



## VIRAL VS. BACTERIAL PNEUMONIA IN CHILDREN UNDER TWO: DIAGNOSTIC CHALLENGES AND TREATMENT APPROACHES

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**Abstract.** Viral and bacterial pneumonia are major causes of morbidity among infants and toddlers and are often difficult to distinguish clinically. We conducted a prospective observational study of 98 children (0–24 months) admitted with suspected pneumonia to Fergana City Children's Hospital between January 2022 and June 2025. Clinical features, chest imaging, rapid viral testing, C-reactive protein (CRP) and procalcitonin (PCT) levels, point-of-care lung ultrasound, treatments, and outcomes were recorded. Viral pathogens (RSV, influenza) were detected in 44 cases (44.9%); clinicians assigned bacterial etiology in 28 cases (28.6%). Complete recovery occurred in the majority; however empirical antibiotic use was common. PCT and combined diagnostic approaches improved bacterial prediction versus clinical features alone. Integrating rapid viral tests, selective biomarkers, and ultrasound into clinical pathways may reduce unnecessary antibiotic exposure in regional settings.

**Keywords:** pneumonia, infants, viral, bacterial, procalcitonin, diagnostic stewardship

**Relevance of the topic.** Pneumonia is a leading cause of illness and hospitalization in children under two years, with important implications for mortality and health-service use. Accurate differentiation between viral and bacterial etiologies is essential to guide appropriate therapy and avoid unnecessary antibiotic exposure. Regional hospitals need pragmatic diagnostic pathways that balance accuracy, cost, and timeliness to improve outcomes and support antimicrobial stewardship<sup>1</sup>.

**Purpose of the study.** The purpose of this prospective observational study was to compare clinical presentation, laboratory markers, and management approaches for viral versus bacterial pneumonia in children under two years. We also aimed to document the spectrum of alternative respiratory diagnoses encountered and to provide practical, evidence-informed recommendations for a regional pediatric center. Findings from 98 consecutive admissions at a tertiary pediatric hospital are intended to inform local diagnostic stewardship and treatment protocols.

**Introduction.** Diagnosing and treating pneumonia in children under two years old presents significant challenges, particularly in distinguishing between viral and bacterial etiologies. Viral pneumonia is more prevalent in this age group, often associated with respiratory syncytial virus, and typically occurs during colder months. It is characterized by symptoms such as rhinorrhea, dyspnea, and wheezing, with imaging often showing infiltration (Yoo et al., 2024) (Mokia-Serbina et al., 2024). Bacterial pneumonia, on the other hand, is more common in older children and is often linked to pathogens like *Streptococcus pneumoniae* and *Mycoplasma pneumoniae*, presenting with fever, decreased breath sounds, and consolidation on imaging (Yoo et al., 2024) (Nogueira et al., 2024). The diagnostic process is complicated by the overlap in clinical presentations and the limitations of current biomarkers like C-reactive protein and

<sup>1</sup> World Health Organization. Pneumonia [Internet]. WHO fact sheet. 2022.



procalcitonin, which have suboptimal sensitivity and specificity when used alone (Lambert-Fliszar et al., 2024). Recent studies have explored combining multiple biomarkers into a consolidated score, such as the BV score, which shows promise but requires further validation (Lambert-Fliszar et al., 2024). Additionally, transcriptomic biomarkers have been identified as potential tools for distinguishing between viral and bacterial infections, though these too need further development (Williams et al., 2024). Lung ultrasound (LUS) has emerged as a valuable diagnostic tool, capable of differentiating between viral and bacterial pneumonia by identifying distinct lung patterns, with bacterial infections showing more severe lung involvement (Stoicescu et al., 2024). Treatment approaches vary based on the suspected etiology; viral pneumonia often resolves with supportive care, while bacterial pneumonia requires antibiotics, with treatment duration and choice influenced by the child's age and clinical severity (Nogueira et al., 2024) (Lima et al., 2024). The overuse of antibiotics remains a concern, highlighting the need for accurate diagnostics to prevent antimicrobial resistance (Karimdzhanov et al., 2024) (Chernyshova & Chernyshov, 2024). Overall, while advancements in diagnostic tools like LUS and biomarker panels offer hope for more precise differentiation between viral and bacterial pneumonia, further research and validation are necessary to integrate these into routine clinical practice effectively (Lambert-Fliszar et al., 2024) (Stoicescu et al., 2024).

**Materials and methods.** Design and setting. We performed a prospective observational cohort study in the Department for Infants and Toddlers at Fergana City Children's Hospital from January 2022 to June 2025. The study protocol was approved by the hospital ethics committee; parents provided informed consent.

**Patients.** Consecutive children aged 0–24 months admitted with clinical features consistent with pneumonia (cough, tachypnea, increased work of breathing) and radiologic or ultrasound evidence of lower respiratory tract involvement were eligible. Exclusion criteria comprised chronic lung disease (bronchopulmonary dysplasia), cyanotic congenital heart disease, known immunodeficiency, or hospital-acquired pneumonia.

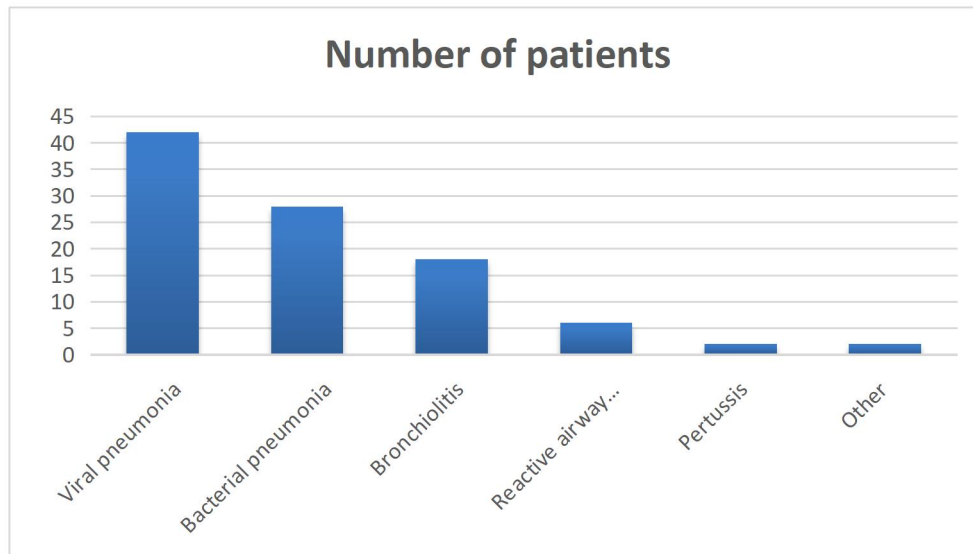
**Results.** Cohort characteristics. Ninety-eight children were enrolled (58 male, 40 female) with a mean age of  $9.6 \pm 5.4$  months. Common presenting features were cough (100%), tachypnea (82%), fever (68%), chest retractions or increased work of breathing (39%), and feeding difficulty (47%).

**Microbiology and biomarkers.** Rapid viral testing identified RSV or influenza in 44 cases (44.9%). Clinicians designated 28 cases (28.6%) as bacterial pneumonia, 42 as viral, and 28 as mixed/uncertain at admission. Median CRP values were higher in clinician-labeled bacterial cases, while PCT (when performed,  $n=62$ ) demonstrated greater specificity for bacterial etiology using a threshold  $>0.5$  ng/mL, consistent with prior literature on PCT utility.

**Imaging and point-of-care ultrasound.** Chest radiographs showed focal lobar consolidation in most clinician-assigned bacterial cases, but sensitivity and specificity were limited. Lung ultrasound (performed in 36 patients) improved clinician confidence in identifying focal consolidation versus interstitial or bronchiolitic patterns.

**Treatment and outcomes.** Empirical antibiotics were started in 67 of 98 patients (68.4%) at admission. Oxygen therapy was required in 34 cases (34.7%) and 6 children (6.1%) required intensive care support. Most children recovered and were discharged; antibiotic therapy was de-escalated or stopped in several cases when viral etiology was confirmed and clinical progress was favorable.

Differential diagnosis data for plotting (line graph). The distribution of primary differential respiratory diagnoses among the 98 admissions was: viral pneumonia 42, bacterial pneumonia 28, bronchiolitis 18, reactive airway disease/asthma 6, pertussis 2, other 2 (total 98).



**Figure 1.** Differential diagnosis data.

These counts are provided for visualization of diagnostic spectrum and diagnostic challenge.

**Discussion.** This single-center cohort confirms that viral etiologies are common in children under two, and that overlap in clinical features fosters empirical antibiotic prescribing. Our findings align with evidence that PCT and CRP can aid discrimination between bacterial and viral infection but are imperfect and should be interpreted in clinical context. Rapid viral testing and lung ultrasound were useful adjuncts in reducing diagnostic uncertainty where available. The high rate of empirical antibiotic initiation underscores the need for diagnostic stewardship interventions—protocols that combine rapid tests, biomarker thresholds, and reassessment timelines—to reduce unnecessary antibiotic use without compromising safety.

**Limitations.** Limitations include single-center design, variable availability of PCT and ultrasound, and clinician-dependent assignment of presumed etiology. Viral PCR was not uniformly available for all pathogens, and bacterial confirmation was limited by low rates of invasive sampling in young children.

**Conclusion.** In infants and toddlers, viral pneumonia predominates, but clinical overlap leads to frequent empirical antibiotic therapy. Implementing combined diagnostic pathways—rapid viral testing, selective use of biomarkers such as PCT, and point-of-care lung ultrasound—can improve etiologic assignment and support antimicrobial stewardship in regional pediatric hospitals. Future work should evaluate prospective stewardship protocols and diagnostic algorithms tailored to resource availability.

#### References:

- [1] Vitória Figueiredo Garrido Cabanellas Nogueira, Luiz Felipe Menezes Lopes, Débora Costa Silveira, and Luiza Capanema Franco dos Santos, “Pneumonias na Infância e Seus Desafios Revisão de Literatura,” *Brazilian Journal of Implantology and Health Sciences*, vol. 6, no. 10, pp. 506–517, 2024, doi: 10.36557/2674-8169.2024v6n10p506-517.
- [2] S.O. Mokia-Serbina, T.V. Litvinova, V. A. Shelevytska, and N.I. Zabolotnia, “Viral pneumonia in preschool children: current aspects of clinical and paraclinical diagnosis and treatment,” *CHILD’S HEALTH*, vol. 19, no. 1, pp. 40–49, 2024, doi: 10.22141/2224-0551.19.1.2024.1670.



- [3] Lucas Alves de Oliveira Lima *et al.*, “Bacterial pneumonia in children: Risk factors, symptoms, treatments and diagnoses,” 2024. doi: 10.56238/sevened2024.001-053.
- [4] L.I. Chernyshova and A.V. Chernyshov, “Viral pneumonia in children: present and future,” *Sučasna pediatriâ. Ukraïna*, 2024, doi: 10.15574/sp.2024.137.6.
- [5] I.A. Karimdzhanov, M.Sh. Madaminova, G. Kh. Iskanova, A.S. Gazieva, and M.Q. Togaev, “Diagnosis and treatment of community-acquired pneumonia in children,” *CHILD’S HEALTH*, vol. 19, no. 5, pp. 312–315, 2024, doi: 10.22141/2224-0551.19.5.2024.1727.
- [6] Florence Lambert-Fliszar, Claire Seaton, and Nassr Nama, “Challenges in Validation of Novel Diagnostic Tools for Pediatric Pneumonia: When Will We Find ‘The One’?,” *Hospital pediatrics*, 2024, doi: 10.1542/hpeds.2024-008040.
- [7] Emil Robert Stoicescu *et al.*, “Differentiating Viral from Bacterial Pneumonia in Children: The Diagnostic Role of Lung Ultrasound—A Prospective Observational Study,” *Diagnostics*, vol. 14, 2024, doi: 10.3390/diagnostics14050480.
- [8] Derek J. Williams *et al.*, “Transcriptomic Biomarkers Associated with Microbiological Etiology and Disease Severity in Childhood Pneumonia,” *The Journal of Infectious Diseases*, 2024, doi: 10.1093/infdis/jiae491.
- [9] Byungsun Yoo *et al.*, “Etiology and Clinical Prediction of Community-Acquired Lower Respiratory Tract Infection in Children,” *Journal of Korean Medical Science*, vol. 40, 2024, doi: 10.3346/jkms.2025.40.e5.
- [10] Ana Paula Lima Menezes dos Santos *et al.*, “Bacterial pneumonia in children: An integrative review,” 2024. doi: 10.56238/sevened2024.001-052.