



## COMPARATIVE EFFICACY OF AMOXICILLIN VS. AZITHROMYCIN IN THE TREATMENT OF PEDIATRIC PNEUMONIA

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### ABSTRACT

**Introduction:** Community-acquired pneumonia (CAP) remains a significant cause of morbidity and mortality among pediatric populations worldwide.

**Objective:** The main objective of the study is to find the comparison in the efficacy of amoxicillin vs. azithromycin in the treatment of pediatric pneumonia.

**Methodology of the study:** This comparative study was conducted at different regions of Pakistan (Lahore, Islamabad, and Faisalabad) from 2021 to 2022. Data were collected from 185 patients suffering from pneumonia. Data on patient demographics, clinical presentations, treatment adherence, and outcomes are collected and managed using standardized forms and electronic medical records. Patients receive amoxicillin at a dose of 50 mg/kg/day, divided into three doses, for a duration of 7 days. Patients receive azithromycin at a dose of 10 mg/kg on the first day, followed by 5 mg/kg/day for the next 4 days. Assessed by resolution of fever, reduction in respiratory symptoms, and improvement in overall well-being, evaluated on days 3, 5, and 7 of treatment.

**Results:** Data were collected from 185 pneumonia patients. The mean age was comparable between the groups ( $5.4 \pm 3.1$  years for amoxicillin and  $5.2 \pm 3.0$  years for azithromycin). Gender distribution was similar, with 54.8% males in the amoxicillin group and 54.3% males in the azithromycin group. There were no statistically significant differences observed in clinical improvement rates by Day 7 (90% for amoxicillin vs. 88% for azithromycin,  $p = 0.68$ ) or radiographic improvement rates by Day 7 (85% for amoxicillin vs. 83% for azithromycin,  $p = 0.70$ ).

**Conclusion:** Amoxicillin and azithromycin are highly effective and safe for the treatment of pediatric community-acquired pneumonia, with no significant differences in clinical outcomes, microbial eradication, or adverse effects

**Keywords:** Community-acquired pneumonia, Pediatric Pneumonia, Amoxicillin, azithromycin, Respiratory symptoms

### **Introduction**

Community-acquired pneumonia (CAP) remains a significant cause of morbidity and mortality among pediatric populations worldwide. Despite advancements in vaccination and antibiotic therapies, CAP continues to present considerable clinical challenges, particularly in terms of selecting the most effective and safe antibiotic regimen [1]. Among the various treatment options, amoxicillin and azithromycin are two of the most commonly prescribed antibiotics for pediatric CAP. Amoxicillin, a  $\beta$ -lactam antibiotic, is favored for its broad-spectrum activity against many of the pathogens typically responsible for CAP in children, particularly *Streptococcus pneumoniae* [2]. Its efficacy, safety profile, and affordability have made it a cornerstone of pediatric respiratory infection management. However, the rising incidence of  $\beta$ -lactamase producing organisms and concerns about antibiotic resistance necessitate ongoing evaluation of its clinical effectiveness [3]. Azithromycin, a macrolide antibiotic, offers a different spectrum of activity, including efficacy against atypical pathogens such as *Mycoplasma pneumoniae* and *Chlamydia pneumoniae*, which are increasingly recognized as significant contributors to pediatric CAP. Azithromycin's once-daily dosing and shorter treatment duration provide a convenience that can enhance compliance, especially in pediatric patients [4]. Community-acquired pneumonia (CAP) in children is not only a clinical concern but also a public health issue, with significant implications for healthcare systems due to its prevalence and potential for severe outcomes [5]. The choice of antibiotic treatment is critical in managing CAP effectively, minimizing complications, and curbing the development of antibiotic resistance. This study focuses on two widely used antibiotics: amoxicillin and azithromycin, examining their comparative efficacy in pediatric CAP treatment. Amoxicillin, a  $\beta$ -lactam antibiotic, disrupts bacterial cell wall synthesis, leading to cell lysis and death [6]. Its effectiveness against *Streptococcus pneumoniae*, the most common cause of bacterial pneumonia in children, makes it a first-line treatment [7]. Amoxicillin is also known for its favorable safety profile and low cost, which are important considerations in pediatric care. However, the emergence of resistant bacterial strains poses a challenge to its continued efficacy, necessitating continuous monitoring and evaluation [8]. On the other hand, azithromycin, a macrolide antibiotic, inhibits bacterial protein synthesis by binding to the 50S ribosomal subunit. It is particularly effective against atypical pathogens such as *Mycoplasma pneumoniae* and *Chlamydia pneumoniae*, which are increasingly identified in pediatric pneumonia cases [9]. Azithromycin's pharmacokinetic properties, including a longer half-life and higher tissue penetration, allow for shorter treatment courses and once-daily dosing, which can improve adherence in pediatric patients. While both antibiotics are effective, their differing mechanisms of action and spectrums of activity raise important questions about their relative benefits and potential drawbacks [10]. For instance, azithromycin's broad spectrum and extended tissue concentration might contribute to the development of resistance more readily than amoxicillin. Conversely, the convenience of azithromycin's dosing schedule can lead to better patient compliance, a critical factor in pediatric treatment success [11].

### **Objective**

The main objective of the study is to find the comparison in the efficacy of amoxicillin vs. azithromycin in the treatment of pediatric pneumonia.

### **Methodology of the study**

This comparative study was conducted at different regions of Pakistan (Lahore, Islamabad, and Faisalabad) from 2021 to 2022. Data were collected from 185 patients suffering from pneumonia.

### **Inclusion Criteria**

- Age between 6 months and 12 years
- Clinical diagnosis of CAP (fever, cough, tachypnea, and abnormal lung findings)

- Radiographic confirmation of pneumonia
- Written informed consent from parents or guardians

**Exclusion Criteria**

- Known allergy to  $\beta$ -lactam or macrolide antibiotics
- Hospitalization within the past 30 days
- Chronic pulmonary diseases (e.g., cystic fibrosis, bronchiectasis)
- Immunocompromised state or ongoing immunosuppressive therapy
- Recent antibiotic use (within the past two weeks)
- Severe CAP requiring immediate hospitalization

**Data collection**

Data on patient demographics, clinical presentations, treatment adherence, and outcomes are collected and managed using standardized forms and electronic medical records. Patients are randomly assigned to two treatment groups:

Group I: amoxicillin

Group II: azithromycin.

Patients receive amoxicillin at a dose of 50 mg/kg/day, divided into three doses, for a duration of 7 days. Patients receive azithromycin at a dose of 10 mg/kg on the first day, followed by 5 mg/kg/day for the next 4 days. Assessed by resolution of fever, reduction in respiratory symptoms, and improvement in overall well-being, evaluated on days 3, 5, and 7 of treatment. Microbial Eradication Rates were determined through follow-up sputum cultures or nasopharyngeal swabs. Adverse Effects was monitored and recorded throughout the treatment period. Comparison of rates of hospitalization post-treatment initiation were also noted. Statistical analyses are performed using SPSS v29 to compare the efficacy and safety outcomes between the two treatment groups. A p-value of <0.05 is considered statistically significant.

**Results**

Data were collected from 185 pneumonia patients. The mean age was comparable between the groups ( $5.4 \pm 3.1$  years for amoxicillin and  $5.2 \pm 3.0$  years for azithromycin). Gender distribution was similar, with 54.8% males in the amoxicillin group and 54.3% males in the azithromycin group. The mean severity scores were also comparable, at  $3.2 \pm 0.8$  for the amoxicillin group and  $3.3 \pm 0.7$  for the azithromycin group, indicating similar baseline characteristics across both groups.

**Table 1: Baseline Characteristics of the Patients**

Characteristic	Amoxicillin Group (n=93)	Azithromycin Group (n=92)
Mean Age (years)	$5.4 \pm 3.1$	$5.2 \pm 3.0$
Male (%)	51 (54.8%)	50 (54.3%)
Female (%)	42 (45.2%)	42 (45.7%)
Mean Severity Score	$3.2 \pm 0.8$	$3.3 \pm 0.7$

By Day 3, 65% of patients in the amoxicillin group and 62% in the azithromycin group showed significant improvement. By Day 5, these rates increased to 82% for the amoxicillin group and 80% for the azithromycin group. By Day 7, 90% of the patients in the amoxicillin group and 88% in the azithromycin group demonstrated clinical improvement, indicating that both antibiotics were similarly effective over the course of treatment.

**Table 2: Clinical Improvement Rates**

Time Point	Amoxicillin Group (n=93)	Azithromycin Group (n=92)
Day 3	65% (60/93)	62% (57/92)
Day 5	82% (76/93)	80% (74/92)
Day 7	90% (84/93)	88% (81/92)

Microbial eradication rates were evaluated, showing that 88% of patients in the amoxicillin group and 85% in the azithromycin group achieved eradication of the causative pathogens. A minority of patients did not achieve eradication: 12% in the amoxicillin group and 15% in the azithromycin group.

**Table 3: Microbial Eradication Rates**

Outcome	Amoxicillin Group (n=93)	Azithromycin Group (n=92)
Eradicated (%)	88% (82/93)	85% (78/92)
Not Eradicated (%)	12% (11/93)	15% (14/92)

In terms of adverse effects, gastrointestinal symptoms were reported in 10% of patients in the amoxicillin group and 12% in the azithromycin group. No other adverse effects were noted in either group, and the majority of patients reported no adverse effects (90% in the amoxicillin group and 88% in the azithromycin group). Regarding hospitalization rates, 5% of patients in the amoxicillin group required hospitalization, compared to 7% in the azithromycin group. The majority of patients in both groups did not require hospitalization (95% in the amoxicillin group and 93% in the azithromycin group)

**Table 4: Adverse Effects and hospitalization rates**

Adverse Effect	Amoxicillin Group (n=93)	Azithromycin Group (n=92)
Gastrointestinal	10% (9/93)	12% (11/92)
Other	0% (0/93)	0% (0/92)
None	90% (84/93)	88% (81/92)

Outcome	Amoxicillin Group (n=93)	Azithromycin Group (n=92)
Hospitalized (%)	5% (5/93)	7% (6/92)
Not Hospitalized (%)	95% (88/93)	93% (86/92)

There were no statistically significant differences observed in clinical improvement rates by Day 7 (90% for amoxicillin vs. 88% for azithromycin,  $p = 0.68$ ) or radiographic improvement rates by Day 7 (85% for amoxicillin vs. 83% for azithromycin,  $p = 0.70$ ). Similarly, microbial eradication rates were comparable (88% for amoxicillin vs. 85% for azithromycin,  $p = 0.54$ ). Adverse effects (10% for amoxicillin vs. 12% for azithromycin,  $p = 0.64$ ), hospitalization rates (5% for amoxicillin vs. 7% for azithromycin,  $p = 0.62$ ), and compliance rates (95% for amoxicillin vs. 98% for azithromycin,  $p = 0.44$ ).

**Table 5: Summary of Primary and Secondary Outcomes with p-values**

Outcome	Amoxicillin Group (n=93)	Azithromycin Group (n=92)	p-value
Clinical Improvement (Day 7)	90% (84/93)	88% (81/92)	0.68
Radiographic Improvement (Day 7)	85% (79/93)	83% (76/92)	0.70
Microbial Eradication	88% (82/93)	85% (78/92)	0.54
Adverse Effects	10% (9/93)	12% (11/92)	0.64
Hospitalization Rates	5% (5/93)	7% (6/92)	0.62
Compliance Rates	95% (88/93)	98% (90/92)	0.44

## Discussion

Our findings suggest that both antibiotics are effective, with no significant differences in clinical improvement, radiographic improvement, microbial eradication, adverse effects, hospitalization rates, or compliance. Both treatment groups showed high rates of clinical improvement by Day 7 (90% for amoxicillin and 88% for azithromycin), indicating that both antibiotics are highly effective in resolving the symptoms of CAP [11]. Similarly, radiographic improvement rates were high and comparable between the groups (85% for amoxicillin and 83% for azithromycin), further supporting the clinical efficacy of both antibiotics. The lack of significant difference ( $p = 0.68$  for clinical improvement and  $p = 0.70$  for radiographic improvement) suggests that either antibiotic can be

considered a first-line treatment option for pediatric CAP [12]. The microbial eradication rates were also similar between the two groups (88% for amoxicillin and 85% for azithromycin), with a p-value of 0.54. This indicates that both antibiotics are effective in eliminating the causative pathogens of CAP [13]. The choice between amoxicillin and azithromycin may, therefore, be guided by other factors, such as the specific pathogen suspected or confirmed, patient allergy history, and local resistance patterns. Both amoxicillin and azithromycin were well-tolerated, with mild adverse effects reported in 10% and 12% of patients, respectively [14]. The types of adverse effects were mainly gastrointestinal, such as nausea and diarrhea, and there was no significant difference in the incidence of adverse effects between the two groups ( $p = 0.64$ ). This finding is important for clinical decision-making, as it highlights the safety profile of both antibiotics in the pediatric population [15]. The hospitalization rates post-treatment initiation were low in both groups (5% for amoxicillin and 7% for azithromycin), with no significant difference observed ( $p = 0.62$ ). This indicates that both antibiotics are effective in preventing disease progression that would necessitate hospitalization, further supporting their use as first-line treatments for outpatient management of pediatric CAP [16]. Compliance rates were high in both groups, slightly favoring azithromycin (95% for amoxicillin and 98% for azithromycin), although the difference was not statistically significant ( $p = 0.44$ ). Azithromycin's once-daily dosing regimen and shorter treatment duration might contribute to better compliance, particularly in young children [17]. This could be a consideration in clinical practice, where ensuring adherence to the treatment regimen is critical for successful outcomes. The results of this study have several implications for clinical practice [18]. Given the comparable efficacy and safety profiles of amoxicillin and azithromycin, the choice of antibiotic can be tailored based on individual patient factors and local epidemiological data. For instance, amoxicillin may be preferred in cases where *Streptococcus pneumoniae* is the predominant pathogen, while azithromycin might be favored in situations where atypical pathogens are suspected, or in patients with a history of  $\beta$ -lactam allergy.

## Conclusion

Amoxicillin and azithromycin are highly effective and safe for the treatment of pediatric community-acquired pneumonia, with no significant differences in clinical outcomes, microbial eradication, or adverse effects.

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