Volume 4, Issue 3, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

PRESCRIBING PATTERNS OF COMBINATION PHARMACOTHERAPY AMONG CHILDREN HOSPITALIZED WITH PNEUMONIA IN TERTIARY CARE HOSPITALS OF PESHAWAR, PAKISTAN: A RETROSPECTIVE CROSS-SECTIONAL STUDY

Namrah Aasi[*1], Sadia Zeb[2], Muhammad Tayyab Tariq[3], Shamshad Aziz[4], Haroon Rahim[5], Syed Asim Shah[6]

*[*1]Department of Pharmacy, University of Lahore, Pakistan*
[2]Department of Pharmaceutical Sciences, The Superior University, Lahore, Pakistan
[3]Doctor of Medical Laboratory Sciences, University of Lahore, Pakistan
[4]Lecturer MLT, HBS College Of Rehabilitation and Allied Health Sciences, Islamabad, Pakistan
[5]Principal & Professor, Khubaib Institute of Pharmaceutical Sciences, Haripur, Khyber Pakhtunkhwa, Pakistan
[6]Lecturer, Sarhad University of Science and Information Technology, Islamabad Campus, Pakistan

[*1]namrahassi@gmail.com, [2]sadiazeb010@gmail.com, [3]tayyabtariqsumra@gmail.com, [4]shamshadaziz644@gmail.com, [5]hrahimpk@gmail.com, [6]syedasimshah10@gmail.com

DOI: https://doi.org/10.5281/zenodo.24028442

Keywords
pediatric pneumonia; prescribing patterns; combination therapy; bronchodilators; corticosteroids; paracetamol; drug utilization; Pakistan

Article History
Received: 15 January 2026
Accepted: 28 February 2026
Published: 14 March 2026

Copyright @Author
Corresponding Author: *
Namrah Aasi

Abstract

Background: *Hospital management of childhood pneumonia rests on appropriate antibiotic therapy supplemented by supportive medicines, but documented prescribing patterns for these supportive co-medications in Khyber Pakhtunkhwa are scarce.*

Objective: *To describe the drug-combination prescribing patterns used for children hospitalized with pneumonia in tertiary care hospitals in Peshawar, and to explore whether the number of co-prescribed agents was related to documented drug–drug interaction level.*

Methods: *A retrospective, cross-sectional chart review was conducted on 180 children aged 2 months to 12 years with clinically confirmed pneumonia receiving documented pharmacotherapy (non-probability convenience sampling). Regimens were classified into five categories and re-expressed as class-level exposure (bronchodilator, corticosteroid, paracetamol) and number of agents. Proportions are reported with Wilson 95% confidence intervals; a Cochran–Armitage test assessed trend in documented interaction across number of agents.*

Results: *One hundred and forty-eight children (82.2%; 95% CI 76.0–87.1) received combination therapy and 32 (17.8%) received an antibiotic alone. The leading regimens were antibiotic + bronchodilator (24.4%), antibiotic + bronchodilator + paracetamol (23.9%) and antibiotic + corticosteroid (23.3%). Bronchodilators were prescribed to 48.3% of children, paracetamol to 34.4% and corticosteroids to 23.3%. One adjunct was added in 58.3% and two in 23.9%. Any documented interaction occurred in 29.4% overall and did not trend with the number of agents (34.4%, 28.6% and 27.9% for none, one and two adjuncts; $p = 0.569$).*

Conclusion: *Adjunctive co-prescribing is the norm rather than the exception in hospitalized pediatric pneumonia in Peshawar, with bronchodilators the most frequent add-on. The documented interaction burden did not rise with*

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

regimen complexity. Indication-level data and stewardship audit are needed to judge the appropriateness of these adjuncts.

1. INTRODUCTION

Pneumonia remains a leading infectious cause of hospitalization and death among children in low- and middle-income countries, with the burden concentrated in South Asia and sub-Saharan Africa.[1] Management guidelines centre on appropriate antimicrobial therapy and supportive care.[2,3] In everyday hospital practice, however, the antibiotic is rarely the only medicine prescribed: bronchodilators are added for airway symptoms, corticosteroids for presumed airway inflammation, and antipyretics for fever and discomfort.[4]

Drug utilization studies describe what is actually prescribed and are an essential first step toward rational-use audit and pharmacist-led stewardship. Local evidence on the pattern of adjunctive co-prescribing in hospitalized pediatric pneumonia is limited, even though prescribing here is shaped by unique features of the setting, including high antimicrobial resistance pressure,[5,6] limited diagnostic confirmation and variable adherence to protocols.

This study therefore aimed to (i) describe the combination drug regimens prescribed to children hospitalized with pneumonia in tertiary care hospitals in Peshawar; (ii) express prescribing at the level of adjunct drug class and number of co-prescribed agents; and (iii) explore whether regimen complexity was related to documented drug–drug interaction level.

2. Materials and Methods

2.1 Study design and setting

A descriptive, cross-sectional drug utilization study was conducted by retrospective review of hospital medical records at participating tertiary care hospitals in Peshawar, Khyber Pakhtunkhwa, Pakistan. The report follows the STROBE recommendations for cross-sectional studies.[7]

2.2 Participants

Children aged 2 months to 12 years with a confirmed clinical diagnosis of pneumonia, admitted to a participating hospital, with complete medication and outcome records, were eligible. Using non-probability convenience sampling, 180 children met all criteria and formed the analytic sample.

2.3 Variables

The primary variable was the drug-combination regimen, recorded as: antibiotic only; antibiotic + paracetamol; antibiotic + bronchodilator; antibiotic + corticosteroid; and antibiotic + bronchodilator + paracetamol. Two derived variables were constructed from this classification: (a) exposure to each adjunct class (any bronchodilator, any corticosteroid, any paracetamol) and (b) the number of agents co-prescribed with the antibiotic (none, one, two). Documented drug–drug interaction level (none, minor, moderate) was extracted as recorded in the clinical or pharmacy notes and reflects the overall interaction assessment for each patient's regimen rather than specific interacting drug pairs.

2.4 Statistical analysis

Categorical variables are presented as counts and percentages with Wilson score 95% confidence intervals.[8] Trend in the proportion of children with any documented interaction across the number of co-prescribed agents was assessed with the Cochran–Armitage test. All tests were two-tailed with $\alpha = 0.05$. Analyses were performed in IBM SPSS Statistics and verified independently in Python (SciPy).

2.5 Ethical considerations

Ethical clearance was obtained from the respective hospital administration and institutional ethical review committee. No personally identifying information was collected.

3. Results

3.1 Regimen distribution

Combination therapy was prescribed to 148 of 180 children (82.2%; 95% CI 76.0–87.1), while 32 (17.8%; 95% CI 12.9–24.0) received an antibiotic alone. The most frequent regimen was antibiotic + bronchodilator (44; 24.4%), followed closely by antibiotic + bronchodilator + paracetamol (43; 23.9%) and antibiotic + corticosteroid (42; 23.3%). Antibiotic +

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

paracetamol was the least common combination (19; 10.6%) (Table 1; Figure 1). Within the sample, the antibiotic backbone included the aminoglycoside gentamicin, co-prescribed with ampicillin in approximately one in five children (21.7%).

Table 1. Distribution of drug-combination regimens among hospitalized children with pneumonia (n = 180).

Regimen	n	%	95% CI
Antibiotic + bronchodilator	44	24.4	18.7–31.2
Antibiotic + bronchodilator + paracetamol	43	23.9	18.2–30.6
Antibiotic + corticosteroid	42	23.3	17.8–30.0
Antibiotic only	32	17.8	12.9–24.0
Antibiotic + paracetamol	19	10.6	6.9–15.9
Total	**180**	**100.0**	—

CI, Wilson score confidence interval.

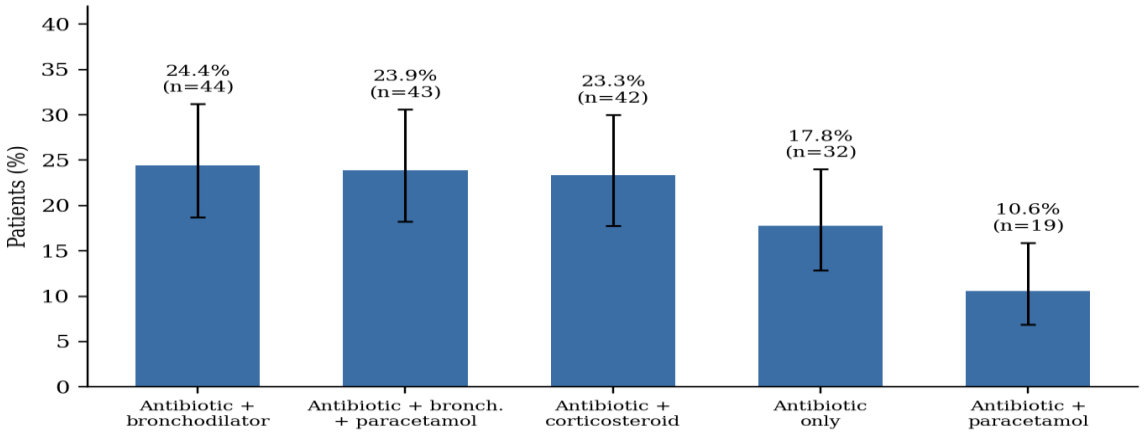


Figure 1. Prescribed drug-combination regimens with 95% Wilson confidence intervals (n = 180).

3.2 Adjunct class exposure and number of agents

Re-expressed by drug class, bronchodilators were given to 87 children (48.3%; 95% CI 41.1–55.6), paracetamol to 62 (34.4%; 95% CI 27.9–41.6) and corticosteroids to 42 (23.3%; 95% CI 17.8–30.0). By regimen complexity, 105 children (58.3%; 95% CI 51.0–65.3) received the antibiotic plus a single adjunct, and 43 (23.9%; 95% CI 18.2–30.6) received two adjuncts (Table 2). No child received a regimen with a corticosteroid and a second adjunct.

Table 2. Adjunct class exposure and number of co-prescribed agents (n = 180).

Characteristic	n	%	95% CI
Any bronchodilator	87	48.3	41.1–55.6
Any paracetamol	62	34.4	27.9–41.6
Any corticosteroid	42	23.3	17.8–30.0
Antibiotic alone (no adjunct)	32	17.8	12.9–24.0
Antibiotic + one adjunct	105	58.3	51.0–65.3
Antibiotic + two adjuncts	43	23.9	18.2–30.6

Classes are not mutually exclusive: children receiving bronchodilator + paracetamol are counted in both class rows.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

3.3 Regimen complexity and documented interaction level

Across the cohort, 127 children (70.6%) had no documented interaction, 34 (18.9%) a minor interaction and 19 (10.6%) a moderate interaction; no severe interaction was documented. The proportion with any documented interaction was 34.4% (11/32) among children on antibiotic alone, 28.6% (30/105) with one adjunct and 27.9% (12/43) with two adjuncts, with no evidence of a trend (Cochran–Armitage Z = −0.57, p = 0.569). Moderate interactions were documented in 9.4%, 8.6% and 16.3% of these groups respectively (Table 3).

Table 3. Documented interaction level by number of agents co-prescribed with the antibiotic.

Agents added to antibiotic	None	Minor	Moderate	Total	Any, %
None (antibiotic only)	21	8	3	32	34.4
One adjunct	75	21	9	105	28.6
Two adjuncts	31	5	7	43	27.9
Total	**127**	**34**	**19**	**180**	**29.4**

Trend in any documented interaction: Cochran–Armitage Z = −0.57, p = 0.569.

4. Discussion

More than four in five hospitalized children in this cohort received at least one medicine alongside the antibiotic, and bronchodilators were the most common add-on, prescribed to almost half. This pattern indicates that adjunctive co-prescribing is a routine component of inpatient pneumonia care in the study setting, rather than an exception reserved for selected patients.

Because the study captured the regimen but not the clinical indication, it cannot establish whether each adjunct was warranted. Bronchodilators and corticosteroids have defined roles where wheeze or bronchospasm is documented, whereas guideline recommendations for pneumonia centre on the antimicrobial and supportive care,[2,3] and local comparative work has focused mainly on antibiotic choice.[9] The proportion of children receiving a corticosteroid (23.3%) and a bronchodilator (48.3%) therefore identifies where indication-linked audit would be most informative, without in itself implying inappropriate use.

A reassuring secondary finding is that documented interaction did not accumulate as regimens became more complex: the proportion with any documented interaction was, if anything, numerically highest among children on an antibiotic alone. This is compatible with the generally low interaction potential of the commonly used adjuncts, but it should be read cautiously, because interaction level was a global clinical assessment and not a pair-level screen, and the groups were small. The presence of gentamicin in roughly one-fifth of regimens remains relevant for stewardship and monitoring, given its dose- and duration-dependent nephrotoxicity and ototoxicity.

4.1 Strengths and limitations

Strengths include complete medication data for a well-defined hospital cohort and transparent interval estimation. Limitations include the retrospective, single-city, convenience-sampled design; the lack of clinical indication, dose, duration and antibiotic-specific data; the categorical interaction variable; and the small subgroup sizes, which limit precision (confidence intervals for regimen-level proportions span roughly 12 percentage points or more). Findings may not generalize to primary care or to other provinces.

5. Conclusion

Combination pharmacotherapy is the dominant prescribing pattern for children hospitalized with pneumonia in the participating tertiary hospitals, with bronchodilators the most frequent adjunct. Documented interaction level did not increase with the number of co-prescribed agents. Prospective studies that capture indication, dose, duration and antibiotic choice are needed to support rational-use audits and antimicrobial stewardship.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

5.1 Recommendations

- Introduce indication-linked audit of bronchodilator and corticosteroid prescribing in pediatric pneumonia admissions.
- Embed pharmacist review of regimens in pediatric wards, prioritizing antibiotic selection and aminoglycoside monitoring.
- Design prospective drug utilization studies recording indication, dose and duration to allow appropriateness assessment.

Declarations

Ethics approval and consent to participate. The data used for illustration were obtained under approval from the institutional ethical review committee and the administration of the participating hospitals; individual consent was waived for this retrospective record review and all data were anonymized.

Consent for publication. Not applicable.

Availability of data and materials. The dataset is available from the corresponding author on reasonable request.

Competing interests. The authors declare that they have no competing interests.

Funding. This work received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

REFERENCES

Rudan I, Boschi-Pinto C, Biloglav Z, Mulholland K, Campbell H. Epidemiology and etiology of childhood pneumonia. Bull World Health Organ. 2008;86(5):408–416.

Bradley JS, Byington CL, Shah SS, et al. The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clin Infect Dis. 2011;53(7):e25–e76.

World Health Organization. Revised WHO classification and treatment of childhood pneumonia at health facilities: evidence summaries. Geneva: WHO; 2014.

Iqbal N, Zafar F, Iqbal M. Factors influencing the outcome of severe pneumonia among children having age from 2 months to 5 years in a tertiary healthcare hospital. Pak J Health Sci. 2023;4(1).

Naylor NR, Atun R, Zhu N, et al. Estimating the burden of antimicrobial resistance: a systematic literature review. Antimicrob Resist Infect Control. 2018;7:58.

Saleem Z, Godman B, Azhar F, et al. Progress on the national action plan of Pakistan on antimicrobial resistance: a narrative review and implications. Expert Rev Anti Infect Ther. 2022;20(1):71–93.

von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet. 2007;370(9596):1453–1457.

Wilson EB. Probable inference, the law of succession, and statistical inference. J Am Stat Assoc. 1927;22(158):209–212.

Rehman Z, Ziaullah, Shah AI. Comparison of efficacy of amoxicillin versus ceftriaxone in children with pneumonia. J Saidu Med Coll. 2017;7(2):127–130.