

International Journal of Research in MEDICAL SCIENCE

ISSN Print: 2664-8733
ISSN Online: 2664-8741
Impact Factor (RJIF): 8.35
IJRMS 2025; 7(2): 369-373
www.medicalpaper.net
Received: 18-09-2023
Accepted: 22-10-2023

Torres Flores Luis Fernando
Internal Medicine, Benemerita
Universidad Autonoma de
Puebla, Puebla, Mexico

Reyes Baez Odalyvianey
Internal Medicine, Benemerita
Universidad Autonoma de
Puebla, Puebla, Mexico

Garduño Rojas Adrian Jorge
Emergency Medicine,
Benemerita Universidad
Autonoma de Puebla, Puebla,
Mexico

Herrera Uriostegi Diana Maria
Internal Medicine, Benemerita
Universidad Autonoma de
Puebla, Puebla, Mexico

Perez Perez Andrea Ceret
Internal Medicine, Benemerita
Universidad Autonoma de
Puebla, Puebla, Mexico

Corresponding Author:
Torres Flores Luis Fernando
Internal Medicine, Benemerita
Universidad Autonoma de
Puebla, Puebla, Mexico

Relationship between antimicrobial resistance and adherence to the Clinical Practice Guideline in patients with community-acquired pneumonia hospitalized at the general zone hospital No 20 “La Margarita

Torres Flores Luis Fernando, Reyes Baez Odalyvianey, Garduño Rojas Adrian Jorge, Herrera Uriostegi Diana Maria and Perez Perez Andrea Ceret

DOI: <https://www.doi.org/10.33545/26648733.2025.v7.i2f.174>

Abstract

Pneumonia is an infection of the pulmonary parenchyma that requires targeted treatment based on the etiologic agent and its antimicrobial susceptibility profile. This study aimed to determine the relationship between bacterial resistance and antibiotic prescribing patterns according to adherence to the Clinical Practice Guideline (CPG) in patients with community-acquired pneumonia hospitalized at the General Hospital of Zone 20 “La Margarita”. A descriptive, observational, retrospective, and cross-sectional study was conducted. Seventy-one patients aged over 19 years with confirmed pneumonia and positive sputum cultures with antibiograms were included. Patients with viral pneumonia, severe immunodeficiency, mechanical ventilation, intensive care admission, or pregnancy were excluded. Adherence to the CPG was 78.87%. The most frequent pathogen was *Streptococcus pneumoniae* (18.2%), followed by *Serratia marcescens* (16.9%). The most commonly used antibiotics were ceftriaxone combined with a macrolide and fluoroquinolones as monotherapy. High resistance to macrolides and good susceptibility to fluoroquinolones and carbapenems were observed. No statistically significant association was found between CPG adherence and bacterial resistance ($p>0.05$), nor with age or length of hospital stay. These findings suggest that although guideline adherence is high, resistance to commonly used antibiotics such as macrolides persists, underscoring the need to adjust empirical therapy and periodically update treatment guidelines.

Keywords: Community-acquired pneumonia, antibiotic resistance, clinical practice guideline, antimicrobial therapy, bacterial susceptibility, hospitalized patients

Introduction

Community Acquired Pneumonia (CAP) is one of the leading causes of hospitalization and mortality worldwide. Its clinical management is based on the empirical use of antibiotics, which should be guided by clinical practice guidelines to optimize outcomes and reduce antimicrobial resistance. Bacterial resistance is an increasing phenomenon, often associated with the inappropriate prescription of antimicrobial treatments. Guidelines recommend regimens combining beta-lactams with macrolides or fluoroquinolones, depending on patient risk factors. However, adherence to these recommendations is not always optimal, which may contribute to the emergence of resistance. In Mexico, few studies have evaluated this relationship at a local level. Therefore, this study aims to determine whether there is an association between antibiotic resistance and adherence to clinical practice guidelines (CPG) in hospitalized patients with CAP.

Materials and Methods

An observational, descriptive, retrospective, and cross-sectional study was conducted at the General Hospital of Zone 20 “La Margarita” (Puebla, Mexico) between January 1, 2022, and December 31, 2023.

Patients aged ≥ 19 years with a clinical and/or radiological diagnosis of community-acquired pneumonia (CAP), positive sputum culture with bacterial growth and antibiogram, and complete medical records were included. Cases requiring intensive care admission, viral or atypical pneumonia, severe immunodeficiency, pregnancy, neurological diseases, death, or therapeutic noncompliance were excluded.

The sample size was calculated as $N=85$, with a 95% confidence level and 5% precision, resulting in 70 patients; sampling was non-probabilistic and convenience-based. Adherence to the Clinical Practice Guideline (CPG) was assessed using a verification checklist (13 items covering diagnosis, severity assessment, and treatment; positive adherence $\geq 80\%$). Data were obtained from electronic medical records and analyzed using SPSS v25. Qualitative variables were expressed as frequencies and percentages; quantitative variables as mean $\pm$ standard deviation or median and interquartile range, depending on distribution. The association between qualitative variables was evaluated using the Chi-square or Fisher's exact test, with statistical significance set at $p < 0.05$.

Results

During the study period (January 2022, December 2023), 85 hospitalized patients with a diagnosis of community-acquired pneumonia (CAP) were identified at the General Hospital of Zone 20 "La Margarita." Fourteen cases were excluded due to the absence of sputum culture, incomplete data, or a history of neurological or cerebrovascular disease, leaving 71 patients who met the inclusion criteria.

The sample consisted of 43 women (60%) and 28 men (40%) table1, with a mean age of 68 ± 8 years, showing no statistically significant differences between sexes ($p > 0.05$). The most frequent age groups were 61-65 years (23.9%) and < 60 , 66-70, and 71-75 years (19.7% each) Table 2.

Regarding initial antibiotic regimens, the combination of ceftriaxone + clarithromycin was predominant (28.2%), followed by levofloxacin monotherapy (19.7%) and ceftriaxone + levofloxacin (19.7%). Other regimens included ceftriaxone alone (12.7%), moxifloxacin (8.5%), ceftriaxone + azithromycin (4.2%), and less frequent combinations such as clarithromycin + ceftriaxone + levofloxacin (2.8%), cefepime (1.4%), cefotaxime + clarithromycin (1.4%), and imipenem/cilastatin (1.4%). Antibiotic changes were documented in 14 patients, mainly toward respiratory fluoroquinolones Table 3.

Microbiological analysis identified 13 distinct pathogens. *Streptococcus pneumoniae* was the most frequent (18.2%), followed by *Serratia marcescens* (16.9%), *Mycoplasma pneumoniae* (8.5%), *Haemophilus influenzae* (7%), *Staphylococcus aureus* (7%), *Enterobacter cloacae* (7%), *Escherichia coli* (5.6%), *Moraxella catarrhalis* (5.6%), *Enterococcus faecalis* (4.2%), *Klebsiella pneumoniae* (2.8%), *Klebsiella oxytoca* (2.8%), *Chlamydophila pneumonia* (2.8%), and *Legionella pneumophila* (1.4%) Table 4.

Regarding antimicrobial susceptibility, high sensitivity was observed for levofloxacin and moxifloxacin (97.2% each), followed by meropenem (81.7%). Ceftriaxone showed 56.3% sensitivity, 16.9% intermediate sensitivity, and 26.8% resistance. Clarithromycin and azithromycin exhibited the highest resistance rates (90.1% each) Table 5. Adherence to the Clinical Practice Guideline (CPG) was 78.87%. The Chi-square test showed no significant association between CPG adherence and antimicrobial resistance ($p > 0.05$) or between adherence and sex ($p > 0.05$). Likewise, no significant differences were observed in hospital stay duration between patients with and without adherence ($p > 0.05$) Table 5.

Figure format

Table 1: Sex distribution of the study sample

	Frequency(n)	Percentage (%)	Mean Age (years)	Standard Deviation (Years)
Gender				
Female	43	60%	69.53	9.17
Male	28	40%	65.89	6.83

Table 2: Age range distribution

	Total	% Total	Male	% Male	Female	% Female
Age Ranges						
< 60 AÑOS	14	19.71%	6	42.86%	8	57.14%
61-65 Years	17	23.94%	8	47.06%	9	52.94%
66-70 Years	14	19.71%	5	35.71%	9	64.29%
71-75 Years	14	19.71%	8	57.14%	6	42.86%
76-80 Years	8	11.27%	1	12.5%	7	87.5%
81-85 Years	4	5.63%	0	0%	4	100%

Table 3: Treatment regimens of study patients

Antibiotic	Frequency	Percentage
Clarithromycin + Ceftriaxone	20	28.2%
Levofloxacin	14	19.7%
Ceftriaxone + Levofloxacin	14	19.7%
Ceftriaxone	9	12.7%
Moxifloxacin	6	8.5%
Ceftriaxone + Azithromycin	3	4.2%
Clarithromycin + Ceftriaxone + Levofloxacin	2	2.8%
Cefepime	1	1.4%
Cefotaxime + Clarithromycin	1	1.4%
Imipenem-Cilastatin	1	1.4%

Table 4: Microorganisms identified in sputum cultures

Microorganismo	Frecuencia	Porcentaje
<i>Streptococcus pneumoniae</i>	20	18.2
<i>Serratia marcesner</i>	12	16.9
<i>Haemophilus influenzae</i>	5	7
<i>Staphylococcus aureus</i>	5	7
<i>Klebsiella pneumoniae</i>	2	2.8
<i>Klebsiella oxytoca</i>	2	2.8
<i>E. coli</i>	4	5.6
<i>Mycoplasma pneumoniae</i>	6	8.5
<i>Chlamydophila pneumoniae</i>	2	2.8
<i>Enterobacter cloacae</i>	5	7.0
<i>Enterococcus fecalis</i>	3	4.2
<i>Moraxella catarrhalis</i>	4	5.6

Table 5: Chi-square test adherence to clinical practice guideline vs. antibiotic resistance

Antibiotic	Adherence	No	Valor X ²	GL	Asymptotic Significance
	Yes				
Levofloxacin					
Susceptible	51	15			
Intermediate	3	0	1.441	2	0.487
Resistant	2	0			
Moxifloxacin					
Susceptible	54	15			
Intermediate	1	0	0.551	2	0.759
Resistant	1	0			
Meropenem					
Susceptible	46	12			
Intermediate	6	1	0.740	2	0.691
Resistant	4	2			
Clarithromycin					
Susceptible	7	0			
Intermediate	0	0	2.080	1	0.149
Resistant	49	15			
Ceftriaxone					
Susceptible	33	7			
Intermediate	7	5	3.679	2	0.159
Resistant	16	3			
Azithromycin					
Susceptible	7	0			
Intermediate	0	0	2.080	1	0.149
Resistant	49	15			

Discussion

In this study, a high level of adherence to the Clinical Practice Guideline (CPG) for the management of community-acquired pneumonia was observed (78.87%), which contrasts with national reports such as that of Mesino *et al.*, who documented a compliance rate of 42.89%. This difference could be attributed to ongoing staff training and stricter institutional policies at the Hospital General de Zona 20 La Margarita.

The resistance pattern observed reinforces previous findings indicating a growing inefficacy of macrolides against respiratory pathogens. Clarithromycin and azithromycin showed resistance in more than 90% of cases, consistent with international reviews that report variable resistance rates, ranging from 0.2% in Nordic countries to over 40% in regions of Asia. In this context, their empirical use should be reevaluated, prioritizing prescription only after microbiological confirmation.

In contrast, high susceptibility was observed for respiratory quinolones (Levofloxacin and Moxifloxacin) and carbapenems (meropenem), supporting their role as therapeutic options in severe cases or those with documented resistance. However, evidence warns that

indiscriminate use of quinolones can accelerate the emergence of multidrug-resistant strains, so their use should be limited to justified scenarios.

The absence of a statistically significant association between adherence to the CPG and antimicrobial resistance could be explained by the sample size, the local epidemiological profile, or the circulation of resistant strains acquired in the community. Moreover, although adherence was high, 21% of prescriptions did not follow the recommendations, highlighting the need for periodic audits and continuous improvement strategies.

The results have important clinical implications: the observed resistance pattern suggests that empirical therapy should be adapted to the local epidemiology, reducing macrolide use and strengthening microbiological surveillance. Additionally, the frequent identification of *Serratia marcescens* underscores the need to optimize sample collection and processing techniques to minimize contamination or unrepresentative isolates.

Conclusion

Adherence to the Clinical Practice Guideline (CPG) was observed in 78.87% of cases; however, no statistically

significant association was found between the resistance of the isolated microorganisms and the antibiotic prescription patterns, which in most cases followed the CPG recommendations, consisting of a beta-lactam plus a macrolide. Similarly, no statistically significant differences were observed between CPG adherence and either patient age or length of hospital stay.

Regarding antibiotics prescribed for the treatment of pneumonia, the most frequently used regimen was a beta-lactam combined with a macrolide, followed by quinolone monotherapy. Microorganisms were found to be resistant to clarithromycin and azithromycin, but highly susceptible to levofloxacin.

Serratia marcescens was isolated in 16.9% of cases, indicating the need to review the procedures for collecting sputum cultures.

Acknowledgments

The authors would like to express their sincere gratitude to the Mexican Social Security Institute (IMSS) for their support in conducting this study. We also extend our appreciation to all the collaborators, staff, and colleagues who contributed to the development, data collection, and analysis of this article. Their dedication and expertise were essential to the successful completion of this work.

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article

Fernando TFL, Odalyvianey RB, Jorge GRA, Maria HUD, Ceret PPA. Relationship Between Antimicrobial Resistance and Adherence to the Clinical Practice Guideline in Patients With Community-Acquired Pneumonia Hospitalized at the General Zone Hospital No. 20 "La Margarita. *International Journal of Research in Medical Science.* 2025;7(2):369-373.

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