Clinical, epidemiological, and etiological profile of inpatients with community-acquired pneumonia at a general hospital in the Sumaré microregion of Brazil*

Perfil clínico, epidemiológico e etiológico de pacientes com pneumonia adquirida na comunidade internados em um hospital geral da microrregião de Sumaré, SP

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Abstract

Objective: To analyze the clinical, etiological, and epidemiological aspects of community-acquired pneumonia (CAP) in hospitalized individuals. **Methods:** We prospectively studied 66 patients (> 14 years of age) with CAP admitted to the *Hospital Estadual Sumaré*, located in the Sumaré microregion of Brazil, between October of 2005 and September of 2007. We collected data related to clinical history, physical examination, pneumonia severity index (PSI) scores, and laboratory tests (blood culture; sputum smear microscopy and culture; serology for *Chlamydophila pneumoniae*, *Mycoplasma pneumoniae*, and *Legionella pneumophila*; and detection of *Legionella* sp. and *Streptococcus pneumoniae* antigens in urine). **Results:** The mean age of patients was 53 years. Most had a low level of education, and 55.7% presented with at least one comorbidity at the time of hospitalization. The proportion of elderly people vaccinated against influenza was significantly lower among the inpatients than in the general population of the Sumaré microregion (52.6% vs. > 70%). Fever was less common among the elderly patients ($p < 0.05$). The clinical evolution was associated with the PSI scores but not with age. The etiology was confirmed in 31 cases (50.8%) and was attributed to *S. pneumoniae*, principally detected by the urinary antigen test, in 21 (34.4%), followed by *C. pneumoniae*, in 5 (8.2%). The mortality rate was 4.9%, and 80.3% of the patients were classified as cured at discharge. **Conclusions:** The knowledge of the etiologic profile of CAP at the regional level favors the appropriate choice of empirical treatment, which is particularly relevant in elderly patients and in those with comorbidities. The lack of influenza vaccination in elderly patients is a risk factor for hospitalization due to CAP.

Keywords: Chlamydophila pneumoniae; Community-acquired infections; Pneumonia; Streptococcus pneumoniae; Influenza vaccines.

Resumo

Objetivo: Analisar aspectos clínicos, etiológicos e epidemiológicos das pneumonias adquiridas na comunidade (PAC) em indivíduos internados. **Métodos:** Foram estudados prospectivamente 66 pacientes com PAC maiores de 14 anos no Hospital Estadual Sumaré, localizado na cidade de Sumaré (SP), entre outubro de 2005 e setembro de 2007. Coletamos dados sobre história clínica, exame clínico, escore *pneumonia severity index* (PSI) e exames laboratoriais (hemocultura, bacterioscopia/cultura de escarro, sorologias para *Chlamydophila pneumoniae*, *Mycoplasma pneumoniae* e *Legionella pneumophila*, além de antígenos urinários de *Legionella* sp. e *Streptococcus pneumoniae*). **Resultados:** A idade média dos pacientes foi de 53 anos, a maioria tinha baixa escolaridade, e 55,7% apresentavam pelo menos uma comorbidade no momento da internação. O percentual de idosos vacinados contra influenza entre os internados foi significativamente menor que os da comunidade dos municípios da microrregião de Sumaré (52,6% vs. > 70%). A febre foi menos frequente entre os idosos ($p < 0,05$). A evolução clínica se associou com o escore PSI, mas não com a idade. A etiologia foi confirmada em 31 (50,8%) dos casos, sendo 21 (34,4%) devido a *S. pneumoniae*, detectado principalmente pelo antígeno urinário; seguido de *C. pneumoniae*, em 5 (8,2%). Receberam alta hospitalar por cura 80,3% dos pacientes. A taxa de letalidade foi de 4,9%. **Conclusões:** O conhecimento do perfil etiológico de PAC no âmbito regional favorece a escolha adequada da terapia empírica, que é particularmente relevante em pacientes idosos e naqueles com comorbidades. A falta da vacinação contra influenza em idosos é um fator de risco de internação por PAC.

Descritores: Chlamydophila pneumoniae; Infecções comunitárias adquiridas; Pneumonia; Streptococcus pneumoniae; Vacinas contra influenza.

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Introduction

Community-acquired pneumonia (CAP) is a major cause of morbidity and mortality in the population, especially among the elderly and patients with chronic diseases.[1-3] In Brazil, data on the incidence of CAP are sparse, especially among adults. Records of hospitalization for pneumonia from government statistics, provided by the Information Technology Department of the Unified Health Care System, indicate that pneumonia is the second leading cause of hospitalization, accounting for 11.8% of all hospitalizations in southeastern Brazil in 2007.[3,4]

Although a high incidence of CAP is reported in Brazil, most studies focus on treatment options and on the clinical course of the disease. Little is known about the microbiological patterns at the local and regional levels or about the patterns of CAP severity in adults in Brazil.[5,6] Treatment protocols and case management protocols are often based on investigations of the disease in countries in the northern hemisphere. It should be borne in mind that the worldwide multicenter antimicrobial surveillance program, known as SENTRY, and the Latin American *Sistema Regional de Vacunas* (Regional Vaccination System) II program have been a reference for guiding therapy in Brazil.[7,8]

Despite advances in diagnostic techniques, it is estimated that, in approximately 50% of the cases, the etiology remains undefined, even in countries where access to etiological investigation is part of the protocols for the treatment of patients with pneumonia.[9,10]

It is believed that *Streptococcus pneumoniae* is the major etiologic agent of bacterial pneumonia in various regions of the world.[5,11,12] In addition to pneumococcal infection, infections with *Haemophilus influenzae*, *Staphylococcus* sp., *Moraxella catarrhalis*, and gram-negative aerobic bacilli have been identified, as have cases of pneumonia caused by *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae*, and *Legionella pneumophila*, previously designated "atypical".[8,10,13]

Viruses continue to be etiologic agents that are frequently associated with CAP and are poorly identified.[11,12] The influenza virus is the most common cause of CAP in epidemics of viral respiratory infection, having the greatest impact on the morbidity and mortality of at-risk populations, such as the elderly and patients with chronic diseases.[5,14] Some studies have investigated the impact of high influenza vaccination coverage, showing a reduction in the number of hospitalizations for and deaths from respiratory infection in the elderly, especially in periods of higher viral circulation.[14-17]

The objective of the present study was to describe the clinical, epidemiological, and etiological profile of CAP in inpatients at a general hospital located in a city in southeastern Brazil, in order to characterize the epidemiological context and treatment of the disease in the region.

Methods

This was a prospective sequential study of all 66 patients with CAP admitted to the *Hospital Estadual Sumaré* between October of 2005 and September of 2007. The hospital is located in the city of Sumaré, Brazil, and has 226 beds, of which 35 are in the clinical medicine ward and 10 are in the adult ICU, which is a referral center for the Sumaré microregion, an area with 630,000 inhabitants. This hospital has been certified as level III (the highest rating given) by the Brazilian National Accreditation Committee, which evaluates hospitals within established parameters.

The inclusion criteria were as follows: being over 14 years of age; having been diagnosed with pneumonia (presence of one or more symptoms and plain chest X-ray findings suggestive of pneumonia); not having used immunosuppressive drugs; and not having been hospitalized within 72 h prior. The exclusion criteria were as follows: being suspected of having nosocomial pneumonia; having neurological sequelae or dementia; and not being able to understand the objectives of the study. The patients were invited to participate in the study, and all participating patients gave written informed consent. The study design was approved by the Research Ethics Committee of the State University at Campinas School of Medical Sciences (Process no. 241/2005).

All 66 cases occurring in the study period were prospectively investigated by means of a questionnaire applied at the bedside in order to complement the information contained in the medical charts. In addition, when necessary, the case was discussed with the clinician

in charge. We collected sociodemographic data (age, gender, level of education, marital status, and occupation); data on vaccination history, occupational history, alcoholism, and smoking; clinical data (signs, symptoms, and comorbidities); and data on the clinical course of the case (length of hospital stay, outcome, and ICU admission).

The patients were classified in accordance with the pneumonia severity index (PSI).[3,18]

The etiological investigation included sputum smear microscopy, sputum culture, pleural fluid culture, and culture of two blood samples collected before the administration of antibiotics. Most researchers agree that running more than three routine blood cultures within 24 h does not significantly increase the rate of positive results.[3] Serology (ELISA) was performed for *C. pneumoniae*, *M. pneumoniae*, and *L. pneumophila*. Results were considered positive based on the following parameters: for *C. pneumoniae*, a three times greater titer in the second sample or IgG ≥ 0.512 AU/mL in the first sample; for *M. pneumoniae*, IgG > 40 AU/mL or positive IgM; and for *L. pneumophila*, an initial titer > 1:256 or a four times greater titer in the convalescent phase.[5] In addition, the levels of *S. pneumoniae* and *L. pneumophila* antigens were determined in urine samples.

Three consecutive sputum samples were sent for microscopy and culture. In order to determine smear adequacy and increase the specificity of the methods of microbiological investigation, the samples were examined under optical microscopy by the method described by Bartlett et al. for grading the quality of sputum.[19] The sputum samples selected for microscopy were examined by Gram staining and smeared onto media for the culture of aerobic bacteria. This was achieve by a semiquantitative technique, samples from each patient being cultured on a blood agar plate, a chocolate agar plate, and a MacConkey agar plate.[20]

Urine samples were collected at the time of hospitalization and stored at −20°C, after which they were subjected to the Binax NOW® tests (Binax Inc., Portland, ME, USA) for *S. pneumoniae* and for *L. pneumophila* serogroup 1. Both tests consist of an immunochromatographic assay on a nitrocellulose membrane with distinct bands, onto which rabbit anti-*Streptococcus pneumoniae* and anti-*Legionella pneumophila* antibodies are fixed, as are anti-species antibodies for control. The immobilized anti-species antibodies capture the anti-species conjugate and form a control band. The antigen in the urine sample reacts with the conjugated specific antibody and is immobilized on the test band region. All positive tests were repeated.

Etiological confirmation was defined as positive results by serology, by culture of a sterile specimen, blood, or pleural fluid, or by the urinary antigen test. Because they can have an effect on decisions regarding treatment, sputum smear microscopy results were classified as suggestive or highly suggestive. The treatment options were presented in order to illustrate the profile of the antibiotic therapy instituted.

The proportions found between the study variables were compared by chi-square test with Yates' correction, and the level of statistical significance was set at 5% ($p < 0.05$).

Results

Of the 66 patients that met the established eligibility criteria for CAP, 5 received a confirmed diagnosis of tuberculosis after additional investigation and were excluded from the analysis.

Table 1 allows the identification of the sociodemographic profile of the patients. The mean age was 53 years (range: 18-96 years), and 55 patients (57.3%) were male. Most resided in neighboring cities in the Sumaré microregion. Regarding education, 19 patients (31.1%) had had four or fewer years of schooling and 72.1% had had eight or fewer years. Therefore, this was a population of patients who had a low level of education and worked predominantly in construction or in the service sector.

Of the 19 patients ≥ 60 years of age, 10 (52.6%) reported having received influenza vaccination in the preceding year, compared with only 2 (11.1%) for pneumococcal vaccination. Of the 42 patients < 60 years of age, 10 (23.8%) reported having been immunized against influenza in the preceding year and none reported having received pneumococcal vaccination, although the latter had been formally recommended for 18 (42.9%). Of all CAP inpatients for whom vaccination had been formally recommended (n = 37), only 12 (32.4%) and 2 (5.4%) received influenza vaccination and pneumococcal vaccination, respectively.

Table 1 - Sociodemographic profile, vaccination history, and habits of the individuals diagnosed with CAP (n = 61). *Hospital Estadual Sumaré*, October/2005-September/2007.

Variable	n (%)
Age bracket, years	
< 40	17 (27.9)
40-59	25 (41.0)
≥ 60	19 (31.1)
Gender	
Male	33 (54.1)
Female	28 (45.9)
Marital status	
Married	34 (55.7)
Single	22 (36.1)
Separated	4 (6.6)
Widowed	1 (1.6)
Level of education	
≤ 4 years of schooling	19 (31.1)
Junior high (complete)	25 (41.0)
High school (complete)	10 (16.4)
College	2 (3.3)
Illiterate	4 (6.6)
No data	1 (1.6)
Current occupation	
Industry	1 (1.6)
Agriculture	3 (4.9)
Services	18 (29.6)
Self-employed professional	11 (18.0)
Homemaker/maid/cleaner	10 (16.4)
Student	1 (1.6)
Retired	12 (19.8)
Unemployed	3 (4.9)
Place of residence	
Sumaré microregion[a]	50 (82.0)
Other cities in the state of São Paulo	11 (18.0)
2005/2006 influenza vaccination [b]	
< 60 years (n = 18)	2 (11.1)
≥ 60 years (n = 19)	10 (52.6)
Pneumococcal vaccination[b]	
< 60 years (n = 18)	0 (0.0)
≥ 60 years (n = 19)	2 (10.5)
Smoking status[c]	
Smoker	23 (37.7)
Former smoker	16 (27.8)
Nonsmoker	22 (34.5)
Alcoholism[d]	
Yes	13 (21.3)
No	48 (78.7)

[a]The Sumaré microregion includes the cities of Sumaré, Hortolândia, Monte Mor, Nova Odessa, and Santa Bárbara D'Oeste. [b]There were 37 patients for whom vaccination had been formally recommended. [c]Smokers were defined as individuals who reported smoking every day, regardless of the quantity of tobacco smoked. [d]Alcoholics were defined as individuals who reported drinking, on a daily basis, more than one bottle of a nondistilled (brewed) alcoholic beverage or two or more doses of a distilled alcoholic beverage.

In the year preceding the study, the influenza vaccination coverage of the elderly was reported to be over 70% in the five cities in the Sumaré microregion, being even higher (74%) in the cities where most of our CAP patients resided (Sumaré and Hortolândia).[22] The vaccination coverage among the patients ≥ 60 years of age was significantly lower among the CAP inpatients than in the general population (52.6% vs. > 70%; $p < 0.05$).

At admission, 34 patients (55.7%) were found to have at least one chronic disease, and chronic diseases were more common in the patients ≥ 60 years of age (94.1%; Table 2).

Although the mean length of hospital stay was 13.6 days, 34 patients (55.7%) were discharged within the first 10 days. The shortest hospital stay was 3 days and the longest was 60 days. Only 5 patients (8.2%) were submitted to mechanical ventilation, and 5 (8.2%) were transferred to the ICU. A total of 21 patients (34.4%) were started on corticosteroid therapy, and 17 (27.9%) received oxygen therapy via a nasal cannula.

Table 3 shows the major symptoms related to pulmonary infection among the patients ≥ 60 years of age and those < 60 years of age. Fever was significantly less prevalent among the former (57.9% vs. 88.1%; $p < 0.05$). Gastrointestinal symptoms occurred in approximately 15% of the patients, especially in those < 60 years of age, making it difficult to diagnose pneumonia at admission. Preceding pulmonary infection, flu symptoms such as fever, rhinorrhea, and sore throat were common (in 21.4%).

The mortality rate of the CAP inpatients was 4.9%. However, by less than 10 days after admission, 27 patients (44.3%) were free of clinical complications. Although 84.2% of the patients ≥ 60 years of age had a PSI of III or IV, whereas 69.1% of the patients < 60 years of age had a PSI of I or II, there were no deaths in the former group and the mortality rate was 7.1% in the latter (Table 4). The PSI was found to be dissociated from disease course among the patients < 60 years of age. All 5 individuals who required ICU admission were < 60 years of age, suggesting more severe profiles. We found that 32 individuals (34.4%) were in categories I or II, that is, theoretically, they could be treated as outpatients.

Table 2 - Chronic diseases associated with community-acquired pneumonia at the time of hospitalization. *Hospital Estadual Sumaré*, October/2005-September/2007.

Comorbidity[a]	n (%)
At least one chronic disease	34 (55.7)
Diabetes	12 (20.0)
Hypertension	23 (38.3)
Heart disease[b]	11 (18.3)
Lung disease[c]	16 (26.7)
Acute/chronic kidney disease	5 (8.1)

[a]Some individuals presented with more than one associated chronic disease. [b]Heart disease: ischemic heart disease; arrhythmias; and heart failure. [c]Lung disease: COPD; asthma; pulmonary emphysema; and pneumoconiosis.

Of the 5 patients admitted to the ICU (all of whom were < 60 years of age), 2 had chronic kidney disease, 1 had liver cirrhosis, and 1 had pleural/pericardial effusion. In addition, the 3 deaths occurred in patients with underlying chronic diseases (liver cirrhosis, COPD/emphysema, and diabetes mellitus, respectively).

Among the patients who had a worse clinical course, there were 6 cases (22.2%) of CAP caused by *S. pneumoniae* and 2 cases (0.9%) of CAP caused by *C. pneumoniae*.

The etiology of CAP was defined in 31 patients (50.8%), and *S. pneumoniae* was the most common agent, being identified in 21 patients (34.4%). In 13 of those 21, the etiology was confirmed by the urinary antigen test, and, in 8 of them, there was no other test result indicative of infection, which added information in 13.1% of the cases of pneumonia. The most prevalent microorganism in blood cultures and sputum cultures was *S. pneumoniae*. The second most common agent was *C. pneumoniae*, in 5 cases (8.2%). Neither serology nor the urinary antigen test identified *L. pneumoniae* in any of the samples investigated (Table 5).

Table 3 - Distribution of the symptoms reported by the patients at the time of hospitalization, by age. *Hospital Estadual Sumaré*, October/2005-September/2007.

Symptom[a]	< 60 years	≥ 60 years	p*
	n = 42	n = 19	
	n (%)	n (%)	
Cough	41 (97.6)	17 (89.5)	0.47
Fever	37 (88.1)	11 (57.9)	0.01
Chest pain	31(73.8)	13 (68.4)	0.89
Dyspnea	30(71.4)	18 (94.7)	0.07
Expectoration	25 (61.0)	15 (78.9)	0.28
Malaise	25 (59.5)	14 (73.7)	0.43
Myalgia	25 (59.5)	10 (52.6)	0.86
Wheezing	13 (31.0)	9 (47.4)	0.34
Anorexia	15 (36.6)	5 (26.3)	0.62
Abdominal pain	11 (26.2)	2.(10.5)	0.29
Rhinorrhea	9 (21.4)	4 (21.1)	0.76
Sore throat	9 (21.4)	4 (21.1)	0.76
Vomiting	9 (21.4)	2 (10.5)	0.48
Nausea	8 (19.0)	2 (10.5)	0.64
Diarrhea	4 (9.8)	0 (0.0)	0.29**

[a]Some individuals presented with more than one symptom (n = 61). *p < 0.05; chi-square test. **Fisher's exact test.

Positive results were obtained in 8.2% of the blood cultures. As shown in Table 5, the rate of positivity on sputum smear microscopy and sputum culture was 13.3% and 15.5%, respectively, considering only the 45 samples (73%) determined to be adequate by the method described by Bartlett et al.[19]

The antibiotic therapy of choice was the clavulanate-amoxicillin combination, which was prescribed in 25 patients (73.5%), although it was necessary to change the regimen to other classes of antibiotics in 13 patients (48.1%) who had an unfavorable clinical course and in 5 (14.7%) who were discharged within less than 10 days. Quinolones, clindamycin, and third-generation cephalosporins were also administered, as were other combinations.

Discussion

In the present study, most of the patients evaluated had a low level of education, were socioeconomically disadvantaged, had comorbidities associated with pneumonia, and resided in the Sumaré microregion, where access to ambulatory care can be considered poor and resolution rates are low.

The influenza vaccination coverage among the CAP inpatients ≥ 60 years of age was significantly lower than that reported for their area of residence and age bracket, underscoring the importance of immunobiology in the prevention of hospitalizations for pneumonia.[21] The capacity to prevent hospitalizations and deaths has been described as one of the major benefits of the influenza vaccine.[15-17] Although pneumococcal vaccination coverage has been expanding in Brazil, it is still small and insufficient for the at-risk populations. Many studies have identified the role of health care teams and, especially, that of physician recommendation as being determining factors

Table 4 - Clinical course, ICU admission, and outcome in the patients hospitalized for community-acquired pneumonia. *Hospital Estadual Sumaré*, October/2005-September/2007.

Variable	< 60 years	≥ 60 years	Total	p*
	n (%)	n (%)		
Clinical course[a]				
> 10 days or death	19 (45.2)	8 (42.1)	27 (44.3)	0.95
≤ 10 days	23 (54.8)	11 (57.9)	34 (55.7)	
PSI, score				
I	11(26.2)	0 (0.0)	11 (0.0)	0.01
II	18 (42.9)	3 (15.8)	21 (34.4)	
III	6 (14.3)	8 (42.1)	14 (23.0)	
IV	7 (16.7)	8 (42.1)	15 (24.6)	
Outcome				
Death	3 (7.1)	0 (0)	3 (4.9)	0.47
Cure/referral	39 (92.9)	19 (100)	58 (95.1)	
Total	42 (68.9)	19 (31.1)	61 (100)	

PSI: pneumonia severity index. [a]Clinical course: length of hospital stay in days or death. *p < 0.05; chi-square test.

of the participation of individuals in vaccination campaigns.[22-24]

The high prevalence of cases of pneumonia caused by *S. pneumoniae* in the hospital under study and the low vaccination coverage in the surrounding region draw attention to the incipient use of immunization in general and specialized clinical practice.

Proportionally, pneumococcal strains were more commonly identified among the patients who had a more favorable clinical course, and the most common treatment option was the clavulanate-amoxicillin combination. This initial empirical treatment often needed to be altered during hospitalization, especially among the patients who had a poor clinical course.

The prevalence of chronic diseases (55.7%) was often the reason for hospitalization among the patients evaluated in the present study, this prevalence being higher (94.1%) among the patients ≥ 60 years of age. Some authors have drawn attention to the occurrence of complications and clinical decompensation of chronic diseases in the presence of pulmonary infection, leading to greater severity of illness.[1-3]

The results of the present study confirm the nonspecific clinical expression of pulmonary infection in the elderly,[25,26] especially the low rates of fever among such patients. Conversely, the presence of rhinorrhea and sore throat (in approximately 20% of the patients) in both age groups raises the suspicion of viral infection preceding bacterial infection.

The PSI classification suggested that a large proportion of patients who could be followed as

Table 5 - Results of the etiological investigation by positivity on one or more tests, at the time of hospitalization, in patients with community-acquired pneumonia (n = 61). *Hospital Estadual Sumaré*, October/2005-September/2007.[a]

Agent	Blood culture	Sputum		Serology[c]	Urine test[d]	Total
		Smear microscopy[b]	Culture			n (%)
Streptococcus pneumoniae	4	4	5	-	13	21 (34.4)
Staphylococcus aureus	1	2	2	-	-	2 (3.3)
Chlamydophila pneumoniae	-	-	-	5	-	5 (8.2)
Total identified, n (%)	5 (8.2)	6 (13.3)	7 (15.6)	8 (13.1)	13 (21.3)	31 (50.8)
Other/contaminants	-	3	4	-	-	6 (9.8)
Undefined etiology, n (%)	26 (42.6)					

[a]In some cases, more than one test was positive. [b]Likely cases: Bartlett's test and sputum smear microscopy (adequate samples, n = 45). [c]Serology (2 samples) for *C. pneumoniae*, *Mycoplasma pneumoniae*, and *Legionella pneumophila*. [d]Detection of *S. pneumoniae* antigen in urine.

outpatients were hospitalized, this was especially true for 70% of the patients < 60 years of age, given that they had a PSI of I or II. However, in this age group, there was a higher ICU admission rate and a higher mortality rate. Although few cases were analyzed, these results suggest that the PSI underestimated the severity of illness in the CAP patients < 60 years of age.

Conversely, the PSI classified 84% of the CAP cases among the patients ≥ 60 years of age as cases for hospitalization, although there were no deaths and some cases evolved to clinical resolution. In the Sumaré microregion, where access to health care facilities can be considered poor and the resolution rates are assessed as low, the teams who first saw the patients opted for hospitalization in order to ensure access to and the appropriate use of medications, as well as the subsequent clinical assessment of patients, especially of elderly patients with chronic diseases. The low CAP-related mortality rate in this hospital might be attributable to this admission profile.

Although hospital stays were longer and clinical complications were more common in the patients ≥ 60 years of age than in those < 60 years of age, survival rates were higher in the former group. It should be noted that the PSI was not used in the decision-making process regarding hospitalization at the time of admission, which made it difficult to analyze this index. In addition, the small sample size precludes accurate conclusions about the severity of illness or the etiology of the cases.

The etiology of CAP was established in 31 patients (50.8%), which confirms data in the literature showing that the etiologic diagnosis is not established in 40-50% of cases of pneumonia, despite the use of a number of existing microbiological and serological methods.[9,11]

In the present study, the proportion of positive blood cultures was 8.2%. This might be attributable to antibiotic therapy prior to hospitalization. Despite being low, the blood culture positivity rate found in the present study is similar to those reported in other studies (5-14%).[10,27]

Despite being performed after the use of the qualitative test described by Bartlett et al.[19] and having their positivity assessed only in the properly collected samples, neither sputum smear microscopy nor culture contributed to elucidating the etiology of the cases evaluated in the present study. Although sputum smear microscopy and culture are inexpensive, their use as a tool for the etiologic diagnosis of CAP is controversial because of their low specificity and the large proportion of improperly collected samples, which limits their diagnostic power in the management of pneumonia.[28,29] It is believed that the use of PCR in sputum samples can improve the detection of etiologic agents.[30] However, the present study showed that the etiology can be confirmed by detection of *S. pneumoniae* antigen in urine samples. Its use as a routine test in cases of pneumonia can bring highly relevant benefits to the choice of antibiotic therapy, especially in cases of severe illness.[3]

Although detection of IgG by ELISA is not specific for *C. pneumoniae*, a three to four times greater titer in the second sample, collected during the respiratory infection, suggests infection with this organism. Despite the small absolute number of cases, physicians should consider positivity for *C. pneumoniae* (in 8.2%) and *M. pneumoniae* (in 4.9%) when prescribing empirical treatment for patients with CAP who reside in this particular region. The absence of *L. pneumophila*-positive cases might be attributable to the small number of patients analyzed or even to the low prevalence of this microorganism in the region. In a study of individuals with CAP who were treated as outpatients, Rocha et al. found similar results.[5]

Chief among the limitations of the present study are the small sample size, the fact that the PSI criteria was not used as a variable in the decision-making process regarding hospitalization, and the fact that other criteria, such as the CURB-65 or CRB-65 scores, which could identify severe cases missed by the PSI, were not used. In addition, no standard treatment protocol was followed after the cases were diagnosed. Treatment was the responsibility of the clinician at the time of hospitalization and during routine ward visits. However, the study protocol was strictly followed. Therefore, the outcome of the pneumonia cases might have been affected by treatment decisions and by the clinical approach. It is of note that, after the results of the present study were made known, the routine practice for the treatment

of CAP cases began to be standardized in the hospital under study. Regarding elucidation of the diagnosis, loss to clinical follow-up after hospital discharge made it impossible to arrive at a definitive etiological diagnosis in some cases (those in which a second biological sample for serology was not collected).

In conclusion, we found that most CAP cases in the study region occurred in patients < 60 years of age, who had a worse clinical course, and that the severity of illness in such patients was underestimated by the PSI. The mortality rate was low (4.9%) and was concentrated among the patients < 60 years of age. The hospitalization of individuals that could have been followed as outpatients, based on the PSI, was justified by the need to ensure access to medication and to clinical follow-up, especially among the elderly and patients with chronic diseases. Not being vaccinated against influenza was a risk factor for CAP-related hospitalization among the elderly patients evaluated in the present study. There are several risk factors related to the occurrence and severity of CAP, factors that are affected by aspects such as the morbidity profile at the local/regional level, the specific vaccination coverage, and the circulation patterns of pathogens, as well as the level of access to and quality of health care. Knowledge of these factors in a given region can inform therapeutic decisions in cases of pneumonia.

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