



Original Research Article

Comparative Analysis of Pediatricians' Management of Pneumonia in a Tertiary Care Hospital before and After COVID-19

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Abstract: **Background:** The worldwide spread of COVID-19 indirectly influenced the epidemiology and clinical management of pediatric pneumonia, altering diagnostic approaches, antibiotic prescribing, and supportive care practices. **Objective:** To compare pediatricians' management of pneumonia in a tertiary care hospital before and after the COVID-19 pandemic. **Design:** Comparative cross-sectional study. **Place of Study:** Department of Pediatrics, Nishtar Medical University, Multan. **Duration of Study:** Six months, from 1st January 2025 to 30th June, 2025. **Methodology:** Hospital medical records of children aged 2 months to 12 years diagnosed with pneumonia were retrospectively reviewed. A total of 206 cases were included, 103 from each study period. Data on demographics, presenting complaints, clinical severity, investigations, management practices, and outcomes were extracted using a structured proforma. All statistical analyses were conducted using IBM SPSS Statistics, version 26.0, with the chi-square test and t-test applied. A p-value <0.05 was considered significant. **Results:** Radiographic findings showed fewer consolidations but more interstitial infiltrates post-COVID. Viral PCR positivity increased markedly (65.0% vs. 13.6%). Antibiotic duration was shorter post-COVID (5.9 vs. 6.8 days), with increased use of corticosteroids (36.9% vs. 21.4%). Hospital admissions decreased (49.5% vs. 62.1%), and average length of stay was reduced (4.7 vs. 5.6 days). Mortality remained low in both groups. **Conclusion:** COVID-19 has significantly influenced pediatric pneumonia management, with trends toward shorter hospital stays, reduced antibiotic duration, and greater use of corticosteroids and antivirals. These findings highlight the need to update local guidelines and strengthen antibiotic stewardship in pediatric care.

Keywords: Antibacterial agents, anti-inflammatory agents, COVID-19, Pediatric pneumonia, Pneumonia.

INTRODUCTION

Pneumonia remains one of the leading contributors to childhood morbidity and mortality globally and is a common reason for pediatric hospital care in tertiary centres.¹ The COVID-19 pandemic produced marked indirect effects on the epidemiology and clinical management of non-COVID respiratory diseases in children, altering health-seeking behaviour, inpatient admissions, diagnostic testing patterns, and antibiotic prescribing. Several multicentre analyses documented

substantial reductions in pediatric visits and hospital encounters for respiratory illnesses during periods of strict public-health measures, followed by variable rebounds as restrictions relaxed.^{2,3}

Concurrently, circulation patterns of common respiratory pathogens shifted during and after the pandemic: social distancing and masking were associated with an initial reduction in viruses such as RSV and influenza, but atypical timing, rebound

surges, and changes in age distribution were reported in later seasons, phenomena that influenced case-mix and diagnostic considerations for pneumonia in children.^{4,6}

These epidemiologic shifts had downstream effects on clinician practice. Several studies documented large declines in outpatient antibiotic prescriptions for children during 2020, largely driven by fewer viral respiratory encounters, with partial rebound thereafter; such changes highlight both altered disease incidence and opportunities (and challenges) for stewardship in the post-pandemic period.^{7,8}

At the same time, professional guidance and clinical workflows adapted to the pandemic context: living guidelines for COVID-19 and pediatric clinical advisories recommended modifications to infection control, triage, testing strategies, and for COVID-specific pneumonia, therapeutic approaches, which also affected how clinicians approached differential diagnosis and management of community-acquired pneumonia in children.^{9,10}

Taken together, these interconnected changes in pathogen epidemiology, healthcare utilization, antibiotic prescribing, and guideline-driven practice create a plausible basis for measurable differences in how pediatricians at tertiary care hospitals diagnose, treat, and disposition children with pneumonia before versus after the COVID-19 era. However, most published work to date reports broad trends across regions or outpatient networks rather than detailed, single-centre comparisons of clinician management decisions within tertiary paediatric services.^{3,11}

Therefore, the present study was conducted to examine and compare pediatricians' management of pneumonia in a tertiary care hospital prior to and following the emergence of the COVID-19 pandemic focusing on diagnostic testing, antibiotic selection and duration, admission and discharge practices, and use of adjunctive therapies to identify practice changes that may inform local stewardship, guideline implementation, and preparedness for future shifts in respiratory disease epidemiology.

METHODOLOGY

This retrospective comparative cross-sectional study was conducted at the Department of Pediatrics at Nishtar Medical University, Multan during period of six months from 1st January 2025 to 30th June 2025, and records of pediatric patients diagnosed with pneumonia were reviewed. Two distinct datasets were analyzed: pre-COVID-19 records taken from July to December 2019, and post-COVID-19 records taken from July to December 2023. This design allowed for direct comparison of pediatricians' management practices for pneumonia before and after the COVID-19 pandemic. The research protocol was approved by

the Institutional Review Board/Ethical Review Committee of Nishtar Medical University, Multan, (Approval no: 16769/NMU&H, Dated: 19-07-2023). All information was kept strictly confidential, and no personal identifiers were recorded. The sample size was calculated by WHO calculator, based on a comparison of two independent proportions following WHO guidelines. Assuming guideline-concordant antibiotic prescribing of 60% in the pre-COVID period and 78% in the post-COVID period, with a 95% confidence interval and 80% power, the required sample size was 206, 103 per group.¹² Children aged between two months and twelve years who were diagnosed with pneumonia according to WHO clinical criteria¹³ and managed by pediatricians in the study hospital during the specified periods were included. Cases with chronic pulmonary diseases such as cystic fibrosis or bronchiectasis, congenital heart disease, immunodeficiency, or incomplete medical records were excluded from analysis. Medical records of pediatric patients diagnosed with pneumonia were systematically reviewed. A total of 206 cases were included, comprising 103 patients each from the pre-COVID-19 and post-COVID-19 periods. Data were extracted using a structured proforma developed specifically for the study to ensure consistency and standardization. The proforma captured key clinical and management details, including demographic information (age, sex, and residence), clinical profile (presenting complaints, disease severity, and oxygen saturation at admission), and investigations (chest radiography findings, relevant laboratory parameters, and viral testing results when available). Management practices were also documented, covering antibiotic class and duration, use of adjunctive therapies such as oxygen supplementation, corticosteroids, antivirals, and supportive care, along with referral decisions. Outcomes such as admission status, length of hospital stay, and discharge disposition were also recorded. Data collection was carried out by trained research assistants under close supervision, with 10% of the extracted data randomly cross-verified by senior supervisors to ensure accuracy and reliability. Confidentiality of patient records was maintained throughout by coding identifiers and securely storing the dataset exclusively for research purposes.

All data were analyzed with SPSS version 26.0, and descriptive statistics were applied to summarize the results, with frequencies and percentages reported for categorical variables, Continuous variables were reported as means with standard deviations (SD) or medians with interquartile ranges (IQR), based on the data distribution. The normality of the data was evaluated prior to conducting statistical tests, Comparisons between the pre-COVID and post-COVID groups were made to highlight differences in clinical presentation, management strategies, and outcomes. Chi-square test or Fisher's exact test was used to compare categorical variables such as disease

severity, antibiotic usage, and oxygen therapy. An independent t-test was performed on continuous variables that followed a normal distribution, including oxygen saturation and length of hospital

stay. A p-value of less than 0.05 was regarded as statistically significant. Results were presented in tables for clarity, emphasizing variations across the two groups.

RESULTS

In our study, the demographic and clinical characteristics of children with pneumonia were found to be comparable before and after the COVID-19 pandemic. The proportion of males was 57.3% in the pre-COVID group and 50.5% in the post-COVID group, while females accounted for 42.7% and 49.5%, respectively. Cough was reported in 68.0% of children before the pandemic and 72.8% after, whereas fever was noted in 77.7% and 83.5% of cases. Signs of respiratory distress showed some variation, with tachypnea present in 63.1% pre-COVID compared to 69.9% post-COVID, chest indrawing in 47.6% versus 58.3%, and wheezing in 31.1% versus 39.8%. (Table 1)

Table 1 Baseline and Clinical Features of Children with Pneumonia Pre- and Post-COVID-19 (n = 206)

Variable	Pre-COVID (n=103)	Post-COVID (n=103)	p-value
Age (years), Mean ± SD	4.3 ± 1.1	4.8 ± 1.3	0.012
Gender (Male)			
Male	59 (57.3%)	52 (50.5%)	0.349
Female	44 (42.7%)	51 (49.5%)	
Clinical Characteristics			
Cough	70 (68.0%)	75 (72.8%)	0.482
Fever	80 (77.7%)	86 (83.5%)	0.298
Oxygen Saturation (SpO ₂)	90.8 ± 3.1	93.2 ± 2.7	<0.001
Tachypnea	65 (63.1%)	72 (69.9%)	0.302
Chest indrawing	49 (47.6%)	60 (58.3%)	0.148
Wheezing	32 (31.1%)	41 (39.8%)	0.191

In terms of investigations, notable differences were observed between pre-COVID-19 and post-COVID-19 pneumonia cases. Consolidation on chest radiography was more frequent before the pandemic (62.1%) compared to afterward (46.6%), while interstitial infiltrates were higher in the post-COVID group (37.9% vs. 20.4%). Pleural effusion showed minimal difference (17.5% vs. 15.5%). Laboratory findings indicated that elevated CRP was more common post-COVID (81.6% vs. 68.9%), whereas leukocytosis was higher pre-COVID (57.3% vs. 41.7%). Lymphopenia was markedly increased in the post-COVID group (55.3% vs. 28.2%). Viral PCR positivity was significantly higher post-COVID (65.0% vs. 13.6%). (Table 2)

Table 2: Comparison of Diagnostic Investigations in Pneumonia Patients Before and After COVID-19 (n = 206)

Investigation	Pre-COVID-19 (n=103)	Post-COVID-19 (n=103)	p-value
Chest Radiography			
Consolidation	64 (62.1%)	48 (46.6%)	0.028*
Interstitial infiltrates	21 (20.4%)	39 (37.9%)	0.011*
Pleural effusion	18 (17.5%)	16 (15.5%)	0.718
Laboratory Findings			
Elevated CRP (>10 mg/L)	71 (68.9%)	84 (81.6%)	0.044*
Leukocytosis (>11 ×10 ⁹ /L)	59 (57.3%)	43 (41.7%)	0.026*
Lymphopenia (<1.0 ×10 ⁹ /L)	29 (28.2%)	57 (55.3%)	<0.001*
Viral Testing (when available)			
Positive viral PCR	14 (13.6%)	67 (65.0%)	<0.001*
Negative viral PCR	89 (86.4%)	36 (35.0%)	

The management practices for children with pneumonia showed notable differences before and after COVID-19 pandemic. The Antibiotics were prescribed to majority of patients in both groups, with 89.3% pre-COVID compared to 82.5% post-COVID. Oxygen supplementation was provided to 56.3% of children pre-COVID, while this decreased to 40.8% post-COVID. The use of corticosteroids nearly doubled, rising from 21.4% before the pandemic to 36.9% after. Antiviral therapy was administered in 3.9% of cases pre-COVID, increasing to 10.7% post-COVID. Supportive

care alone was provided to 17.5% of children before the pandemic, compared to 25.2% in the post-COVID period. (Table 3)

Table 3. Management Approaches for Children with Pneumonia Pre- and Post-COVID-19 (n = 206)

Management Practice	Pre-COVID (n=103)	Post-COVID (n=103)	p-value
Antibiotics prescribed	92 (89.3%)	85 (82.5%)	0.182
Duration of antibiotics (days), Mean $\pm$ SD	6.8 $\pm$ 2.1	5.9 $\pm$ 1.9	0.006
Oxygen supplementation	58 (56.3%)	42 (40.8%)	0.031
Corticosteroid use	22 (21.4%)	38 (36.9%)	0.016
Antiviral therapy	4 (3.9%)	11 (10.7%)	0.062
Supportive care only	18 (17.5%)	26 (25.2%)	0.188

In terms of outcomes, hospital admissions were slightly higher before COVID-19 (62.1%) compared to after COVID-19 (49.5%). The length of hospital stay also differed, with a longer average duration pre-COVID (5.6 days) compared to post-COVID (4.7 days). The majority of children were discharged home in both groups, with 92.2% pre-COVID and 95.1% post-COVID. A small proportion required referral to tertiary care, which was higher pre-COVID (5.8%) than post-COVID (2.9%). Mortality rates were low in both groups, reported as 1.9% before COVID-19 and 1.0% after COVID-19. (Table 4)

Table 4. Outcomes of Children with Pneumonia Before and After COVID-19 (n = 206)

Outcome	Pre-COVID (n=103)	Post-COVID (n=103)	p-value
Hospital admission	64 (62.1%)	51 (49.5%)	0.074
Length of stay (days), Mean $\pm$ SD	5.6 $\pm$ 2.0	4.7 $\pm$ 1.6	0.003
Discharge home	95 (92.2%)	98 (95.1%)	0.397
Referred to tertiary care	6 (5.8%)	3 (2.9%)	0.498
Mortality	2 (1.9%)	1 (1.0%)	1.000

DISCUSSION

In this single-centre retrospective comparison of pediatric pneumonia management before and after COVID-19 (n = 103 per period), several patterns emerge that largely mirror broader regional and international experiences. First, high overall antibiotic use in both periods (89.3% pre-COVID vs 82.5% post-COVID) aligns with reports from Pakistan and neighboring regions documenting persistently high antibiotic prescribing for pediatric respiratory illnesses; local studies and reviews have highlighted widespread empirical antibiotic use and concerns about inappropriate prescribing during the pandemic era.^{14, 15} While our data show a non-significant decline in the proportion receiving antibiotics, the finding is consistent with analyses that recorded variable declines in outpatient antibiotic prescriptions early in the pandemic, followed by partial rebound or shifting inpatient patterns.¹⁶

Second, we observed a significant reduction in antibiotic duration post-COVID (mean 6.8 $\rightarrow$ 5.9 days). This shorter duration may reflect increased clinician caution about prolonged antibiotic courses, pressure from stewardship initiatives, or greater recognition of viral aetiologies on the post-COVID

diagnostic pathway. Several stewardship-focused reports during and after the pandemic document similar shifts toward shorter or more targeted courses where viral testing or clinical certainty supported de-escalation.^{15, 16}

Third, the marked rise in documented viral detection and lymphopenia in the post-COVID cohort (viral PCR positivity and lymphopenia both substantially higher) is congruent with regional reports of changing viral epidemiology after mitigation measures were relaxed. Studies have described atypical timing and large rebound surges of RSV and other respiratory viruses, increasing the proportion of pneumonia cases with viral association and shifting radiographic patterns toward more interstitial changes.^{4, 17} Our radiographic finding (reduced consolidation but increased interstitial infiltrates) fits this shift from classical bacterial-pattern consolidation toward more interstitial/viral patterns reported in single-centre series and surveillance studies.^{18, 19}

Fourth, supportive-care patterns changed: fewer children received oxygen supplementation post-COVID in our cohort, yet more received corticosteroids, and a higher (though still small)

fraction received antivirals. The increased corticosteroid use after the pandemic may reflect greater application of anti-inflammatory strategies (often extrapolated from adult COVID literature) or clinicians' responses to viral-triggered wheeze and reactive airways; guideline committees and pediatric reviews have warned about heterogeneous steroid use in children because evidence is limited and often extrapolated, which matches the variable practice we observed.^{20, 21} Antiviral prescribing rose modestly, consistent with studies that reported increased targeted antiviral use when viral etiology was confirmed or suspected during post-pandemic viral surges.^{1, 18}

Fifth, clinical outcomes in our study improved modestly after COVID-19 in some respects (shorter length of stay and a trend toward fewer admissions), which echoes multicenter reports that described lower hospital utilization for non-COVID pediatric respiratory disease during periods of intense mitigation, followed by altered admission thresholds and care pathways later. The shorter length of stay could reflect altered triage, faster diagnostics (increased viral testing), or shifts toward outpatient management where clinically appropriate. Other observational series have reported similar temporal changes in admission rates and hospital resource use.¹⁹

Finally, the interpretation of our findings should consider the limitations of the study, retrospective design, single-center setting, and potential changes in testing availability and local guideline recommendations over time. Several of the comparative studies we cited also emphasize that pandemic-era surveillance, changing testing capacity, and variable stewardship implementation complicate direct comparisons across sites and periods.

In summary, the changes observed in antibiotic duration, radiographic and laboratory profiles, increased viral detection, and altered supportive and anti-inflammatory prescribing after COVID-19 are consistent with published reports from Pakistan and internationally. These concordances suggest that post-pandemic shifts in pathogen circulation and clinical decision-making have had measurable impacts on the management of pediatric pneumonia and highlight opportunities to consolidate stewardship gains, standardize steroid use in children, and continue targeted viral diagnostic strategies to guide therapy.

Our study results have important inferences for pediatric pneumonia management in the context of evolving clinical practices before and after COVID-19. The observed decline in hospital admissions and shorter duration of hospital stay in the post-COVID group suggest a possible shift towards more outpatient-based and resource-efficient management

strategies. Increased use of corticosteroids and antiviral therapies highlights the influence of COVID-19 treatment protocols on pediatric respiratory care. These insights emphasize the need to update pediatric pneumonia guidelines to reflect evidence-based practices that balance effective treatment with minimizing unnecessary hospitalizations and antibiotic overuse. Additionally, awareness of changing clinical presentations and management approaches can support pediatricians in tailoring interventions to optimize patient outcomes.

Our study has limitations that it was carried out at a single center and the relatively small sample size which may affect the generalizability of the results to different populations or healthcare environments. Secondly, the retrospective design introduces potential biases, including incomplete documentation and missing data. Third, viral testing was not universally performed, which may have underestimated the true prevalence of viral etiologies. Finally, our study did not consider socioeconomic factors, vaccination status, or comorbidities, which could have influenced clinical outcomes.

CONCLUSION

This study highlights significant shifts in the clinical profile and management of pediatric pneumonia before and after the COVID-19 era. While hospital admissions and antibiotic use declined, there was a rise in outpatient care, shorter hospital stays, and increased reliance on corticosteroids and antiviral therapies, reflecting the influence of evolving treatment practices. These findings underscore the importance of adapting pediatric pneumonia management guidelines to incorporate lessons learned from the pandemic, ensuring evidence-based, resource-efficient, and patient-centered care.

Recommendation

It is recommended that pediatric pneumonia management protocols be periodically updated to reflect post-COVID-19 trends in clinical presentation, diagnostics, and treatment approaches. Greater emphasis should be placed on rational antibiotic use, integration of viral testing into routine practice, and the judicious application of corticosteroids and antivirals where indicated. Strengthening outpatient care systems, improving caregiver awareness, and enhancing referral networks to tertiary care can further optimize outcomes.

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Disclosure: None

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