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COMPARISON OF THREE SEVERITY SCORING MODELS FOR MORTALITY PREDICTION OF COMMUNITY-ACQUIRED PNEUMONIA

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ABSTRACT
Introduction: Community-acquired pneumonia (CAP) is among the leading cause of morbidity and mortality worldwide. Several scoring models have been developed to accurately asses a disease severity and early to predict the outcome, however an optimal prognostic tool still is not clearly defined. The aim of this study was to compare three commonly used scores in patients with CAP, in order to determine the best tool that will early identify those with increased risk for mortality. **Methods:** The study included 129 patients aged ≥18 years with CAP hospitalized at the intensive care unit (ICU) at the University Clinic for Infectious Diseases in Skopje, during a 3-year period. Demographic, clinical and biochemical parameters were recorded and three scores were calculated at admission: SOFA (Sequential Organ Failure Assessment Score), SAPS II (Simplified Acute Physiology Score) and APACHE II (Acute Physiology and Chronic Health Evaluation II). Primary outcome was 30-day in-hospital mortality. Receiver Operating Curve (ROC) analysis was performed and areas under the curve (AUC) were compared to evaluate mortality prediction capacities of the scores. **Results**: The mean age of the patients was 61 year, predominantly were males (66,7%), most (79,1%) had co-morbid condition and Charlson Comorbidity index was significantly increased in non-survivors. An overall mortality was 43.4%. All severity scores had higher values in patients who died, that was statistically significant with the outcome. The AUC values of the scores were 0,749 for SOFA, 0.749 for SAPS II and 0.714 for APACHE II, showing similar prediction ability. **Conclusion**. Commonly used severity scoring models accurately identified patients with CAP that had an increased risk for poor outcome, but none of them showed to be superior over the others in ability to predict the mortality.

Key words: community-acquired pneumonia, severity scores, mortality

INTRODUCTION
Community-acquired pneumonia is one of the most common, potentially fatal infectious disease and one of the leading cause for hospitalization, health care costs and death worldwide. Approximately 20 % cases are admitted to hospital and 8-36 % require treatment in ICU due to disease severity [1,2]. An accurate assessment of disease severity and early prediction of poor outcome is of crucial importance for successful management [3,4]. Therefore, several severity scoring models were developed to guide the clinical decision on the site of care upon the diagnosis and to assess the prognosis of community acquired pneumonia. Frequently used mortality prediction tools in ICU are SAPS II (Simplified Acute Physiology Score) [5], SOFA (Sequential Organ Failure Assessment score) [6], APACHE II (Acute Physiology and Chronic Health Evaluation II) [7] and MPM (Mortality Prediction Model) [8].
The aim of this study was to compare three commonly used severity scoring models in patients with community-acquired pneumonia, in order to define the best tool that will early identify those with increased risk for lethal outcome.

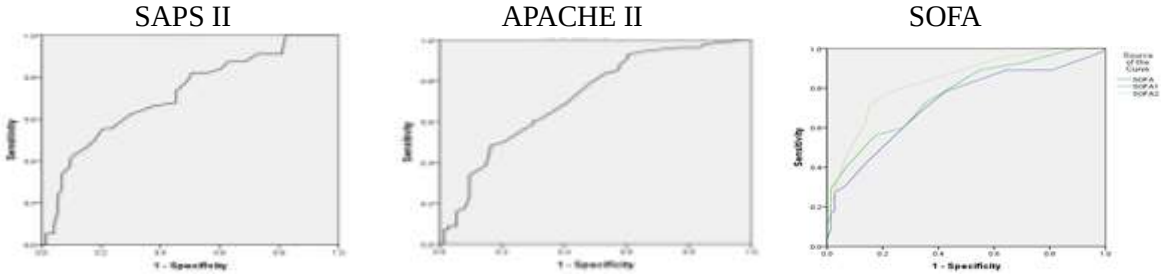
MATERIAL AND METHODS
The study included 129 patients aged ≥18 years with CAP consecutively admitted at the ICU of University Clinic for Infectious Diseases in Skopje, North Macedonia. It was observational and group comparison study that took place from January 2017 to December 2019. Pneumonia was

defined in accordance with IDSA/ATS guidelines. Outcome was defined as survival or death during the 30 days of hospital treatment. Patients were divided into two groups according to the outcome: survivors and non-survivors. In all, demographic, clinical and biochemical parameters were recorded. Charlson Comorbidity Index was calculated to predict the 10-year survival. Three mortality prediction scores were calculated in the first 24 hours of admission: SOFA, SAPS II and APACHE II. All laboratory tests were performed by standard methods in the biochemical laboratory at the hospital. Patients received standard treatment in accordance with the national guideline for pneumonia. Statistical analysis was performed with SPSS 23.0 software. Multivariate analysis using stepwise logistic regression was conducted for all variables that were found to have a P value ≤0.1 on univariate analysis. To assess the predictive values a ROC analysis was performed and AUCs were calculated for each score. $P<0.05$ was considered as significant.

RESULTS

A total of 129 patients were enrolled in the study. The mean age was 61.07 ± 16.36 years and 66.7% were males. The overall 30-day mortality rate was 43.4 %. Most (79.1%) had one or more comorbid condition and Charlson Comorbidity Index was higher in non-survivors that showed significant association with the outcome. The baseline characteristics, clinical findings and biochemical parameters are presented in Table 1. The mean values of analyzed severity scoring models are shown in Table 2. All significantly differ between the groups, i.e. the deceased patients had higher values of every score. Results from ROC analysis are presented on Figure 1 and Table 3, showing that all scores had similar values of AUC (0,749 for SOFA and SAPS II, 0,714 for APACHE II) presenting that they all have strong ability to predict the mortality in patients with CAP.

Figure 1. ROC curves and areas under the curve of analyzed severity indexes



DISCUSSION

The key finding of our study was that the tested scores adequately identified the patients who had high risk for poor outcome, they all have similar predictive capacity, but none of them showed to be superior over the others in mortality prediction. A overall mortality of 43,4% is high but still within the range of published data [9,10]. Charlson comorbidity index, was higher in non-survivors and was associated with the poor outcome, that corresponds with other studies [11]. SAPS II, SOFA, and APACHE II proved to have a significant association with the mortality and were identified as independent outcome predictors. ROC analysis found similar values of AUC as follows: 0.749 for SAPS II and for SOFA and 0.714 for APACHE II. This finding corresponds with the literature data that confirm the similarity between these models in their ability to predict the mortality [12,13,14].

Table 1. Demographic, clinical and biochemical characteristics of study population

Parameter	All n=129	Survivors n=73	Non-survivors n=56	*P-value*
Age (years)	61.07±16.36	60.47±15.36	61.86± 7.70	0.634

Male Female	86 (66.7) 43 (33.3)	53 (72.6) 20 (27.4)	33 (58.9) 23 (41.1)	0.132
Charlson Comorbidity Index	3.49±2.85	3.01±2.21	4.11±3.43	**0.030**
Body temperature	37.7 ± 0.94	37.80 ± 0.94	37.57 ± 0.95	0.170
Heart Rate	109.15 ± 22.93	106.01 ± 21.63	113.23± 24.18	0.771
Respiratory Rate	31.74 ± 8.69	31.71 ± 9.60	31.77 ± 7.41	0.971
Mean Arterial Pressure	84.19 ± 21.78	89.31 ± 21.41	77.51±20.59	**0.002**
Leucocyte count, $x10^9$/L	13.88 ± 11.71	14.00 ± 12.67	13.73 ±10.45	0.891
Haemoglobin, g/L	124.83 ± 23.68	128.23 ± 23.24	120.39 ± 23.73	0.063
Platelets, $x10^9$/L	223.50 ± 125.80	244.84 ±140.06	195.68 ± 98.79	**0.021**
Serum glucose, mmol/L	9.68 ± 4.95	9.17 ± 4.16	10.35 ± 5.79	0.188
Blood urea, mmol/L	11.96 ± 8.61	10.99 ± 8.22	13.23 ± 9.01	0.143
Alanin-aminotransferase, U/L	61.74 ± 72.61	65.93 ± 76.75	56.39 ± 67.27	0.471
Asparat-aminotransferase, U/L	73.18 ± 95.14	76.20 ± 103.73	69.31 ± 83.69	0.693
C-reactive protein, mg/L	222.67 ± 161.48	234.71 ± 166.59	206.69 ± 154.49	0.335
pH	7.38 ± 0.12	7.41 ± 0.98	7.36 ± 0.13	**0.035**
pO_2, kPa	58.80 ± 16.37	58.97 ± 13.88	58.59 ± 19.14	0.892
Lactates, mmol/L	2.72 ± 2.41	2.22 ± 1.30	3.34 ± 3.21	**0.010**
Oxygen saturation (%)	86.59 ± 9.36	88.36 ± 7.37	84.41 ± 11.03	**0.018**

Table 2. Severity scoring models in study population, stratified by the outcome

Score	All n=129	Survivors n=73	Non-survivors n=56	*P-value*
SAPS II	27.48 ± 21.89	20.69 ± 18.93	36.33 ± 22.47	**<0.001**
SOFA	5.90 ± 3.37	4.70 ± 2.44	7.46 ± 3.78	**<0.001**
APACHE II	34.12 ± 19.72	28.08 ± 18.16	41.99 ± 19.02	**<0.001**

Table 3. Areas under the curves for analysed severity indexes

				95% Confidence Interval	
Severity index	**Area**	**Std. Error**	**Asymptotic Sig.**	Lower Bound	Upper Bound
APACHE II	**.714**	.055	.001	.607	.821
SOFA	**.749**	.055	.000	.642	.857
SAPS II	**.749**	.053	.000	.645	.853

CONCLUSION

The results of this study showed that SOFA, SAPS II and APACHE II scores can accurately identify patients with pneumonia that have an increased risk for lethal outcome, all have strong mortality prediction ability, but none of them demonstrated an advantage over the others.

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