ORIGINAL ARTICLES

Patients Hospitalized With Community-Acquired Pneumonia: a Comparative Study of Outcomes by Medical Specialty Area

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OBJECTIVE: Variability in the management of patients hospitalized with community-acquired pneumonia (CAP) is attributable to many factors. The objective of this study was to determine whether such variability is influenced by the medical specialty area where the patient is treated.

PATIENTS AND METHODS: The treatment and outcomes for a random sample of patients with CAP admitted to 4 hospitals over 2 periods (1 year starting March 1, 1998, and 1.5 years starting March 1, 2000) were compared by medical specialty department. Multiple linear and logistic regression models were used to analyze differences.

RESULTS: Differences were found between departments in the coverage of atypical pathogens (*P*<.001). The adjusted mean length of stay in hospital varied between 6.8 and 9.1 days (*P*<.01), and the duration of intravenous treatment varied between 4.6 and 7.3 days (*P*<.05). Adjusted models showed that mortality in hospital and at 30 days was significantly higher for patients treated in internal medicine departments (odds ratios: 2.1 and 2, respectively) than for those treated in pulmonology departments.

CONCLUSIONS: Interdepartmental differences were observed in how patients hospitalized with CAP were treated and in the outcomes achieved. This variation is probably influenced by the differences that were found in the use of antibiotics.

Key words: *Community-acquired pneumonia. Variability. Treatment. Results.*

Pacientes ingresados por neumonía adquirida en la comunidad: estudio comparativo en función de la especialidad del servicio médico responsable

OBJETIVO: La variabilidad en el manejo de los pacientes ingresados por una neumonía adquirida en la comunidad (NAC) es multifactorial. Nuestro objetivo fue comprobar si en ello influye la especialidad del servicio responsable.

PACIENTES Y MÉTODOS: Se compararon entre servicios el tratamiento y los resultados de una muestra aleatoria de los pacientes ingresados por NAC en 4 hospitales durante 2 períodos (un año desde el 1 de marzo de 1998; un año y medio desde el 1 de marzo de 2000). Se emplearon modelos de regresión lineal múltiple y logística para ajustar las diferencias.

RESULTADOS: Se encontraron diferencias entre servicios en la cobertura de gérmenes atípicos (p < 0,001). La duración media ajustada de la estancia hospitalaria osciló entre 6,8 y 9,1 días (p < 0,01) y la del tratamiento intravenoso entre 4,6 y 7,3 días (p < 0,05). Los análisis ajustados demostraron que la mortalidad intrahospitalaria y a los 30 días fue significativamente superior en los servicios de medicina interna (*odds ratio*: 2,1 y 2, respectivamente) respecto a los de neumología.

CONCLUSIONES: Se observaron diferencias entre servicios en el tratamiento de los pacientes ingresados por NAC y en sus resultados. Es probable que en ello influyan las diferencias encontradas en la utilización de los antibióticos.

Palabras clave: *Neumonía adquirida en la comunidad. Variabilidad. Tratamiento. Resultados.*

Introduction

Community-acquired pneumonia (CAP) is a disease with high morbidity and mortality and considerable economic impact. It is a common disease with a well known natural history, there is a general consensus concerning its effective treatment, and an internationally validated severity index exists.[1-3] Observational studies have revealed an association between the care and treatment of these patients and the outcomes obtained.[4-7] All of these characteristics make CAP a highly suitable disease in which to study whether treatment differs and the possible impact of such difference on outcomes. The studies carried out to date have found considerable variation in the treatment of patients with CAP between different countries and between different hospitals in the same country.[8-16] Considerable differences have been found between hospitals in the admission decision,[11-13] the length of stay in hospital,[8-11] and antibiotic use.[14-16]

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The variations observed in the treatment of patients hospitalized for CAP may initially be attributed to factors related to the patients themselves. The factors that have the greatest impact on mortality are the severity of the disease and the presence of concomitant disease.[17,18] However, patient-related factors do not explain all the aforementioned differences,[8-16] which may be conditioned by other factors, such as the structure and organization of the health care system, the type of hospital, the social and cultural characteristics of the population in question, and factors related to the attending physician.

The impact on patient treatment of the medical specialty of the attending physician is one of the factors that has been debated and studied in relation to various diseases, although the results obtained have been inconclusive. Studies carried out in Canada have revealed that patients diagnosed with congestive heart failure and treated by cardiologists received a better quality of care and achieved better outcomes than similar patients treated by internists.[19] Similar differences have also been found between patients treated by internists and subspecialists for acute myocardial infarction, acute nonhemorrhagic stroke, and asthma.[20] However, because of the different models for specialization that exist in different countries, especially in North America, the results of studies carried out in Canada and the United States of America that identify differences in the treatment of various diseases depending on the specialty of the physician must be interpreted with caution. Little information about such differences is available for Spain.[21]

The hypothesis of the present study was that the variability observed in the treatment of patients hospitalized for CAP might be explained in part by the medical specialty of the hospital department responsible for their care. The objective of our study was, therefore, to analyze the influence that medical specialty has on the treatment of patients hospitalized for CAP and on the outcomes achieved.

Patients and Methods

Study Design

The study was carried out in 4 teaching hospitals with similar staffs and technical resources located in the Basque Country of northern Spain: hospital 1 with 450 beds and a catchment population of 250 000; hospital 2 with 650 beds and a catchment population of 600 000; hospital 3 with 900 beds and a catchment population of 500 000; and hospital 4 with 1000 beds and a catchment population of 600 000. All the hospitals had intensive care units, and none had a dedicated intermediate care unit for the treatment of pneumonia.

Differences in treatment and outcomes were compared in patients hospitalized for CAP during 2 periods (from March 1, 1998 to March 1, 1999; and from March 1 2000 until September 30, 2001) by the medical specialty of the department (or unit) where the patient was treated. The decision to study 2 different periods separated by a 12-month interval was taken in order to neutralize any impact on outcomes that might be caused by changes in etiologic agents from 1 year to the next. Departments were categorized under the following specialty headings: pulmonology, internal medicine, infectious diseases, and a mixed group comprising other specialties. A sample of all the patients hospitalized for CAP in each one of the hospitals was selected retrospectively using a simple randomization technique. The sample used in the case of the largest hospital was larger.

The study was approved by the clinical research ethics committee.

Patients

Adult patients (≥18 years old) admitted with a diagnosis of CAP were included providing that the tentative diagnosis had been made within 24 hours of arrival at the emergency department. Pneumonia was defined as the presence of a pulmonary radiographic infiltrate not known to be preexisting and found in association with symptoms indicative of pneumonia, such as cough, dyspnea, fever, and/or pleural chest pain. Of the patients with pneumonia, the following were then excluded: patients infected with human immunodeficiency virus, immunodeficient patients (defined as those who had solid organ transplants, were splenectomized, and had been treated with at least 10 mg/day of prednisone or equivalent for more than 30 days, those treated with other immunosuppressants, and neutropenic patients ($<1.0\times10^9$/L neutrophils), and individuals who had been hospitalized during the preceding 14 days. Also excluded from the study were 9 patients who were admitted directly from the emergency department to the intensive care unit (ICU), where they died.

Retrospective Selection

A random selection of the admissions records from the 4 hospitals for both periods were reviewed retrospectively. In this revision, the following were all considered to be potential cases of pneumonia: cases with a primary diagnosis of pneumonia on admission—codes 480.0 to 480.9, 481, 482.0 to 482.9, 483.0 to 483.8, 485, 486, 487.0, and 507.0 in the International Disease Classification, ninth revision, clinical modification (IDC-9-CM); and cases with a primary diagnosis on admission of respiratory failure (IDC-9-CM code 518.81) and a secondary diagnosis of pneumonia. For a case to be confirmed as pneumonia the appropriate IDC-9-CM code was required in addition to a tentative diagnosis of CAP within 24 hours of arrival at the emergency department and a chest radiograph indicative of CAP.

The patient records were reviewed by 2 trained reviewers, who used a structured form to record the required information. A member of the research team (P.P.E.) reviewed all of the variables in a sample of 40 histories, and the most relevant of these were evaluated: mortality, ICU admission, mean length of stay, Pneumonia Severity Index (PSI),[1] and readmission at 30 days. The 2 reviewers also recorded the same variables for 40 other patients to evaluate agreement between the 2 groups. Intraclass correlation and kappa coefficients were in excess of 0.99 in all cases.

Patient Characteristics and Indicators Measured

The clinical and demographic characteristics of all the patients were recorded, as well as any prior antibiotic treatment. The PSI was used to determine the severity of disease in the CAP patients.[1] The PSI risk classes were defined in accordance with the recommendations of the original

authors.[1] A case of CAP was defined as severe when it fulfilled at least 2 minor criteria (systolic blood pressure <90 mm Hg, multilobe involvement, ratio of PaO_2 to fraction of inspired oxygen <250), or at least 1 of the 2 major criteria (need for mechanical ventilation and presence of septic shock).[22] In both the calculation of the PSI score and the assessment of whether or not a case of CAP was severe, lost data and laboratory tests not carried out were considered normal.

The following treatment-related indicators were included: *a)* initial antibiotic treatment as per the guidelines issued by the Spanish Society of Pulmonology and Thoracic Surgery (SEPAR) [23]; *b)* coverage of atypical pathogens (inclusion of treatment with macrolides, levofloxacin, or similar agents); *c)* start of antibiotic treatment within 8 hours of arrival in the emergency department; *d)* duration of intravenous antibiotic treatment; and *e)* total duration of antibiotic treatment.

The following outcomes were measured: *a)* mortality in hospital and within 30 days; *b)* ICU admission; *c)* use of mechanical ventilation; *d)* septic shock (defined as systolic blood pressure of <90 mm Hg and need for vasopressor support for >4 hours); *e)* readmission to hospital within 30 days because of complications related to the CAP episode (2 trained pulmonologists independently reviewed all readmission records); and *f)* length of stay in hospital (calculated from the date of admission to the date of discharge). Data on mortality was extracted from both the patient records and a local government database for the Basque Country providing information on vital status.

Statistical Analysis

Frequencies, percentages, means, medians, and standard deviation were used in the descriptive statistical analysis. The χ^2 test and Fisher exact test were used to compare categorical variables by medical specialty area. Continuous variables were analyzed using the Kruskal-Wallis nonparametric test and analysis of variance (applying Scheffé's method in multiple comparisons).

In the adjusted models, the main independent categorical variable was the medical specialty area. The pulmonology departments or units (PDs) and the infectious diseases departments or units (IDDs) were used as the reference group. Multiple linear regression was used to analyze continuous dependent variables (duration of antibiotic treatment, duration of intravenous treatment, and length of stay in hospital). Since the distribution of these variables was not normal, a logarithmic transformation was applied. Parameter estimates and standard errors are presented after exponentiation. The multivariate logistic regression model was used to analyze the other dependent variables, which were all dichotomic. Odds ratios (OR) and 95% confidence intervals (CI) are shown. All models were adjusted for severity (measured using the PSI as a continuous variable), multilobe involvement on chest radiograph, and antibiotic treatment prior to hospital admission.

Adjusted analyses were also performed including the hospital as a variable. Since the results of these analyses were similar, it was not considered necessary to present them here.

Results

A total of 6177 patients who had been admitted to the 4 hospitals with a diagnosis of CAP during the 2 periods studied were identified. Of these, 1475 patients (23.9%) were randomly selected. The diagnosis was confirmed in 1331 of these cases (90.2%). After 219 (16.5%) of these were excluded, the final number of patients included in the study was 1112 (75.4%). Of the patients included, 641 (57.6%) were treated in PDs, 374 (33.6%) in internal medicine departments (IMDs), and 51 (4.6%) in IDDs. The remaining 46 (4.1%), who were dealt with as a mixed group, were treated in a variety of other departments or units (oncology, 16; cardiology, 16; hematology, 5; nephrology, 4; neurology, 3; thoracic surgery, 1; digestive surgery, 1). During both periods, the percentage of confirmation of cases was lower in 1 of the hospitals than in the other 3 owing to minor data entry errors.

Patient Characteristics

Table 1 lists the patients' clinical and sociodemographic characteristics by group. Notable and statistically significant differences between departments were found. Patients treated in PDs and IDDs were younger and their condition was less severe than those treated in IMDs and the mixed group. Over 60% of the patients treated in either IMDs or the mixed group belonged to PSI risk classes IV and V,[1] while under 40% of patients treated in PDs and IDDs belonged to these risk classes. The percentage of patients who fulfilled the criteria for severe CAP was similar in all 4 groups.

Differences in Treatment

Statistically significant differences between departments were observed in the type of antibiotic used (Table 2). The antibiotic most often used overall was amoxicillin-clavulanic acid (31.7%). Comparison of the different specialty areas revealed a greater use of amoxicillin-clavulanic acid in IMDs and the mixed group, and a greater use of cephalosporin plus a macrolide in IDDs and PDs.

Table 3 shows the adjusted and nonadjusted analysis by department of various aspects of the antibiotic treatment used. The choice of treatment was considered appropriate in over 80% of cases in all 4 groups. Statistically significant differences were found in the coverage of atypical pathogens (P<.001): more patients were covered for such pathogens in IDDs (52.9%) and PDs (41.7%) than in IMDs (26.7%) and the mixed group (21.7%). The biggest difference between specialty areas in mean duration of intravenous treatment was 1.7 days, but no statistically significant (P=.07) differences were found.

Adjusted analysis using PDs as a reference group confirmed that fewer atypical pathogens were covered in IMDs (OR, 0.6; 95% CI, 0.5-0.8) and demonstrated that fewer IMD patients received an initial dose of antibiotics within 8 hours of arrival (OR, 0.7; 95% CI, 0.5-0.9). Statistically significant differences (P<.05) were also found in the duration of intravenous treatment when PDs were compared to IMDs and the mixed group (adjusted means in days: PDs, 4.6; IMDs, 5.2; IDDs, 5.5; and the mixed group, 7.3).

TABLE 1
Clinical and Sociodemographic Characteristics of Patients Admitted With Community-Acquired Pneumonia (CAP) by Medical Specialty Area*

Characteristics	Pulmonology (n=641)	Internal Medicine (n=374)	Infectious Diseases (n=51)	Mixed Group (n=46)	*P*
Demographic data					
Mean (SD) age, years	67.6 (16.9)	74.1 (16.6)	53.9 (21.8)	69.7(14.1)	<.001
Age <50 years	103 (16.1)	36 (9.6)	23 (45.1)	4 (8.7)	<.001
Female	222 (34.6)	162 (43.3)	17 (33.3)	14 (30.4)	<.05
Nursing home resident	31 (4.8)	42 (11.2)	2 (3.9)	2 (4.4)	<.01
Prior antibiotic treatment	164 (25.6)	70 (18.7)	16 (31.4)	4 (8.7)	<.01
Comorbidity					
Neoplasm	39 (6.1)	18 (4.8)	1 (2)	22 (47.8)	<.001
Liver disease	11 (1.7)	21 (5.6)	7 (13.7)	2 (4.4)	<.001
Congestive heart failure	67 (10.5)	56 (15)	9 (17.7)	12 (26.1)	<.01
Cerebrovascular disease	73 (11.4)	73 (19.5)	7 (13.7)	3 (6.5)	<.01
Kidney disease	17 (2.7)	23 (6.2)	2 (3.9)	7 (15.2)	<.001
Chronic obstructive pulmonary disease	226 (35.3)	81 (21.7)	5 (9.8)	11 (23.9)	<.001
Diabetes mellitus	88 (13.7)	52 (13.9)	5 (9.8)	13 (28.3)	<.05
Number of concomitant diseases					
1	237 (37)	134 (35.8)	14 (27.5)	21 (45.7)	.31
≥2	125 (19.5)	83 (22.2)	9 (17.7)	21 (45.7)	<.001
Physical examination					
Altered mental status	38 (5.9)	49 (13.1)	10 (19.6)	6 (13)	<.001
Pulse rate >125/min	46 (7.2)	42 (11.2)	4 (7.8)	5 (10.9)	.16
Respiratory rate >30/min	124 (19.3)	85 (22.7)	11 (21.6)	11 (23.9)	.58
Systolic blood pressure <90 mm Hg	13 (2)	18 (4.8)	0 (0)	5 (10.9)	<.01
Temperature <35ºC or >40ºC	7 (1.1)	5 (1.3)	0 (0)	0 (0)	.73
Laboratory and radiographic results					
Urea nitrogen >30 mg/dL	147 (22.9)	138 (36.9)	10 (19.6)	16 (34.8)	<.001
Glucose >250 mg/dL	47 (7.3)	30 (8)	2 (3.9)	5 (10.9)	.60
Hematocrit <30%	7 (1.1)	20 (5.4)	2 (3.9)	3 (6.5)	<.001
Sodium <130 mmol/L	21 (3.3)	21 (5.6)	0 (0)	3 (6.5)	.10
PaO_2<60 mm Hg	236 (36.8)	143 (38.2)	14 (27.5)	15 (32.6)	.46
Arterial pH<7.35	35 (5.5)	31 (8.3)	2 (3.9)	2 (4.4)	.26
Pleural effusion	44 (6.9)	31 (8.3)	1 (2)	7 (15.2)	.07
Multilobar pneumonia	153 (23.9)	86 (23)	13 (25.5)	10 (22.2)	.97
PSI risk class†					
I	92 (14.4)	32 (8.6)	24 (47.1)	3 (6.5)	<.001
II	146 (22.8)	34 (9.1)	6 (11.8)	2 (4.4)	<.001
III	147 (22.9)	78 (20.9)	3 (5.9)	11 (23.9)	<.05
IV	194 (30.3)	159 (42.5)	12 (23.5)	16 (34.8)	<.001
V	62 (9.7)	71 (19)	6 (11.8)	14 (30.4)	<.001
Mean (SD) PSI	85.6 (33.2)	102.1 (37)	74.5 (43.3)	110.4 (34.6)	<.001
Severe CAP‡	69 (10.8)	38 (10.2)	7 (13.7)	5 (10.9)	.89

*Values are number (percentage) unless otherwise noted. Percentages exclude patients with lost data. PSI indicates Pneumonia Severity Index.
†Patients in class I have the lowest severity and mortality, and those in class V, the highest.
‡Severity was defined as the presence of at least 2 minor findings (systolic blood pressure <90 mm Hg, multilobe involvement, PaO_2/fraction of inspired oxygen <250), or at least 1 of 2 major findings (need for mechanical ventilation and presence of septic shock).

TABLE 2
Use of Antibiotics by Department*

Antibiotics	Pulmonology (n=641)	Internal Medicine (n=374)	Infectious Disease (n=51)	Mixed Group (n=46)	*P*
Macrolides	34 (5.4)	7 (1.9)	3 (5.9)	2 (4.4)	<.05
Amoxicillin-clavulanic acid	186 (29.3)	138 (37.1)	10 (19.6)	16 (35.6)	<.05
Second- or third-generation cephalosporin	163 (25.6)	113 (30.4)	11 (21.6)	14 (31.1)	.28
Second- or third-generation cephalosporin + macrolide	157 (24.7)	57 (15.3)	15 (29.4)	4 (8.9)	<.001
Others	96 (15.1)	57 (15.3)	12 (23.5)	9 (20)	.36

*Data are expressed as number (percentage). Percentages exclude patients with lost data.

TABLE 3
Comparison by Department of Treatments Used. Adjusted and Nonadjusted Analyses*

Treatment	Pulmonology (n=641)	Internal Medicine (n=374)	Infectious Disease (n=51)	Mixed Group (n=46)	*P*
Appropriate antibiotic (%)†	560 (88.1)	329 (90.6)	44 (86.3)	36 (81.8)	.27
Adjusted	Reference	1.2 (0.8-1.8)	0.9 (0.4-2.1)	0.6 (0.3-1.4)	
Coverage for atypical pathogens (%)‡	267 (41.7)	99 (26.7)	27 (52.9)	10 (21.7)	<.001
Adjusted	Reference	0.6 (0.5-0.8)	1.4 (0.8-2.5)	0.5 (0.3-1.1)	
Antibiotic within 8 hours (%)	470 (77.8)	247 (71.4)	38 (77.6)	26 (74.3)	.17
Adjusted	Reference	0.7 (0.5-0.9)	1 (0.5-2)	0.9 (0.4-2)	
Mean (SD) duration of antibiotic treatment, days§	14.8 (5.9)	14.4 (4.8)	15.1 (4.8)	13.3 (5)	.34
Adjusted mean, days	13.9	13.7	14.1	12.3	
Mean duration of intravenous treatment, days (%)§	5.8 (5.3)	6.5 (4.7)	5.9 (3.9)	7.5 (4.5)	.07
Adjusted mean, days	4.6	5.2‖	5.5	7.3‖	

*Values are number (percentage) unless otherwise noted; in the case of adjusted analysis they are shown as odds ratio (95% confidence interval) for the categorical variables and as adjusted means for the continuous variables. Percentages exclude patients with lost data. The analyses are adjusted for the Pneumonia Severity Index, multilobe radiographic involvement, and antibiotic treatment prior to hospital admission.
†Appropriate antibiotic treatment was defined as the agent recommended in the clinical guidelines of the Spanish Society of Pulmonology and Thoracic Surgery (SEPAR).
‡Coverage for atypical pathogens was defined as being an antibiotic treatment including a macrolide or a quinolone.
§Patients who died were excluded.
‖P<.05 (pulmonology as a reference).

TABLE 4
Stratified Analysis of Mortality at 30 Days by Department and Severity*

Severity	Pulmonology (n=641)	Internal Medicine (n=374)	Infectious Disease (n=51)	Mixed Group (n=46)	*P*
PSI†					
I-III	0.5	3.5	0	6.3	<.05
IV-V	13.3	23	22.2	23.3	.05
Severe CAP‡	11.6	39.5	14.3	40	<.01

*Values are expressed as percentages. PSI indicates Pneumonia Severity Index; and CAP, community-acquired pneumonia.
†Patients in Class I have the lowest mortality, and those in class V, the highest.
‡Severe CAP was defined as the presence of at least 2 of the following minor findings (systolic blood pressure <90 mm Hg, multilobe involvement, PaO_2/fraction of inspired oxygen <250), or at least 1 of 2 major findings (need for mechanical ventilation, presence of septic shock).

Outcome Indicators

Table 4 shows the differences in mortality at 30 days between specialty areas by severity. Statistically significant differences were found both between patients at low risk (PSI classes I, II, and III, *P*<.05) and between patients at high risk (PSI classes IV and V, *P*<.05). Mortality was higher among low risk patients treated in IMDs (3.5%) and the mixed group (6.3%) (predicted mortality of 0.1%-2.8%).[1] Mortality in the whole subgroup of high risk patients was similar to the predicted risk (predicted mortality of 8.2%-31.1%)[1]; however, mortality among patients treated in PDs was lower than among those treated in other departments or units (13.3% in PDs as compared to 23% in IMDs, 22.2% in IDDs, and 23.3% in the mixed group). Statistically significant differences (*P*<.01) between departments were also observed in the mortality of patients classified as having severe CAP (PDs, 11.6%; IDDs, 14.3%; IMDs, 39.5%; and the mixed group, 40%).

Table 5 shows the comparison of outcomes by department. Statistically significant differences were found between departments in mortality at 30 days, in-hospital mortality, and ICU admission. The greatest difference in mean length of stay in hospital was 3.3 days (*P*<.001), and the median ranged from 6 to 10 days (*P*<.001).

Adjusted analysis (Table 6) using the PD group as the reference confirmed the statistically significant differences between departments in mortality at 30 days and in-hospital mortality. These were higher in patients treated in the IMDs (mortality at 30 days, OR=2; 95% CI, 1.2-3.3; in-hospital mortality, OR=2.1; 95% CI, 1.3-3.5). It also revealed statistically significant differences (*P*<.01) in the length of stay in hospital when PDs were compared to IMDs and the mixed group (adjusted means in days: PDs, 6.8; IDDs, 7.4; IMDs, 8.6; mixed group, 9.1). No significant differences were found when the IDD group was used as the reference in adjusted analyses.

Discussion

The present study revealed statistically significant differences in treatment and outcomes among patients admitted for CAP depending on the specialty area of the department or unit where they were treated. We observed that length of stay in hospital adjusted for severity was between 1.2 and 2.3 days shorter in PDs and IDDs than in IMDs and the mixed group comprising various departments or units. There was no evidence that this shorter stay had any negative impact on the clinical outcomes measured. Adjusted analysis of the data also revealed significant differences in mortality in hospital and at 30 days.

As far as the authors have been able to ascertain, the present study is the first attempt to evaluate interdepartmental differences in the treatment of patients hospitalized with CAP in Spain. These differences were evaluated on the basis of indicators of care and treatment extracted from existing records, and the most important outcomes were assessed. Adults of all ages were included in the study, and the hospitals studied were similar.

The level of appropriateness of the antibiotic treatment prescribed was high in all departments. However, analysis adjusted for severity revealed significant differences in the coverage of atypical pathogens and the initiation of antibiotic treatment within 8 hours of arrival. Notable differences between departments were found in the initial choice of antibiotic and in the timing of the first dose when this decision was made by physicians in the emergency department. Since the patients admitted to IMDs and those in the mixed group were on the whole older, a less specific clinical context in these cases may have given rise to a delay in diagnosis.[24] The greater use of amoxicillin-clavulanic acid in IMDs may have been the result of a higher prevalence of suspected aspiration.

In our opinion, interdepartmental differences in length of stay in hospital indicate a possible area for improvement since the economic repercussions of this aspect of treatment are considerable.[25] As reported by other authors,[26] we observed considerable variability in the timing of the switch from intravenous to oral antibiotics. Some studies have shown that an early switch from intravenous to oral administration can significantly reduce the length of stay in hospital without increasing risk.[27] It is always possible that the patients who stayed in hospital for a shorter period may have been discharged while still clinically unstable. We consider this unlikely, however, because instability at the time of discharge is generally associated with a higher rate of readmissions and mortality at 30 days.[28]

The percentage of CAP patients treated in the ICU was lower than that found by other researchers[29,30] and differed significantly between departments. Less severe disease could explain the low percentage of ICU admissions in the case of the PD and IDD groups, but does not explain the phenomenon in the case of patients treated in IMDs, who tend to be more severely ill. Since no reliable indicator exists for identifying patients requiring intensive care, we cannot advance any definitive conclusions concerning ICU admission; however, the data compiled indicate the need for further debate and research on the criteria currently used to decide on ICU admission.

It is noteworthy that the mortality rate of patients diagnosed with CAP varied significantly depending on which specialty area provided care. This finding should, however, be interpreted with caution because the characteristics of the populations of patients treated in the different departments were not homogeneous. Although a validated tool (PSI[1]) was used to assess the severity of all the patients' conditions, other factors not taken into account may have affected the results of our study. For example, the study did not exclude the terminally ill patients usually found in the older age groups and did not take into account suspected aspiration because of the scant reliability of data on this condition when collected retrospectively.

TABLE 5
Comparison of Results by Department*

Results	Pulmonology (n=641)	Internal Medicine (n=374)	Infectious Disease (n=51)	Mixed Group (n=46)	*P*
Mortality at 30 days	36 (5.6)	58 (15.5)	4 (7.8)	8 (17.4)	<.001
In-hospital mortality	33 (5.2)	55 (14.7)	4 (7.8)	8 (17.4)	<.001
ICU admission	24 (3.7)	4 (1.1)	1 (2)	0 (0)	<.05
Mechanical ventilation	10 (1.6)	2 (0.5)	1 (2)	0 (0)	.40
Septic shock†	16 (2.5)	5 (1.3)	2 (3.9)	0 (0)	.33
Readmission within 30 days	15 (2.3)	12 (3.2)	0 (0)	0 (0)	.33
Length of stay in hospital, days‡					
Mean (SD)	8.1 (6)	10.4 (6.3)	7.8 (4)	11.1 (5.1)	<.001
Median	6	9	7	10	<.001

*Values are number (percentage) unless otherwise indicated. ICU indicates intensive care unit.
†Septic shock was defined as systolic blood pressure <90 mm Hg and the need for vasopressor support for >4 hours.
‡Excluding patients who died.

TABLE 6
Adjusted analysis

Results	Pulmonology (n=641)	Internal Medicine (n=374)	Infectious Disease (n=51)	Mixed Group (n=46)
Mortality at 30 days	Reference	2 (1.2-3.3)	1.4 (0.4-5)	2 (0.8-5.1)
In-hospital mortality	Reference	2.1 (1.3-3.5)	1.6 (0.5-5.7)	2.2 (0.9-5.8)
Length of hospital stay, days†	6.8	8.6‡	7.4	9.1‡

*Odds ratios (95% confidence interval) are shown for categorical variables and adjusted means for continuous variables. The analyses are adjusted for the Pneumonia Severity Index, multilobe involvement on chest radiograph, and antibiotic treatment prior to hospital admission.
†Excluding patients who died.
‡*P*<.01 (pulmonology as a reference).

It was not an objective of this study to identify associations between specific treatments and outcomes. However, as has been suggested by other authors,[31] some of the interdepartmental differences in outcomes found may have been related to the differences observed in the use of antibiotics, such as whether treatment was started within 8 hours of arrival or the early switch from intravenous to oral administration.

Some further limitations of the present study should be considered. Firstly, the use of a retrospective review of patient records may introduce bias. However, the agreement between different reviewers was analyzed and found to be excellent. The results analyzed were the key indicators available for all patients. Furthermore, the identification of CAP cases was free of bias because compatible clinical and radiographic evidence were required to confirm diagnosis. Secondly, while we used important outcomes, we did not evaluate other highly relevant parameters, such as the resolution of symptoms, the patients' return to normal daily activity or work, radiographic resolution, or degree of patient satisfaction. Thirdly, some of the interdepartmental differences in outcomes could be attributed to action taken in emergency departments. While these work in the same way in all the hospitals studied, their decisions varied by specialty of the admitting physician. Differences were found in the severity of the patients' condition, in the antibiotics prescribed, and in the initiation of antibiotic treatment within 8 hours of arrival.

In conclusion, significant differences were found between departments in the treatment of patients admitted for CAP, the length of stay in hospital, and mortality in hospital and within 30 days. A more skilled use of antibiotics could explain some of the differences observed. Our findings contribute information to the study of variations in the treatment of patients admitted for CAP and point towards possible areas of improvement. The next step should be to reliably identify which aspects of the treatment of these patients gave rise to the differences observed.

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