
ISSN: 3068-8965
Journal of Pediatric Advance Research

ATHENAEUM SCIENTIFIC PUBLISHERS

Research Article

Clinical Characteristics, Management and In-Hospital Outcomes of Children with Polymerase Chain Reaction (PCR)-Confirmed Pertussis at a Provincial Referral Hospital in Vietnam

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Citation: Huong PTT. Clinical Characteristics, Management, and In-Hospital Outcomes of Children with Polymerase Chain Reaction (PCR)-Confirmed Pertussis at a Provincial Referral Hospital in Vietnam. J Pediatric Adv Res. 2026;5(2):1-5.

https://doi.org/10.46889/JPAR.2026.5211

Received Date: 30-07-2026

Accepted Date: 24-08-2026

Published Date: 31-08-2026

Abstract

Background: Pertussis remains an important cause of hospitalization in young infants, particularly before completion of primary immunization.

Methods: We conducted a single-center observational study of 36 consecutive children hospitalized with real-time polymerase chain reaction-confirmed Bordetella pertussis infection from 1 April 2024 through 31 March 2025. Demographic, vaccination, clinical, laboratory, radiographic, treatment and in-hospital outcome data were summarized. Because of the small sample and sparse outcome counts, associations with transfer to a higher-level hospital were assessed using two-sided Fisher exact tests and interpreted as exploratory.

Results: The mean age was 13.73 months, 21 children (58.3%) were male and 13 (36.1%) were aged <2 months. Paroxysmal cough occurred in all children; facial flushing, mucus production, post-tussive vomiting and cyanosis/apnea occurred in 94.4%, 83.3%, 55.6% and 55.6%, respectively. Eight children (22.2%) developed respiratory failure. Absolute lymphocyte counts were ≥10 × 10^9/L in 21 (58.3%). Macrolides were administered to all children. Thirty-three children (91.7%) were discharged from the study hospital and three (8.3%) were transferred. All transfers occurred among infants aged <2 months (3/13 vs 0/23; p = 0.040) and children with respiratory failure (3/8 vs 0/28; p = 0.008). Mean length of stay was 12.31 days (SD 5.74; range 2-30).

Conclusion: In this small hospital cohort, very young age and respiratory failure were associated with transfer to a higher-level facility. The findings support close monitoring of young infants with pertussis but should be considered hypothesis-generating because of the single-center design and small number of transfer events.

Keywords: Bordetella Pertussis; Child; Infant; Hospitalization; Respiratory Failure; Vietnam

Introduction

Pertussis is a highly contagious, vaccine-preventable respiratory infection caused predominantly by Bordetella pertussis. Despite established childhood immunization programs, pertussis continues to cause substantial morbidity, with the greatest risk of severe disease concentrated in neonates and young infants who are too young to have completed primary immunization [1-3]. Age-dependent and sometimes atypical presentations can delay recognition in this group. Published data describing contemporary pediatric pertussis in Vietnam remain limited, particularly outside national referral centers. Local estimates of clinical presentation, use of hospital resources and short-term outcomes may improve early recognition and referral decisions. We therefore described the demographic, vaccination, clinical, laboratory, radiographic and treatment characteristics of children hospitalized with Polymerase Chain Reaction (PCR)-confirmed pertussis at a provincial referral hospital and explored factors associated with transfer to a higher-level facility and length of stay.

Methodology

Study Design and Setting

This single-center observational study included consecutive pediatric inpatients treated at Bac Ninh Obstetrics and Pediatrics Hospital No. 2, Bac Ninh, Vietnam, between 1 April 2024 and 31 March 2025. Reporting was structured with reference to the STROBE recommendations for observational studies [4].

Participants and Case Definition

Eligible participants were children hospitalized during the study period who had a positive real-time PCR result for B. pertussis from a nasopharyngeal specimen. Clinical features were assessed using age-appropriate concepts described by the Global Pertussis Initiative [1]. Consecutive sampling was used. No sample-size calculation was performed because all eligible cases during the predefined period were included.

Variables and Definitions

Extracted variables included age, sex, preterm birth, vaccination status, presenting symptoms, complete blood count, chest radiographic findings, detected co-pathogens, antibiotic treatment, respiratory failure, length of stay, discharge from the study hospital and transfer to a higher-level facility. The primary in-hospital disposition was discharge from the study hospital versus interhospital transfer. Transfer was treated as a healthcare-disposition outcome and not as a direct measure of death or treatment failure.

Statistical Analysis

Categorical variables are reported as frequencies and percentages. Continuous variables are reported as mean (SD) when approximately symmetric; median (interquartile range) should also be provided if distributions were skewed. Associations between categorical variables and interhospital transfer were reassessed using two-sided Fisher exact tests because of sparse cell counts. Mean length of stay was compared between two groups using an independent-samples t test only when distributional and variance assumptions were considered acceptable; otherwise, a Mann-Whitney U test was preferred. All analyses were exploratory and no multivariable model was fitted because only three transfer events occurred. Two-sided p values <0.05 were considered statistically significant. The original analysis used SPSS version 16.0 (SPSS Inc., Chicago, IL, USA).

Ethics

The study was conducted in accordance with the Declaration of Helsinki and applicable Vietnamese regulations.

Results

Participant Characteristics

All 36 eligible children were included. Mean age was 13.73 months; 13 children (36.1%) were aged <2 months, 21 (58.3%) were male and two (5.6%) had been born preterm. Thirteen children (36.1%) were not yet age-eligible for pertussis vaccination, three (8.3%) were age-eligible but unvaccinated, 13 (36.1%) were incompletely vaccinated and seven (19.4%) were fully vaccinated for age. Paroxysmal cough occurred in all children. Facial flushing was present in 34 (94.4%), inspiratory whoop in 23 (63.9%), mucus production in 30 (83.3%), rhinorrhea in 28 (77.8%), post-tussive vomiting in 20 (55.6%), cyanosis/apnea in 20 (55.6%) and fever in 10 (27.8%). Eight children (22.2%) developed respiratory failure (Table 1).

Characteristic	n	%
Leukocyte count ≥15 × 10^9/L	17	47.2
Absolute lymphocyte count ≥10 × 10^9/L	21	58.3
Platelet count >400 × 10^9/L	22	61.1
Abnormal chest radiograph	26	72.2
Confirmed co-pathogen	23	63.9

Characteristic	n	%
Data are n (%). Thresholds and definitions should be prespecified in Methods. WBC, white blood cell count		

Table 1: Laboratory, radiographic and microbiological characteristics (n = 36).

Treatment and In-Hospital Outcomes

All children received a macrolide: 18 (50.0%) received azithromycin, 13 (36.1%) clarithromycin and five (13.9%) received both agents during hospitalization. Thirty-two children (88.9%) received a third-generation cephalosporin, 11 (30.6%) received an aminoglycoside and two (5.6%) received meropenem or imipenem. Mean length of stay was 12.31 days (SD 5.74; range 2-30); 17 children (47.2%) stayed >14 days. Thirty-three children (91.7%) were discharged from the study hospital and three (8.3%) were transferred to a higher-level facility (Table 2).

Treatment Characteristic	n	%
One antibiotic class	2	5.6
Two antibiotic classes	18	50.0
Three antibiotic classes	8	22.2
>3 antibiotic classes	8	22.2
Azithromycin	18	50.0
Clarithromycin	13	36.1
Both azithromycin and clarithromycin	5	13.9
Third-generation cephalosporin	32	88.9
Aminoglycoside	11	30.6
Meropenem or imipenem	2	5.6
Categories for number of antibiotic classes are mutually exclusive; individual agents are not. Clarify whether macrolides were sequential or concurrent and provide dose and duration if required by the target journal		

Table 2: Antibacterial treatment during hospitalization (n = 36).

Exploratory Factors Associated with Transfer

All three transfers occurred among infants aged <2 months and among children with respiratory failure. In exploratory Fisher exact tests, age <2 months ($p = 0.040$) and respiratory failure ($p = 0.008$) were associated with transfer. Other evaluated associations were imprecise and did not reach the prespecified significance threshold (Table 3). Effect estimates and confidence intervals were not stable because several cells contained zero events.

Characteristic	Discharged, n/N (%)	Transferred, n/N (%)	Fisher p
Male sex	19/21 (90.5)	2/21 (9.5)	1.000
Age <2 months	10/13 (76.9)	3/13 (23.1)	0.040
Not vaccinated	13/16 (81.3)	3/16 (18.8)	0.078
Respiratory failure	5/8 (62.5)	3/8 (37.5)	0.008

Characteristic	Discharged, n/N (%)	Transferred, n/N (%)	Fisher p
Abnormal chest radiograph	23/26 (88.5)	3/26 (11.5)	0.545
WBC ≥15 × 10^9/L	14/17 (82.4)	3/17 (17.6)	0.095
Lymphocytes ≥10 × 10^9/L	18/21 (85.7)	3/21 (14.3)	0.250
Confirmed co-pathogen	20/23 (87.0)	3/23 (13.0)	0.288
Two-sided Fisher exact tests. These unadjusted analyses are hypothesis-generating; only three transfers occurred. The vaccination comparison uses the original 16/20 dichotomy and must be reconciled with the age-appropriate four-level vaccination variable before submission			

Table 3: Exploratory associations with interhospital transfer (n = 36).

Length of Stay

The original aggregate table suggested longer mean hospitalization among younger and incompletely vaccinated children. However, the reported vaccination group labels and denominators were inconsistent across tables and the supplied summary statistics did not reproduce the reported p-values. Inferential results for length of stay are therefore not presented pending reanalysis of patient-level data.

Discussion

In this cohort of 36 children hospitalized with PCR-confirmed pertussis, more than one-third were younger than 2 months and nearly one-quarter developed respiratory failure. All three interhospital transfers occurred in children younger than 2 months and in those with respiratory failure. These findings identify a clinically vulnerable subgroup, although the small number of events precludes precise estimation or independent risk-factor analysis. The concentration of severe disease in early infancy is consistent with international evidence. Young infants may present before receiving sufficient primary vaccine doses and have limited physiological reserve [2,3]. Maternal pertussis vaccination has been associated with substantial reductions in pertussis and pertussis-related hospitalization among young infants in multiple settings [3,5]. Our study did not collect maternal vaccination status and therefore cannot assess this relationship directly; nevertheless, this is an important variable for future Vietnamese surveillance. Leukocytosis and lymphocytosis are recognized features of pertussis, particularly in young infants, but they are neither universally present nor sufficiently specific to distinguish pertussis from other respiratory infections in isolation [1,6]. In the present cohort, 47.2% had leukocyte counts ≥15 × 10^9/L and 58.3% had absolute lymphocyte counts ≥10 × 10^9/L. Neither threshold was significantly associated with transfer in the exploratory analysis and confidence around these comparisons was wide. Antibacterial exposure was extensive: 94.4% received at least two antibiotic classes and 88.9% received a third-generation cephalosporin. Macrolides eradicate B. pertussis and reduce transmission, particularly when started early, but improvement in established paroxysmal symptoms may be limited [7]. The present data do not establish that additional broad-spectrum antibiotics improved outcomes, because treatment was not randomized and co-infection definitions require clarification. Antibiotic utilization should therefore be described rather than characterized as an effective 'aggressive protocol. This study has several limitations. It was conducted at a single hospital and included only 36 children, with three transfers and no documented post-transfer outcomes in the supplied dataset. Selection was restricted to hospitalized PCR-confirmed cases, so findings cannot be generalized to community cases or used to estimate incidence. Sparse events prevented multivariable adjustment and produced unstable associations. Transfer may reflect referral capacity as well as clinical severity. Definitions of vaccination status, co-infection, respiratory failure and radiographic abnormality require explicit standardization. Finally, the length-of-stay analysis requires reanalysis from patient-level data. The study nevertheless provides contemporary local data from northern Vietnam and uses laboratory confirmation in all participants. A multicenter prospective registry with standardized severity criteria, maternal and childhood vaccination histories, antimicrobial timing, intensive-care interventions and 30-day outcomes would provide more robust evidence.

Conclusion

Among 36 children hospitalized with PCR-confirmed pertussis, infants younger than 2 months accounted for all transfers to a higher-level facility and respiratory failure was strongly associated with transfer in an exploratory analysis. These results support

heightened monitoring and early escalation planning for young infants. Larger multicenter studies with standardized definitions and follow-up are needed before independent predictors or treatment effects can be inferred.

Conflict of Interest
The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding Statement
This research did not receive any specific grant from funding agencies in the public, commercial or non-profit sectors.

Acknowledgement
The authors have no acknowledgments to declare.

Data Availability Statement
The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement
The project did not meet the definition of human subject research under the preview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement
Informed consent was obtained from all participants included in the study.

Authors' Contributions
All authors contributed equally to this paper.

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