



## Application of the Clinical Score of Bacterial Pneumonia, to Determine Etiological Suspect in Children from 3 Months to 5 Years with Community Acquired Pneumonia

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Article History	Abstract
Received: 08 May 2023 Revised: 28 August 2023 Accepted: 31 August 2023	<i>Community-acquired pneumonia is one of the main causes of morbidity and mortality in pediatric age, the etiological diagnosis is important to establish an effective and timely treatment. The unavailability of the necessary tests to determine the specific etiology, in this study The clinical prediction score for bacterial pneumonia was applied to determine suspected etiology and thus carry out the initial management of children with community-acquired pneumonia between the ages of 3 months to 5 years admitted to the pediatric service of the Pablo Jaramillo Humanitarian Specialized Hospital. Crespo, March - July 2019. It is a descriptive, prospective study, carried out with a sample of 73 children. As a result, it was obtained that 60% of the children had an etiological suspicion of bacterial pneumonia and 40% viral pneumonia. The clinical manifestations were more evident in patients with suspected bacterial pneumonia, mainly fever. The clinical evolution was favorable in all the patients, which agrees with the etiological suspicion determined by the clinical prediction score for pneumonia and the pertinent treatment instituted on admission. The application of this score is a feasible, fast and reliable tool to determine initial treatment in a hospitalized patient with community-acquired pneumonia.</i>
CC License CC-BY-NC-SA 4.0	<b>Keywords:</b> <i>Pneumonia, Tachypnea, Fever, Bacterial Pneumonia.</i>

### 1. Introduction

In Ecuador, the infant morbidity rate due to Community-Acquired Pneumonia (CAP) was 210 per 100 000 inhabitants, with a mortality of 9.70% compared to general mortality (1-2). Respiratory infections are the main reason for consultation for infectious pathology in primary care, accounting for 10% of

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lower respiratory diseases (3); The high incidence and potential severity of pneumonia is of great concern.

CAP is one of the most frequent infectious diseases of childhood, the frequent causative agents of pneumonia; *Streptococcus pneumoniae* in children under 9 years of age; *Mycoplasma pneumoniae*, from 5 years. (10). It is the leading cause of death in children under five years of age, recorded worldwide 6.3 million in 2013, with infectious diseases accounting for 51.8 % of the causes, pneumonia tops the list with 14.9 % corresponding to 935 000 deaths for that year. Their care requires significant health resources, both in the hospital environment and in the outpatient environment (4)

The diagnosis of pneumonia in pediatrics consists of two phases: first, the clinical assessment, concomitant with radiological and analytical studies; and second, the etiological diagnosis (5). The diagnosis is mainly clinical, with chest X-ray (6). WHO has identified certain diagnostic criteria in areas of the world where appropriate resources do not exist, applying them to infants and children presenting with cough, fever, refusal to feed and/or respiratory distress (7).

In more than 60% of cases, the causative germ is not determined; due to difficulty of access to the site of infection, through invasive procedures such as pulmonary puncture, or bronchoscopy with brushing and broncho-alveolar lavage; Low diagnostic performance of tests within the reach of clinical practice, in less than 10% of patients hospitalized for CAP the germ is isolated in blood (8-9)

The abuse of antibiotics and overdiagnosis of pneumonia make it difficult to use cultures, indirect immunofluorescence or serological studies to reach the etiological diagnosis. Initial management is based on the physician's judgment, using clinical, laboratory, and radiographic data, data that alone do not always distinguish viral or bacterial pneumonia.

A clinical-radiological etiology prediction scale for children hospitalized for pneumonia by Moreno et al., based on a pre-existing model (Khamapirad-Glezen, 1987). The scale achieved a sensitivity of 100%, specificity of 93.8%, positive predictive value of 75.8%, and negative predictive value of 100% for bacterial etiology (11). It rules out bacterial pneumonia at hospital admission and decreases the need to initiate antibiotics in hospitalized patients, prevents the development of antibiotic resistance, reduces the number of patients with adverse events to antibiotics, and health costs (12-13-14). In this study, the clinical prediction score of bacterial pneumonia was applied, establishing suspected etiology, the initial management of children with CAP between the ages of 3 months and 5 years admitted to the pediatric service of the Pablo Jaramillo Crespo Specialized Hospital was determined.

## 2. Materials And Methods

**A Study site:** Pediatrics Service of the Pablo Jaramillo Crespo Specialized Humanitarian Hospital, teaching medical center of Second Level of Care.

**Universe:** Patients hospitalized for CAP who met the inclusion and exclusion criteria in the period March – July 2019.

**Type of study:** descriptive, prospective study.

**Study group:** all referred in the universe, 73 patients.

### **Inclusion criteria:**

Children aged 3 months and 5 years hospitalized in the pediatric service of the Humanitarian Clinic with a diagnosis of pneumonia, diagnosed by laboratory tests and radiographs, were included for the present study.

### **Exclusion criteria:**

Patients with comorbidities: asthma, severe malnutrition, immunosuppressed.

Not immunized (pneumococcus, *Haemophilus influenzae*).

Previous antibiotic treatment.

## **Data Collection Document**

### **ANNEXES**

#### **Annex 1**

Number of HCLs: \_\_\_\_\_ Edad: \_\_\_\_\_ Gender: \_\_\_\_\_ Fecha: \_\_\_\_\_

### Bacterial Pneumonia Clinical Prediction Scale

PREDICTOR	POINTS	SCORE	
Axillary temperature greater than or equal to 39°C	3		
Age greater than or equal to 9 months	2		
Absolute neutrophil count greater than or equal to 8000/mm <sup>3</sup>	2		
Band neutrophils greater than or equal to 5%	1		
<b>Radiology</b>	<b>Infiltrator</b>	Well-defined, lobular, segmental	2
		Poorly defined, patches	1
		Peribronchial interstitial	-1
	<b>Localization</b>	One lobe	1
		Multiple lobes in one or both lungs but well defined	1
		Multiple sites, peribronchial and poorly defined	-1
	<b>Minimal Spillage</b>	Minimal	1
		Of course	2
	<b>Abscess, bullae, or Pneumatocele</b>	Doubtful	1
		Of course	2
<b>Atelectasis</b>	Subsegmental	-1	
	Lobar with involvement of the middle lobe or right upper lobe	-1	
	Lobar with involvement of other lobes	0	
<b>TOTAL, SCORE</b>		-3 to 15	

**Moreno L, Krishnan JA, Duran P, Ferrero F. Development and validation of a clinical prediction rule to distinguish bacterial from viral pneumonia in children. *Pediatr Pulmonol* 2006; 41:331–337.**

<4= Viral pneumonia, ≥4= Bacterial pneumonia

**Antibiotic Rotation:**

Do you receive antibiotics? Si \_\_\_\_\_ No \_\_\_\_\_

What antibiotic is Prescribio \_\_\_\_\_

**Fieldwork**

The clinical prediction score of bacterial pneumonia was applied in children with CAP between the ages of 3 months to 5 years admitted to the Pediatrics service of the Humanitarian Clinic, March – July 2019. A document was designed, with the Bacterial Pneumonia Score, the points of each of the components were added to obtain the total score, between the possible ranges -3 and 15 points (Annex 1). The type of treatment administered, days of hospital stay and clinical follow-up (monitoring of vital signs: respiratory rate, temperature, oxygen saturation) at 48 hours, 72 hours and hospital discharge were established; Laboratory and radiological examination results were determined. Patients with favorable outcome were identified. Patients who did not meet these criteria were indicated as an unfavourable outcome. Finally, the reliability of the application of the clinical prediction score of bacterial pneumonia in hospitalized children according to their clinical evolution was evaluated. Data were entered into the SPSS Statistics 20 program, for logical and statistical analysis through descriptive measures of frequency, percentages, measures of central tendency. The results are transferred to the Director of the Pablo Jaramillo Crespo Specialized Hospital, Director of the Teaching Department of the Humanitarian Clinic, Director of the Pediatrics Department of the Humanitarian Clinic and Epidemiology Committee of the Humanitarian Clinic. The dissemination of the results will be carried out through medical journals.

### 3. Results and Discussion

We studied 148 patients hospitalized in the pediatric service with a diagnosis of CAP in the period March – July 2019, of which 73 patients met the inclusion criteria.

#### General aspects of children hospitalized with CAP

Age. 61% in children under 2 years and 39% in over 2 years.

Sex. 51% were male and 39% were female.

Clinical characteristics of children hospitalized with CAP.

Oxygen saturation. Less than 90% in all patients.

Tachypnea. 89% with tachypnea and without tachypnea in 11%.

Fever. The determination of thermal rise more than 38 C ° on the day of hospital admission 86% and normal temperature 14% of children hospitalized with CAP.

Laboratory Tests

Leukocytes. They were determined in 65% of patients with CAP, 59% showed leukocytosis and 6% leukopenia.

Total, and arched neutrophils. Total, neutrophils were more than 8000/ml in 41% and values within normal parameters in 59% of cases; The presence of cayados was determined in 4%.

1. Clinical prediction score of pneumonia and suspected etiology

Based on the Clinical Score of Bacterial Pneumonia it was predicted that 60% bacterial pneumonias and 40% viral

**Table 1.** Clinical score of pneumonia and suspected etiology of community-acquired pneumonia.

Table 1 Clinical score of pneumonia and suspected etiology of community-acquired pneumonia At the Pablo Jaramillo Crespo Specialized Humanitarian Hospital March-July 2019		
ETIOLOGY	N	%
VIRAL	29	40
BACTERIAL	44	60
	73	100

Source: Author Form: Lenin Gabriel. 2021

#### Clinical Features and Etiology of NAC

Tachypnea in 93.2% in children with bacterial pneumonia and 75.8% with viral pneumonia.

Fever more than 39 C ° in 52.3%; viral etiology more than 39 C ° in 6.9%, low-grade fever in 27.6% and absence of fever 20.7%

All patients, regardless of their suspected etiologic, were established at hospital admission oxygen saturation of less than 90%.

In bacterial pneumonia, pleural effusion complication occurred in 4.5%, without requiring surgical treatment. Complications occurred in suspected viral pneumonia; bronchospasm in 34.4% which resolved with bronchodilators.

#### Complementary tests and etiology of CAP

Laboratory tests and etiology of CAP.

Leukocytosis in bacterial pneumonia 0.4%, leukopenia 4.5% and normal parameters 25.1%; elevated neutrophils 47.7%, 52.3% normal and presence of arches 11.4%. C-reactive protein 70.4%, with an average of 48 md/L with a minimum value of 2mg/L and a maximum value of 238mg/L

In pneumonia of suspected viral etiologic leukocytosis was observed in 37.9%, leukopenia in 6.9% and leukocytes in normal parameters in 55.2%

neutrophilia 6.9%, normal 93.1% and no falls were observed. CRP increased by 24.1% with a mean of 6.5 mg/L, minimum value of 0.93 mg/L and maximum value of 60 mg/L.

#### Radiology and etiology of NAC

The chest X-ray determined: infiltrate of right alveolar pattern in 36.4%, left in 4.5% and bilateral in 18.1%, right basal consolidation in 34.1% and left basal in 2.3%, and right parahilar interstitial pattern with 4.6%. The radiographic data in the NAC of suspected viral etiology established a bilateral interstitial pattern in 68.9% and right in 31.1%

#### Treatment of NAC

Antibiotic treatment and etiological suspicion according to the application of the Bacterial pneumonia score.

Antibiotic treatment was administered to all patients with suspected etiological bacterial pneumonia, Amoxicillin plus Sulbactam 79.5%, third-generation cephalosporins 11.4% and Cefuroxime 9.1%. In viral pneumonia, 31% of patients received antibiotics and 69% received symptomatic treatment.

**Table 2.** Antibiotic treatment of acquired pneumonia

<b>Table n°2 Antibiotic treatment of acquired pneumonia in the community of the Pablo Jaramillo Crespo Specialized Hospital March - July 2019</b>				
<b>Antibiotic</b>	<b>YES</b>	<b>%</b>	<b>NO</b>	<b>%</b>
<b>Bacterial</b>	44	100	0	0
<b>Viral</b>	10	34,5	19	65,5

Source: Form, Author: Lenin Gabriel, 2021

Days of hospitalization. The hospital stay of patients with viral pneumonia averaged 3.7 days. For bacterial pneumonia it was an average of 4.2 days

### **Clinical evolution and suspected etiology of CAP**

Tachypnea occurred in 41 patients with bacterial pneumonia, at 48 hours of hospitalization 73.2% of patients no longer showed tachypnea, and at 72 hours all patients had respiratory rate within normal parameters. In viral pneumonia, 22 cases described increased respiratory rate, 48 hours after hospitalization 100% of patients showed absence of tachypnea.

Fever in bacterial pneumonia was determined at hospital admission in 97.7%, at 48 hours of follow-up they persist with thermal rise in 9.1% and with resolution of the thermal rise at 72 hours in 97.7%. In viral pneumonia at hospital admission a thermal rise was determined in 79.3%, at 48 hours there is resolution of the thermal rise in 91.3%, persisting low-grade fever in 2 patients but with favorable evolution so indications are maintained, at 72 hours 100% of patients do not evidence thermal rise.

Oxygen saturation is evident in all patients hospitalized for CAP, in bacterial pneumonia at 48 hours 63.6% persists with saturation less than 90% without supplemental oxygen, at 72 hours 4.5% persists with low oxygen saturation so that in these patients extends their hospital stay to 5 days. In viral pneumonia, 48.3% of patients hospitalized at 48 hours persist with oxygen saturation less than 90%, at 72 hours in 13.8% of patients persist with low oxygen saturations, at 4 and 5 days of hospitalization 100% of patients achieve weaning from supplemental oxygen. In pneumonia of suspected viral etiology, 20 patients did not document the administration of antibiotic treatment, the evolution was favorable in 100% of cases.

In Ecuador, the provinces with the highest number of CAP patients are; Guayas (20.3%), Pichincha (18.9%) and Azuay (7.9%), in other provinces this value is below 5.0% (15). NAC in the Pablo Jaramillo Crespo Specialized Humanitarian Hospital is one of the main causes of hospitalization, the age of hospitalized children was less than 2 years with 61%, with no considerable difference between men and women, with a ratio 1.2/1. Data that are similar to those obtained in several studies where, according to the literature, they are patients under 2 years of age, with a greater predisposition in males (16,17).

The symptomatology of CAP shows oxygen saturation less than 90% and is one of the main factors in deciding hospitalization. Tachypnea in 89% and thermal rise in 86%. Clinical signs consistent with WHO guidelines for the clinical diagnosis of pneumonia (18). Based on the Clinical Score of Bacterial Pneumonia, it was predicted that the highest percentage of CAP were of bacterial etiology with 60%, 1.5 times more frequent compared to viral pneumonia. In a retrospective and descriptive study carried out at the Hospital III de Emergencias Grau in 2010, Moreno et al. applied the clinical prediction scale of pneumonia in all pediatric patients treated with a diagnosis of CAP, 31% of children obtained a score equal to or greater than 4, suggestive of bacterial pneumonia and 69% less than 4 points, suggestive of viral pneumonia (19); A greater number of cases with bacterial ethological suspicion was determined, however the aforementioned study included hospitalized and outpatient patients of which only 40% corresponded to those who were admitted, in our research it was carried out in patients who required hospitalization, of which due to the most notorious and



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serious clinical characteristics of bacterial pneumonia were possibly more frequent in their hospitalization.

Funes and Alverenga in their descriptive and retrospective study conducted at the Benjamin Bloom Hospital in 2010, aimed to evaluate the diagnostic capacity of the clinical prediction score of bacterial pneumonia in children hospitalized for CAP, including 275 patients, 120 diagnosed with viral pathology and 180 with bacterial etiology, results that are similar to those obtained in our study (20).

Among the clinical characteristics and etiology of CAP, tachypnea was evidenced in a higher percentage with 93.2% in children with bacterial pneumonia compared to that of viral etiology which was 75.8%, although there is no marked difference, it is important to determine that tachypnea is one of the important signs indicated by the WHO, with a high predictive value for the diagnosis of community-acquired pediatric pneumonia. (21,22).

Fever more than 39 C ° was determined in a higher percentage in bacterial pneumonia with 52.3% and viral etiology with 6.9%, just as our research in some studies fever more than 39 C ° was more frequently related to bacterial or mixed pneumonia and greater severity of the disease, however, the clinical value of the febrile pattern in patients with CAP has not been corroborated, but in the absence of fever a negative predictive value of 97% has been established (16).

In the complementary examinations and etiology of CAP, leukocytosis was determined in 70.4% compared to pneumonia of suspected viral etiologic, evidencing leukocytes within normal parameters 55.2%. It has regularly been suggested that leukocytosis and predominance of segments suggest bacterial pneumonia, however, these findings are not specific and may occur in viral pneumonia or cannot be determined in some bacterial pneumonias (6).

Elevated absolute neutrophils in bacterial pneumonia were 47.7% compared to 6.9% of children with suspected viral pneumonia. The presence of cayates was reported only in cases of bacterial pneumonia. The number of neutrophils has a discrete specificity as a marker of bacterial infection, while the presence of cayates greater than 5% would allow a reliable prediction of bacterial pneumonia. (23,24)

C-reactive protein in patients with suspected bacterial pneumonia was found with an average of 48mg/L compared to the CRP of children with suspected viral pneumonia with an average of 6.5mg/L, the performance in the etiological diagnosis of pneumonia is reduced, as indicated by a systematic review by Van der Meer where it is determined that CRP does not have sufficient specificity and sensitivity to determine the etiology of CAP. (25)

The radiology in bacterial pneumonia showed the alveolar/consolidative pattern was present in 90.4% mainly in the right pulmonary field. Radiographic data in the NAC of suspected viral etiology established an interstitial pattern in all cases. Although the contribution of chest radiography to the etiological diagnosis of CAP has been controversial (26,27), the variability in radiological interpretations is a limitation, it is important to select a simple interpretation model, which ensures unity of criteria, as Swingler did in his systematic review of 2000, where he organized the interpretation of chest radiographs under defined and simple patterns. (28), in another prospective, non-interventional study in 80 pediatric patients with chest radiographs suggestive of pneumonia, were admitted to the Dr. Exequiel González Cortés Children's Hospital in Santiago, Chile, between September 2005 and August 2006. (29). Swischuk's classification of modified radiographic patterns for pediatrics was used (30,31), the performance of the viral and bacterial pattern was 66 and 82%, respectively.

All patients with suspected etiologic bacterial pneumonia were administered amoxicillin plus sulbactam; first line according to the NAC management protocol of the Pablo Jaramillo Crespo Specialized Humanitarian Hospital. The rational use of drugs, mainly antibiotics, is a matter of constant concern, especially in pediatrics, in the research antibiotics were administered to 31% of patients with suspected etiological bacterial pneumonia (33).

On average, patients with CAP were hospitalized at 12 hours for viral pneumonia. It was determined that tachypnea disappeared at 48 hours in all patients with viral pneumonia, however in pneumonia of

suspected bacterial a normal respiratory rate was determined at 72 hours. Fever disappeared before 72 hours in 98.6%, persisting in a patient with suspected bacterial pneumonia in whom new complementary tests were performed and antibiotic rotation was decided. Oxygen saturation less than 90% persisted at 48 hours of hospitalization in a high percentage in both types of pneumonia, persisting beyond 72 hours in 4.5% of patients with suspected bacterial pneumonia and in a higher percentage in children with viral pneumonia with 13.8%, which was the main factor of long hospital stay.

The application of the clinical prediction score of bacterial pneumonia is useful to determine the etiological suspicion of bacterial pneumonia in the community, because the evolution of all patients was favorable in accordance with the etiological prediction and its pertinent established treatment, results that coincide with a study that analyzed the administration of antibiotics in NAC as an important resource, It was established that clinical evaluation alone leads to overdiagnosis and overtreatment in many cases, if it does not evidence clinical data and complementary tests compatible with bacterial pneumonic process, careful follow-up without antimicrobial therapy is justified. It is more sensible in cases of CAP with suspected or proven viral etiology, to have access to timely and adequate follow-up rather than initially prescribing antibiotics. Good clinical assessment and the course of the disease remain the pillars for deciding whether a viral or bacterial process is at work (34).

#### 4. Conclusion

The majority of patients hospitalized with CAP were younger than 2 years, there was no considerable difference between male and female. The application of a clinical prediction score of bacterial pneumonia is a feasible, fast and reliable tool to determine initial treatment in a hospitalized patient with CAP. Based on the Clinical Score of Bacterial Pneumonia, bacterial etiology was predicted in 60% and viral etiology in 40%. The clinical manifestations were more evident in patients with suspected bacterial pneumonia, mainly fever, oxygen saturation less than 90% Antibiotic treatment was administered to all patients with suspected etiological bacterial pneumonia. In viral pneumonia, 31% of patients received antibiotics and 69% received symptomatic treatment. The clinical evolution was favorable for all patients with CAP, which is consistent with the etiological suspicion determined by the clinical prediction score of pneumonia and the relevant treatment established on admission.

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