Original

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Prospective comparison of severity scores for predicting mortality in community-acquired pneumonia

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ABSTRACT

Introduction. Specific prognostic models for community-acquired pneumonia (CAP) to guide treatment decisions have been developed, such us the Pneumonia Severity Index (PSI) and the Confusion, Urea nitrogen, Respiratory rate, Blood pressure and age ≥ 65 years index (CURB-65). Additionally, general models are available such as the Mortality Probability Model (MPM-II). So far, which score performs better in CAP remains controversial. The objective was to compare PSI and CURB-65 and the general model, MPM-II, for predicting 30-day mortality in patients admitted with CAP.

Methods. Prospective observational study including all consecutive patients hospitalised with a confirmed diagnosis of CAP and treated according to the hospital guidelines. Comparison of the overall discriminatory power of the models was performed by calculating the area under a receiver operator characteristic curve (AUC ROC curve) and calibration through the Goodness-of-fit test.

Results. One hundred and fifty two patients were included (mean age 73.0 years; 69.1% male; 75.0% with more than one comorbid condition). Seventy-five percent of the patients were classified as high-risk subjects according to the PSI, versus 61.2% according to the CURB-65. The 30-day mortality rate was 11.8%. All three scores obtained acceptable and similar values of the AUCs of the ROC curve for predicting mortality. Despite all rules showed good calibration, this seemed to be better for CURB-65. CURB-65 also revealed the highest positive likelihood ratio.

Conclusions. CURB-65 performs similar to PSI or MPM-II for predicting 30-day mortality in patients with CAP. Consequently, this simple model can be regarded as a valid alternative to the more complex rules.

Key words: pneumonia, severity score, mortality

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Evaluación de distintos modelos pronósticos de gravedad en la predicción de la mortalidad en la neumonía adquirida en la comunidad

RESUMEN

Introducción. En la neumonía adquirida en la comunidad (NAC) es esencial una evaluación precoz de la gravedad para un correcto manejo. Existen varios modelos pronósticos específicos como el Pneumonia Severity Index (PSI) o el sencillo CURB-65 (Confusion, Urea nitrogen, Respiratory rate, Blood pressure and age ≥ 65), así como de modelos generales como el Mortality-Probability-Model-II (MPM-II). Ante la controversia existente sobre cuál es el mejor modelo el objetivo fue comparar el PSI , el CURB-65 y el MPM-II en la predicción de la mortalidad hospitalaria a los 30 días.

Pacientes y método. Estudio prospectivo observacional que incluyó consecutivamente todos los pacientes hospitalizados con NAC. La capacidad discriminatoria de los modelos se comparó mediante las áreas bajo la curva ROC y la calibración mediante el test de Goodness-of-fit.

Resultados. Ciento cincuenta y dos pacientes (edad media: 73,0 años; 69,1% varones; 75,0% con más de una comorbilidad asociada). El PSI clasificó el 75,0% como de alto riesgo y el CURB-65 como graves el 61,2%. La mortalidad hospitalaria a los 30 días fue del 11,8%. Los tres modelos obtuvieron valores aceptables y similares de AUC de las curvas ROC. A pesar de que los tres modelos mostraron una buena calibración, esta parece ser mejor para el CURB-65 que también obtuvo el mejor valor predictivo positivo.

Conclusiones. El CURB-65 obtiene una capacidad discriminatoria similar al PSI o al MPM-II en la predicción de la mortalidad hospitalaria a los 30 días en pacientes con NAC y se presenta como una alternativa válida y sencilla al resto de modelos más complejos.

Palabras clave: neumonía, puntuación de gravedad, mortalidad

INTRODUCTION

Community-acquired pneumonia (CAP) is one of the infectious diseases with the highest mortality rate, and generates important healthcare costs. An early evaluation of the severity of CAP is essential for taking important clinical management decisions. At present, different specific models for CAP have been developed for predicting the prognosis, clinical course and outcome of the disease. These models aim to help in the decision taking process, including the choice of the best treatment option, the need for patient hospitalization[1], and the admission to an Intensive Care Unit (ICU).

Among the existing models, special mention must be made of the Pneumonia Severity Index (PSI) developed by Fine et al.[2], which was designed to identify CAP patients with a low 30-day mortality risk. This model was validated in over 40,000 patients in the context of the PORT (Pneumonia Patient Outcomes Research Team) study. The PSI is a complex model including 20 variables, and allows patient stratification into 5 categories of increasing severity. Its main inconvenience is the complexity due to the difficulty of obtaining the different variables. A more recent alternative model is the CURB-65 (Confusion, Urea nitrogen, Respiratory rate and Blood pressure and Age ≥ 65), derived from the original model of the British Thoracic Society (BTS). This model includes only 5 predictive variables that are moreover easy to obtain, and allows patient classification into three severity groups. Its main advantage with respect to the PSI is simplicity of calculation[3]. In parallel to the above, other general prognosis models have been developed for predicting clinical outcome and mortality that are not specific of CAP. One of them is the Mortality-Probability-Model-II (MPM-II) developed by Lemeshow et al.[4] – a mathematical model designed for critical patients, but which has also been applied to less seriously ill subjects. However, the MPM-II has not been specifically validated in CAP patients. In fact, some studies that have evaluated severity in pneumonia patients with non-specific models have used the modified construct Acute Physiology and Chronic Health Evaluation-II or the Simplified Acute Physiology Score[5,6]. To date, agreement has been lacking as to which is the best model for use in CAP[5]. This is probably due to the absence of randomised clinical trials comparing the different models[7]. In addition, some experts consider that the high frequency of CAP may complicate the application of these specific severity models, and that application of the more general models possibly might facilitate routine clinical practice[5]. The above considerations point to the need to determine which of the existing models is able to more precisely predict mortality risk in CAP patients in our hospital setting.

The present study was therefore designed to compare two specific models and a general predictive model in application to CAP. Specifically, we aimed to predict 30-day mortality among patients hospitalised due to CAP using the PSI, the CURB-65 and the MPM-II.

MATERIAL AND METHODS

The study was carried out in a tertiary hospital with 450 beds – including 18 for critical patients – that serves as reference centre for approximately 300,000 inhabitants.

Study design. A prospective observational study was carried out involving the consecutive inclusion of all patients with a confirmed diagnosis of CAP during the year 2009.

The following patients were excluded from the study: paediatric patients (under 18 years of age), immunosuppressed subjects (those with acquired immunodeficiency syndrome or patients receiving chemotherapy), and patients directly admitted ICU. Patients with clinical confirmation of an alternative diagnosis other than pneumonia were also excluded from the study.

In addition, with the purpose of homogenising the patient sample, the administration of an antibiotic treatment different from that protocolized in our centre (a third generation cephalosporin associated to a macrolide drug) was also a exclusion criteria. The diagnosis of CAP was based on the presence of respiratory signs and symptoms (dry or productive cough, pleural pain, and/or dyspnea), fever, auscultatory findings of abnormal breath sounds and crackles, together with the identification of an infiltrate on the chest X-ray.

Study data. For all enrolled patients, baseline demographic information was collected (age, sex, gender, home residence, smoking and alcohol abuse). The clinical data upon admission were also recorded: signs and symptoms of CAP (temperature, respiratory rate (RR), auscultatory findings, pleural pain, hemoptysis), number of days with respiratory symptoms prior to admission, pulse, systolic and diastolic pressure, mental status and comorbid conditions. Laboratory test data (gasometric, haematological, biochemical and microbiological parameters) and radiographic results (pleural effusion and monolobar or plurilobar pulmonary involvement) were also collected.

All patients were stratified according to their severity status at admission based on the three above-mentioned prognostic models (PSI, CURB-65 and MPM-II). Finally, clinical outcomes were also registered: length of hospital stay (LOS), admission to the ICU, time to clinical stability, time to fever normalisation, time of oxygen therapy, duration of antibiotic treatment, hospital readmission and mortality (30-day mortality and hospital mortality, globally and according to the severity classes of the different rules).

Clinical stability was evaluated considering a heart rate <100 beats/min, respiratory rate < 24 breaths/min, temperature < 37.8 ºC, systolic blood pressure >90 mmHg, pulse oximetry > 90%, normal or baseline mental status and oral intake-tolerating adequately. A hospital readmission was considered when a new admission occurred within 30 days after CAP discharge. For all physical examination, clinical, laboratory and radiographic findings the first available measurement after the time of presentation in the emergency department was registered.

Statistical analysis. Descriptive statistics of demographic and clinical variables include absolute and relative frequencies for categorical variables; means and confidence intervals (95%CI) for continuous quantitative variables, and medians and ranges for ordinal quantitative variables. The comparison of continuous variables was performed by using the Student t-test for those with a normal distribution and using the nonparametric Mann-Whitney U test when normality could not be assumed. For dichotomous variables, the chi-square and the Fisher exact test were applied. To compare the overall discriminatory power of the three models the areas under each receiver operating characteristic curves (AUC of ROC curve) were calculated. Values of AUC higher than 0.8 were considered as good, between 0.6-0.8 as acceptable or moderate, and lower than 0.6 as poor. AUCs of the three models were compared pairwise using the contrasts on the basis of a non-parametric Mann-Whitney U test. To determine the accuracy of the models to predict 30-day mortality sensitivity, specificity, negative (NPP) and positive predictive (VPP) values, and positive likelihood ratio (LR+) were estimated. Model's calibration was estimated through the Goodness-of-fit test. Observed and predicted mortality was compared by a chi-square test (Hosmer Lemeshow chi-square statistic). For all analyses, a 2-sided p value <0.05 was considered to be statistically significant. The SPSS (Statistical Package for the Social Sciences) version 13.0 statistical package was used throughout.

RESULTS

General patient characteristics. During the screening period, a total of 222 patients with suspected CAP were admitted, of which 152 (68.5%) were finally included in the study. The excluded patients were 26 (37.1%) immunocompromised (oncohaematological cases and HIV infection), 20 (28.6%) with a suspected CAP not further confirmed, 16 (22.9%) treated with an antibiotic different from that protocolized and 8 (11.4%) directly admitted to the ICU unit. Table 1 shows the patient characteristics, management and outcomes of all patients included in the study. The general profile corresponded to a patient with a mean age of 70 years, a history of smoking, and the presence of at least one comorbid condition.

Estimation of severity according to the PSI, CURB-65 and MPM-II models. Table 2 shows the patient distribution in the different risk groups according to the PSI and CURB-65 models. According to the PSI, 25% were classified as presenting low risk (classes I, II and III), and 75% high risk (classes IV and V). In turn, the CURB-65 classified 30.9% of the cases as not severe (classes 0 and 1) and 61.2% as severe (classes 2, 3, 4 and 5). According to the MPM-II, the mean score for all the patients was -2.1974 (95%CI: -2.404-1.991).

Comparison of mortality rate. The overall hospital mortality rate was 13.2% (20 patients). However, only two deaths (1.3%) occurred after 30 days of admission (days 65 and 70); as a result, the 30-day mortality rate was 11.8%. Table 2 classifies the 30-day mortality rates according to the PSI and CURB-65 severity classes.

Both rules specific for CAP (PSI and CURB-65) revealed the same statistically significant trend of increasing mortality with worsening risk groups. In addition, the observed mortality rate was higher among the subjects classified by the PSI and CURB-65 as high risk with respect to those considered as low risk.

In parallel, and according to the accepted definitions of low and high risk CAP of the PSI and CURB-65 models[8,9], the mortality rate in patients identified as low risk by the PSI (2.6%) was lower than in those patients considered as low risk by the CURB-65 (4.3%). In contrast, the mortality rate in patients classified as high risk by the CURB-65 (15.2%) was slightly higher than in patients classified as high risk by the PSI (14.9%).

Regarding the MPM-II model, the predicted mean mortality rate was 10% (95%CI: 12.7-18.3), which was slightly lower than the overall mortality of the study series, but close to that observed after 30 days of hospital admission.

Comparison of the discriminatory power. Figure 1 shows the ROC curves of the three models in predicting 30-day mortality. The resulting AUC values were 0.713 (95%CI: 0.592-0.835) for the PSI, 0.744 (95%CI: 0.616-0.871) for the CURB-65, and 0.653 (95%CI: 0.540-0.766) for the MPM-II. All models obtained statistically significant AUCs and with acceptable and similar values.

Comparison of the AUCs not revealed significant differences between them. However, it could be suggested that the simple CURB-65 would offer the best discriminatory power, since their lower limit of its 95%CI of the AUC lies farthest from the value 0.5.

Sensitivity, specificity, PPV and NPV. In the PSI model, the sensitivity and specificity were most favourable for the cut-off point of values < V versus V (0.611 and 0.694, respectively). For this point, the LR+ was 1.860, the PPV of 21.1% and the NPV of 93%. Though the sensitivity increased to 0.944 when PSI ≥ IV was chosen as the cut-off, there was an unfavourable drop in the specificity (0.269).

Considering the cut-off point proposed by Fine et al., defining low risk CAP as corresponding to PSI classes I-III and high risk as corresponding to classes IV and V[8], higher sensitivity was obtained (0.944), while specificity (0.269) and LR+ (1.304) were considerably lower. In the CURB-65 model, the cut-off point of highest sensitivity (0.722) and specificity (0.657) corresponded to values of 0,1 and 2 versus values > 2. For this point, the LR+ was 2.104, the PPV of 22% and the NPV of 94.6%. In the same way that the PSI, though the sensitivity increased to 0.889 when CURB-65 > 2 was chosen as the cut-off, there was an unfavourable drop in the specificity (0.336).

After considering the cut-off point established by Lim et al., classifying patients as being at low (CURB-65 classes

Table 1 Patient characteristic, management and outcomes.

Gender (Male / Female)	105/47
Age (years)	73.0 (70.6-75.4)
Nursing home resident	15 (10.3%)
Previous hospital admission	22 (14.5%)
Readmission	29 (19.1%)
Smokers	85 (63.4%)
History of alcohol abuse	42 (31.1%)
Comorbid conditions	38 (25.0%)
Patients with more than one comorbid condition	114 (75.0%)
Cardiovascular	73(48.0%)
COPD or asthma	62 (40.8%)
Diabetes mellitus	32 (21.1%)
Renal disease	36 (23.7%)
Neurological disease	32 (21.1%)
Hepatobiliary disease	15 (9.9%)
Clinical findings	
Length of previous respiratory symptoms (days)	8 (6.4-9.6)
Involvement of more than one lobe	48/123 (39.0%)
Cough and/or expectoration	119 (78.3%)
Dyspnea	108 (71.1%)
Pleural effusion	34 (22.4%)
Mental confusion.	29/135 (21.5%)
Temperature (°C)	37.5 (37.3-37.7)
Basal oxygen saturation (%)	88.6 (87.4-89.8)
Respiratory rate	28.3 (26.9-29.8)
Heart rate	98.3 (94.6-102.0)
Systolic blood pressure	132.8 (127.7-137.9)
Diastolic blood pressure	69.4 (66.9-72.0)
Altered mental status	29 (19.1%)
Clinical outcomes	
Length of hospital stay (days)	13.0 (11.6-14.4)
ICU admission	3 (2.0%)
Time to clinical stability (days)	5.9 (4.8-10.4)
Days of oxygen therapy	8.9 (8.0-9.8)
Time to temperature normalisation	2.8 (2.3-3.3)
Total days of antibiotic treatment	11.6 (9.8-12.8)
30-day mortality	18 (11.8%)
Hospital mortality	20 (13.2%)

*Data expressed as the mean and 95%CI or as frequency (%). The denominator corresponds to the number of patients with the variable registered.

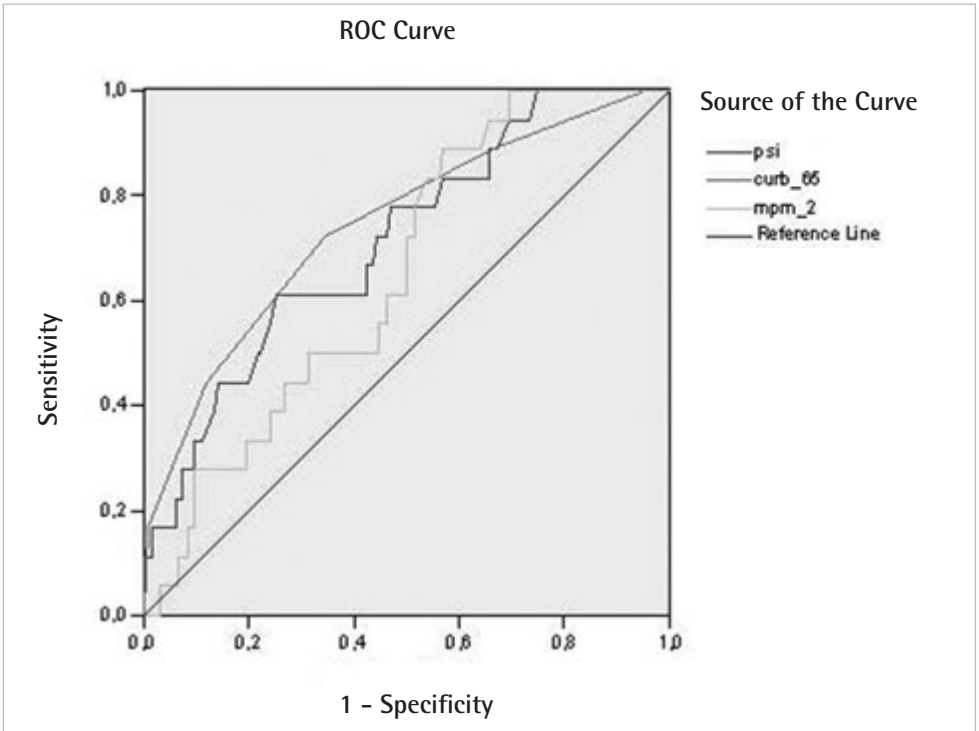

Figure 1 | **ROC curves of the PSI, CURB-65 and MPM-II models in predicting 30-day hospital mortality.**

0 and 1) or high risk (CURB-65 classes 2, 3, 4 and 5)[3,9], a higher sensitivity was obtained (0.889), though specificity (0.336) and LR+ were lower (1.339). Lastly, in the MPM-II model, the cut-off point of greatest sensitivity (0.722), specificity (0.500) and LR+ (1.444) corresponded to a value of ≤ – 2.6960 versus higher values. The predicted mortality rate for this value was 6.32%, which is considerably lower than the observed mortality.

After comparing the three models, the LR+ of CURB-65 was found to be slightly greater than that of the PSI and far greater than that of the MPM-II model.

Calibration and Goodness-of-fit of the models. The evaluation of the goodness-of-fit for the rules was: chi-square value of 2.926, with 3 degrees of freedom (df) (p=0.711) for the PSI and chi-square 2.810, 3 df, (p=0.729) for CURB-65. Both models showed good calibration as reflects the lack of significance that evidences the absence of differences between the observed and predicted mortality rates. In turn, the MPM-II obtained a chi-square value of 1.610, 8df, (p=0.999).

Calibration curves of the PSI, CURB-65 and MPM-II are shown in figures 2, 3 and 4, comparing predicted and observed proportions of mortality.

Despite all three models showed good calibration (p values less than 0.05) but the calibration seemed to be better for the CURB-65 compared to PSI and MPM-II.

Table 2 | **Patients' classification according to the PSI, CURB-65 and MPM-II models, and 30-day mortality.**

	Total patients	30-day mortality	p
PSI class			
I	7 (4.6%)	0 (0%)	0.017
II	3 (2.0%)	0 (0%)	
III	28 (18.4%)	1 (3.6%)	
IV	62 (40.8%)	6 (9.7%)	
V	52 (34.2%)	11 (21.2%)	
CURB-65 class			
0	6 (3.9%)	0 (0%)	< 0.001
1	41 (27%)	2 (4.9%)	
2	46 (30.3%)	3 (6.5%)	
3	35 (23.0%)	5 (14.3%)	
4	20 (13.2%)	5 (25.0%)	
5	4 (2.6%)	3 (75.0%)	

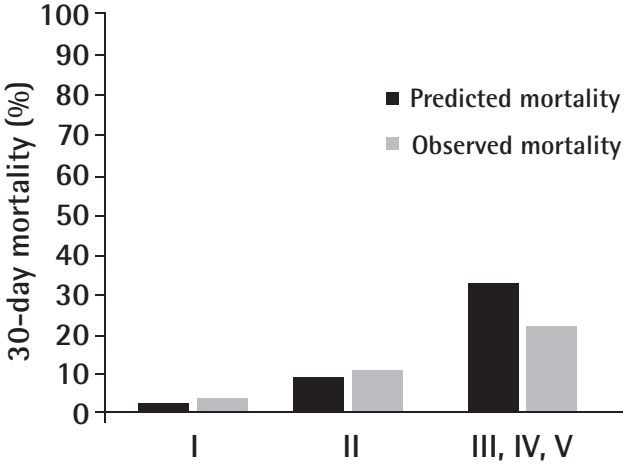

Figure 2 Observed and predicted mortality by the PSI.

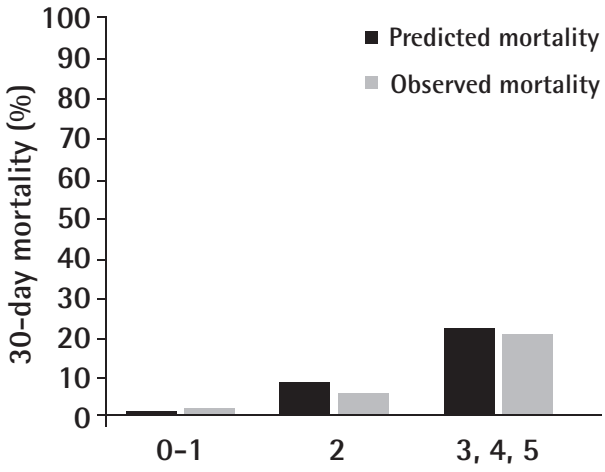

Figure 3 Observed and predicted mortality by the CURB-65.

DISCUSSION

Prediction rules may be useful tools for clinical decision making. Our results showed an acceptable performance for predicting 30-day mortality for PSI, CURB-65 and MPM-II. The three scores predicted well the 30-day mortality, as it can be concluded by the similar values of the AUCs of their respective ROC curves. CURB-65 also presented slightly higher values of predictive (PPV and NPV) values and LR+, what would suggest a better ability of this tool to discriminate between deaths and survivors.

Despite all three models obtained good calibration in a population of patients with CAP admitted to our hospital (p values less than 0.05), the calibration seemed to be better for the CURB-65 compared to PSI and MPM-II.

Additionally, both models showed a significant correlation to mortality rate, with higher values in the more severe classes. However, the mortality rate in patients classified as high-risk patients by the CURB-65 was slightly higher than in patients classified as high risk by the PSI. With respect to sensitivity, specificity and predictive values, all compared rules obtain good and comparable sensitivity and NPV but specificity and PPV are less impressive. However, the LR+ seems to be better for the CURB-65. According to these results, the CURB-65 present a comparable accuracy to predict 30-day mortality in patients with CAP admitted to our hospital than the PSI and MPM-II, which are much more complex and difficult to be routinely applied.

In conclusion, this study confirms the ability of the CURB-65 to predict 30-day mortality from hospitalised CAP patients and, in our opinion, this model should be preferred because of its higher availability. In fact, the CURB-65 is an example of a simple and useful tool in the risk stratification of hospitalised patients that not requires biochemical, clinical or inmunological data difficult to obtain because it only includes four bedside and one laboratory criteria.

As regards which predictive model is best, the studies published to date offer contradictory results[6,9-14]. However, it must be taken into account that in some of these studies the PSI was compared with preliminary models such as the BTS, the modified BTS or the CURB, which served as the basis for posterior designing of the CURB-65. Table 3 summarises the most important studies comparing different models for predicting mortality in CAP patients. As can be seen, some of these studies coincide with our own findings in considering that the CURB-65 offers a predictive capacity comparable or superior to that of the PSI – and thus constitutes a good alternative to the PSI[10-12,21,23]. Of particular note are the studies published by Capelastegui et al. and Yan Man et al., due to the important number of patients involved. However, in the same way as in our study, these authors reported overlapping of the AUCs of the ROC curves of both models. In contrast, other authors have found the PSI to be superior to the new CURB-65[9,14,18-20,24]. In this sense, it should be noted that although Aujesky et al. included a large number of patients in their study, the proportion of high risk subjects was only 6% - a fact that may have influenced the superior predictive capacity obtained by the PSI. In turn, in the study published by Ward et al., the sample size was quite limited, and this likewise may have affected the results obtained.

The controversy and difficulty of choice between these two models is also evidenced by the fact that both have been included in the clinical guidelines on CAP of the Infectious Diseases Society of America (IDSA) and the American Thoracic Society (ATS) 2007. These societies consider both models to be useful in identifying CAP patients susceptible to outpatient management (level I evidence)[7]. However, they preferentially recommend the CURB-65 for identifying high risk cases, in view of its easy application, and reserve the PSI only for those situations in which sufficient resources are available[21]. In any case, neither Society specifies which model is best, due to the lack of randomised clinical trials with other

alternative hospitalisation criteria[7]. Lastly, the current guidelines of the *Sociedad Española de Neumología y Cirugía Torácica* (SEPAR) consider that on the basis of the information available to date, neither of these rules offers unquestionable predictive values. The SEPAR thus recommends that the clinical criteria of the physician, with the individualisation of each case, should prevail in deciding hospital admission[1]. Nevertheless, the mentioned guidelines do consider the PSI to be better in identifying patients with a low mortality risk, while the CURB-65 is taken to be superior in identifying high risk cases. In fact, the PSI model was initially designed to identify low risk subjects susceptible to outpatient treatment, while the CURB-65 was created to identify high-risk patients[9]. Some authors, such as Niederman, consider it advisable to use both models as complementary constructs, since they allow the identification of patients at opposite extremes of the severity scale[25]. However, it is evident that both models have certain limitations. The PSI places much importance on factors such as patient age and comorbidities, but does not directly measure the intrinsic severity of CAP. In addition, it may underestimate severity in young individuals and does not take into consideration social factors that could advise patient admission[1,2,26,27]. For this reason some investigators have suggested the inclusion of certain additional factors in the model, with a view to improving its reliability in predicting the need for hospital admission[28]. In contrast, the CURB-65, which is ideal for identifying cases of high mortality risk, does not take into account the presence of comorbidities[25]. Consequently, its application would pose limitations in elderly patients, in which the mortality risk is dependent not only on the severity of CAP as such but also on the possible destabilisation of other concomitant chronic illnesses[25,27].

To date, very few studies have compared the predictive capacity of general prognostic models such as the MPM-II versus CAP-specific predictive rules. More specifically, we believe that this is the first study to compare the PSI and the CURB-65 with respect to the MPM-II general predictive model. However, the few existing studies have likewise reported better results with the CAP-specific models than with the general constructs[5,6,29]. This may be due to the fact that the latter (including the MPM-II) mainly have been designed for application in critically ill patients. According to our results, the MPM-II should not be used in preference to CURB-65 between CAP patients. Even though this general model obtained a similar performance for predicting mortality than the CURB-65, its clinical use would offer no advantages. Firstly, it requires a higher number of variables in comparison to CURB-65. Secondly, it does not allow a stratification of mortality or an identification of a low risk group of patients susceptible to be treated as outpatients.

The main limitation of our study may result from the exclusion of patients directly admitted to the ICU, since they have precisely the highest mortality rates. The exclusion of those patients was decided on the basis of the IDSA recommendations[7], which define as ICU admission criteria a series of complementary variables not compatible with those contemplated in the three predictive models investigated in our study. In addition, the empirical CAP treatment protocol used in the ICU patients includes antibiotics different from those recommended for the treatment of CAP not requiring admission in this unit –this being another exclusion criterion.

Likewise, it must be considered that we excluded non-critical patients treated with an antibiotic regimen different from the protocolized in our hospital, even though such subjects constituted a minority. These limitations are the result of having sought the greatest possible homogeneity in the patient sample included in the study. The exclusion of the mentioned patient groups aimed to ensure maximum sample homogeneity in order to eliminate the influence of confounding factors such as the type of antibiotic treatment in the evaluation of these prognostic models –thereby increasing the robustness of the data obtained. In fact, most studies that have evaluated the prognostic capacity of these models have not considered the influence of certain factors related to deficient clinical practice such as for example the prescription of inadequate antibiotic treatment, and have included patients receiving a broad range of antibiotic agents. This situation may have exerted a considerable influence upon the predicted variables and could cause us to question the results obtained[5]. It would be interesting for future studies to analyse the possible influence of antibiotic treatment in the validation of the different prognostic models.

In addition, the relatively few patients included in the study may have led the PSI and CURB-65 models to yield AUCs lower than those recorded in earlier studies, affecting the overlap of their corresponding 95%CI. Although several studies have involved a similar number of patients[14,18,24], it is clearly advisable for future research to include larger sample sizes in order to increase the robustness of the obtained results.

In conclusion, these results suggest that the CURB-65 obtain an acceptable and similar performance for predicting 30-day mortality in hospitalised CAP patients than the more complex PSI and MPM-II, what provides additional support for the use of simples scores in the emergency departments. Consequently, this rule should be preferred because of its higher availability in our overcrowded emergency departments. In any case, consideration is required of the clinical heterogeneity of CAP, which makes it difficult for any single prognostic rule to be able to adequately classify all patients. On the other hand, usually the ability of these models is acceptable to predict mortality for a patient group as a whole, but they have limitations in establishing individual predictions. Moreover, some studies have revealed that prognostic rules application does not result in lowered health-care costs[30]. Therefore, prognostic models should be viewed as useful tools in the decision taking process, always in combination with many other factors pertaining to the clinical setting[5].

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