated. Despite the fact that cloxacillin is effective against staphylococcus, the positive cultures did not exhibit drug sensitivity, and the patients were not prescribed the medication. Blood cultures were collected 78% of the time in research by Albuhairei et al.[15] Another study by Khaja et al. sent blood cultures to 33.33% of patients, of whom 25.7% tested positive. The most sensitive medication was ceftriaxone (77.8%), with *Streptococcus pneumoniae* being the main pathogen.[11] In our study, 99% of patients received empirical treatment, which is greater than the 91.43% reported by Khaja et al.[11] All patients had better symptoms despite limited culture testing, indicating successful institutional empirical antibiotic therapy. The primary etiological agents of childhood pneumonia, gram-positive and some gram-negative bacteria, are covered by the institutional empirical therapy regimen. In our investigation, three ADRs were documented. Schrufer et al., Connolly et al., and Khurana et al. reported similar cases. 27–29 The hospital's antimicrobial policy complied with WHO guidelines, according to this study.[3]

Conclusion

The most prevalent dose regimen recommended was intravenous ampicillin 32–66 mg/kg four times a day for a mean length of 3.6±1.26 days. Aminopenicillins were the primary antibacterial class. The majority of antibacterials came from EML, were given intravenously, prescribed under generic names, and were chosen experimentally. There were three documented ADRs. Calculations were made for prescribing indicators.

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