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Comparison of pneumonia severity scores for patients diagnosed with pneumonia in emergency department

Aynur Ecevit Kaya[1], Seda Ozkan[2], Eren Usul[3] & Engin Deniz Arslan[4]

[1]Department of Emergency Medicine, Bursa City Hospital, Bursa, [2]Department of Emergency Medicine, Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Istanbul, [3]Department of Emergency Medicine, Sincan State Hospital, Ankara & [4]Department of Emergency Medicine, Antalya Training & Research Hospital, Antalya, Turkey

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***Background & objectives*: Sepsis due to pneumonia or pneumonia itself is one of the main causes of deaths in patients despite the advanced treatment methods. The optimal prognostic tool in pneumonia is still not clear. This study was aimed to compare the pneumonia severity scores and the possibility of using the new scores in patients who were diagnosed with pneumonia in the emergency department.**

***Methods*: Demographic data, laboratory and imaging results, confusion, elevated blood urea nitrogen, respiratory rate and blood pressure plus age ≥65 yr (CURB-65), pneumonia severity index (PSI), national early warning score (NEWS), NEWS-lactate (NEWS-L) scores, hospitalization, referral, discharge and 30-day mortality of patients who were diagnosed with pneumonia in emergency department were recorded.**

***Results*: A total of 250 patients were included in the study. The most successful score in predicted mortality was found to be NEWS-L. This was followed by NEWS, CURB-65 and PSI, respectively. Most successful scores in anticipation of admission to the intensive care unit were NEWS-L followed by NEWS. This was followed by CURB-65 and PSI scores, respectively. The most successful score in anticipation of hospital admission was NEWS-L, followed by NEWS, CURB-65 and PSI, respectively. There was a significant difference between all pneumonia severity scores of the patients who died and survived within 30 days. There was a significant difference between the scores of patients in intensive care unit (ICU) and service, compared to non-ICU patients.**

***Interpretation & conclusions*: NEWS-L score was found to be the most successful score in predicting mortality, ICU admission and hospitalization requirement. Both NEWS-L and NEWS scores can be used in determining the mortality, need for hospitalization and intensive care of the patients with pneumonia in the emergency department.**

Key words Emergency department - hospitalization - mortality - pneumonia - pneumonia severity scores - prognosis

Pneumonia is responsible for a significant proportion of hospital admissions, treatment costs, loss of work and school days and deaths[1-3]. Various scores have been sought to determine the relationship

between the clincial findings and the laboratory tests of the patients with the severity of pneumonia and thus predict the need for hospitalization, admission into intensive care and/or mortality[4,5]. Confusion, elevated blood urea nitrogen, respiratory rate and blood pressure plus age ≥65 yr (CURB-65) and pneumonia severity index (PSI) scores are the most commonly used scores[6,7]. PSI score assesses hospitalization and mortality by evaluating the patient's demographic information, clinical findings, laboratory findings and co-morbid illnesses and categorizes the patient in a risk group of 1-5[5]. CURB-65 evaluates the patients' consciousness, blood urea level, systolic blood pressure, respiratory rate and age[6]. Studies[3-8] comparing PSI and CURB-65 have shown that short-term mortality is more consistently determined by PSI. However, PSI is not as easy to calculate as CURB-65 and its variables are different[8].

National early warning score (NEWS) is a relatively new score that includes systolic blood pressure, respiratory rate, heart rate, fever, consciousness and oxygen saturation level[9]. NEWS-lactate (NEWS-L) is another scoring system, in which the data of the NEWS score and the lactate level are evaluated together[9]. The purpose of establishing these two scores was to determine the clinical prognosis in a practical way. Better results were obtained with these two scoring systems, which included vital signs[10].

The number of studies comparing NEWS and NEWS-L with other scores is limited. This study was aimed to compare pneumonia severity scores in patients who were diagnosed with pneumonia in the emergency department and to investigate the utility of new scores.

Material & Methods

This study was carried out at the Emergency department of Ankara Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara, Turkey. The study was approved by the local ethical committee and written informed consent was obtained from each participant. All consecutive patients over 18 years of age who were diagnosed with community-acquired pneumonia between October 1, 2015 and May 1, 2016 were included in this study. The minimum sample size required in this study was 234.

Patients with new or worsening of pre-existing infiltration in the chest X-ray and at least two of the symptoms associated with pneumonia (cough, sputum, dyspnoea and pleuritic chest pain) with significant laboratory findings were included. Those with hospital-acquired pneumonia, aspiration pneumonia, pulmonary tuberculosis, pulmonary oedema, and pulmonary thromboembolism were excluded. During the study period, 314 patients diagnosed with pneumonia were recruited. Thirteen patients with hospital-acquired pneumonia and 29 patients with aspiration pneumonia were excluded from the study. A total of 272 patients who met the criteria were included. Twenty two patients who met the study criteria were lost to follow up. Vital signs, biochemistry, complete haemogram, arterial blood gas values, chest X-ray findings, accompanying diseases, consciousness status, age, gender and treatment of the patients were recorded. CURB-65, PSI, NEWS and NEWS-L scores of the patients were calculated. All variables requiring the calculation of the score systems were obtained from the routine examinations of the patients. Patients who were diagnosed with pneumonia in the emergency department were discharged home, hospitalized into the general ward or admitted into ICU depending on their clinical conditions. The follow up and treatment of patients included in this study were not affected by the risk score calculated. The intensive care admission criteria (threatened airway, respiratory rate ≥40 or ≤8 breaths/min, oxygen saturation <90 per cent on ≥50 per cent, respiratory and cardiac arrests, pulse rate <40 or >140 beats/min, systolic blood pressure <90 mmHg, fall in the level of consciousness, rising arterial carbon dioxide with respiratory acidosis) were used in determining whether intensive care was required. The hospital records and national healthy notification system were used for investigating the outcome at 30 days. Telephone call was made for follow up if no record was found from the above two systems. Calculation of risk scores is shown in Tables I and II.

Statistical analysis: Statistical Package for the Social Sciences (SPSS) programme (IBM SPSS Statistics for Windows, version 17.0, SPSS Inc, Chicago, IL) was used to analyze the obtained information. Kolmogorov-Smirnov test was used in groups with >30 patients in the analysis of normality of the data, and the Shapiro-Wilk test was used in those <30. The Mann-Whitney U-test was used to compare data that did not fit the normal distribution, and the Student's *t* test was used to compare data with a normal distribution.

Med Calc statistic software programme (Med Calc Software, version 15, Mariakerke, Belgium) was used for the analysis of receiver operating characteristic

Table I. NEWS versus NEWS-L used in the present study

Physiologic component	3	2	1	0	1	2	3
SBP (mmHg)	≤90	91-100	101-110	111-219			≥220
PR (beats/min)	≤40		41-50	51-90	91-110	111-130	≥131
RR (breaths/min)	≤8		9-11	12-20			≥25
Body temperature (°C)	≤35		35.1-36	36.1-38	38.1-39	≥39, 1	
SpO_2 (%)	≤91	92-93	94-95	96			
Any supplemental oxygen		Yes		No			
Level of consciousness				Alert			Voice, pain, unresponsive
Laboratory component							
Lactate level	When calculating the NEWS-L score, serum lactate level is added on the score of the NEWS score						
NEWS risk class: Score							
I: 0-4	Low risk						
II: 5-6	Moderate risk						
III: ≥7	High risk						
NEWS-L risk class: Score							
I: 0-3	Low risk						
II: 3.1-5.2	Low risk						
III: 5.3-8.0	Moderate risk						
IV: ≥8.1	High risk						

SBP, systolic blood pressure; PR, pulse rate; RR, respiratory rate, SpO_2, peripheral oxygen saturation; NEWS, national early warning score; NEWS-L, national early warning score-lactate. *Source*: Ref. 4

(ROC) curves to compare the performance of the pneumonia risk scores in predicting mortality, need of admission into hospital and intensive care unit (ICU). The area under the ROC curves (AUC) was calculated. Variables with risk scores were defined if a two-sided *P* value was 0.05 or less; 95 per cent confidence intervals (CIs) were calculated. The method of DeLong *et al*[11] was used to calculate the standard error of the area under the curve. An exact binomial Ci was calculated for the area under the curve. Youden index was used to determine the optimal cut-off value, sensitivity and specificity on a ROC curve (Youden index J is defined as $J=\max(\text{sensitivity}_c+\text{specificity}_c-1)$. The cut-point that achieved this maximum was referred to as the optimal cut-point (c). Correlation tests of normally distributed data were performed by Spearman correlation test.

Results

The study included 250 patients. Mean age was 72.3±14.25 yr and 41.6 (n=104) per cent of the patients were females chronic obstructive pulmonary disease (COPD) was the most common associated (39.2%) comorbid diseases (Table III). Of these, 23.6 per cent (n=59) of the patients were ex-smokers and 6.8 per cent (n=17) were active smokers.

Pleural effusion on chest radiograph was detected in 12.8 per cent (n=32) patients, lobar infiltration was detected in 74.8 per cent (n=187) patients and bilateral infiltration was detected in 20.4 per cent (n=51) patients (Table III). Bronchodilator therapy was started with antibiotics in 246 of the patients in the Emergency department. One hundred and one patients were discharged from emergency services with medical therapy. One hundred and forty nine patients were hospitalized, 69 were admitted to the wards, while 80 patients were admitted to the ICU. Mortality was seen in 27 patients during the 30 days of follow up period.

The mean values of the risk scores in the three outcome groups are shown in Table IV. NEWS-L was the most successful in predicting 30-day mortality with a value of 0.96 AUC (95% CI: 0.928-0.981, cut-off value: 13.7). This was followed by NEWS, CURB-65 and PSI, respectively (Fig. 1 and Table V). Pneumonia severity scores were compared between those who died

Table II. CURB-65 and pneumonia severity ındex

CURB-65	Points
Confusion	1
Blood urea nitrogen >20 mg/dl	1
Respiratory rate >29 breaths per minute	1
SBP <90 mmHg or diastolic blood pressure ≤60 mmHg	1
Age ≥65 yr	1
Score	
0-1: Low risk	Outpatient
2: Moderately severe	Hospitalization required
3-5: Severe pneumonia	Hospitalization required; consider ICU admission
PSI	
Characteristic	Points
Age-men	yr
Age-Women	yr-10
Nursing home resident	10
Comorbidity	
Neoplastic disease	10
Liver disease	20
Congestive heart disease	10
Cerebrovascular disease	10
Renal disease	10
Examination	
Altered mental state	20
Respiratory rate ≥30 breaths per minute	20
SBP <90 mmHg	20
Temperature <35°C or ≥40°C	15
Pulse ≥125	10
Laboratory findings	
Arterial *p*H <7.35	30
Urea ≥30 mg/dl	20
Na <130 mg/dl	20
Glucose ≥250 mg/dl	10
Hct <30%	10
PaO_2 <60 mmHg or SaO_2 (air) <90%	10
Pleural effusion	10
PSI risk class: Score	
I: <50	Outpatient
II: 51-70	Outpatient
III: 71-90	Outpatient or short inpatient
IV: 91-130	Hospitalization required
V: >130	Hospitalization required

PSI, pneumonia severity index; Hct, haematocrit; PaO_2, partial oxygen pressure. *Source*: Ref. 3

Table III. Demographic characteristics, vital signs and laboratory findings of the cases

Parameters	All patients	Survived	Dead	*P*	Hospitalized	Non-hospitalized	*P*	ICU admission	Non-ICU admission	*P*
Age†	76;20	76; 20	77; 18	0.46	78;18	73;19	0.01	78; 16	76; 22	0.02
SBP (mmHg)#	125.1±27.4	127.5±26.2	104.4±30.6	0.001	122.5±28.8	128.7±25.6	0.03	117.4±32.0	128.5±32.2	0.01
DBP (mmHg)#	73.3±15.4	74.9±14.7	60.1±16.1	0.001	72.8±16.1	74.0±14.7	0.52	70.5±17.5	75.4±13.9	0.16
PR (beats/min)#	97.5±22.7	95.42±20.76	114.1±27.8	0.001	97.9±23.2	96.8±21.1	0.81	102.9±26.6	94.9±19.6	0.01
RR (breaths/min)†	22;4	21; 4	27; 12	0.001	22;5	20;2	0.001	24; 6	22;2	0.001
Body temperature (°C)#	37.2±0.8	37.3±0.8	37.2±0.8	0.43	37.3±0.8	37.3±0.8	0.71	37.3±0.8	37.2±0.8	0.50
SpO_2 (%)#	87.1±9.1	88.4±8.0	78.1±12.3	0.001	85.2±10.2	90.3±6.2	0.001	83.2±11.6	83.3±11.6	0.08
AVPU#	1;0.699	1; 1	2; 1	0.001	1;1	1;0	0.001	2; 1	1;0	0.001
Blood urea nitrogen (mg/dl)#	65.5±46.2	61.4±43.4	96.2±56.7	0.001	74.5±47.0	51.4±41.6	0.001	83.9±52.1	63.5±27.7	0.01
Creatinine (mg/dl)#	1.3±0.8	1.3±0.7	1.8±1.1	0.01	1.4±0.8	1.2±0.7	0.09	1.5±0.9	1.2±0.5	0.29
Glucose (mg/dl)#	151.1±69.2	149.9±68.9	164.6±76.6	0.53	155.8±72.8	145.2±64.8	0.17	154.8+71.1	156.9±71.1	0.98
ALT (IU/l)#	39.6±125.4	31.7±48.2	102.4±355.4	0.04	50.7±162.7	22.9±23.5	0.02	61.5±211.8	49.5±119.9	0.02
AST (IU/l)#	47.9±140.0	38.7±73	122±369.5	0.001	62.9±181.3	25.8±16.6	0.001	74.2±220.5	37.9±66.2	0.24
Sodium (mmol/l)#	137±6.5	136.6±6.3	140.2±7.6	0.02	137.4±7.6	136.4±4.6	0.17	138.5±9.0	136.1±5.2	0.06
*p*H#	7.36±0.10	7.37±0.09	7.29±0.12	0.001	7.37±0.11	7.39±0.07	0.001	7.32±0.13	7.37±0.08	0.001
pCO_2 (kPa)#	43.2±17.3	43.3±17.2	43.1±18.9	0.5	45.9±20.7	39.2±9.4	0.01	48.3±25.8	48.3±12.0	0.59
pO_2 (kPa)#	57.8±23.6	58.8±23.6	49.8±23.1	0.01	55.3±24.2	61.5±22.5	0.001	58.5±21.5	54.0±19.3	0.65
HCO_3 (mmol/l)#	24.6±6.1	25.0±6.0	20.4±6.1	0.001	24.7±6.6	24.3±5.3	0.97	23.7±7.1	25.8±6.0	0.05
Lactate (mmol/l)#	2.7±2.0	2.4±1.5	5.2±3.5	0.001	3.0±2.4	2.2±1.2	0.02	3.5±2.8	2.4±1.8	0.001
Base deficit (mmol/l)#	-0.2±5.51	3.7±3.6	5.8±5.3	0.001	4.2±4.0	3.5±3.7	0.05	5.3±4.7	3.0±2.5	0.001
SAT O_2 (%)#	81.7±12.1	82.6±11.3	73.4±15.6	0.001	79.5±12.8	84.6±10.5	0.001	78.8±14.3	80.3±10.9	0.94
WBC (µl)#	12611.4±6630.1	12873.9±6641.4	11301.0±6272.3	0.43	12862.5±6687.4	12461.6±6515.2	0.48	12752±6891.7	12992.5±6487.5	0.96
Haematocrit (%)#	38.7±6.8	38.8±6.5	38.0±8.6	0.42	38.0±6.8	39.8±6.7	0.15	37.6±7.5	38.5±5.9	0.38
Haemoglobin (g/dl)#	12.6±2.2	12.6±2.0	12.3±2.9	0.56	12.4±2.1	12.9±2.1	0.061	12.3±2.3	12.4±1.9	0.6
Comorbidity, n (%)										
COPD pulmonary disease, n (%)	98 (39.2)	91 (92.9)	7 (7.1)	0.13	55 (56.1)	43 (43.9)	0.37	22 (40)	33 (60)	0.01
Hypertension, n (%)	97 (38.8)	86 (88.7)	11 (11.3)	0.83	62 (63.9)	35 (36.1)	0.27	33 (53.2)	29 (46.8)	0.92
Diabetes mellitus, n (%)	61 (24.4)	53 (86.9)	8 (13.1)	0.50	45 (73.8)	16 (26.2)	0.01	18 (40)	27 (60)	0.03
Cardiovascular disease, n (%)	45 (18)	37 (82.2)	8 (17.8)	0.09	28 (62.2)	17 (37.8)	0.69	15 (53.6)	13 (46.4)	0.98

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Parameters	All patients	Survived	Dead	*P*	Hospitalized	Non-hospitalized	*P*	ICU admission	Non-ICU admission	*P*
Congestive heart failure, n (%)	31 (12.4)	27 (87.1)	4 (12.9)	0.76	21 (67.7)	10 (32.3)	0.32	9 (42.9)	12 (57.1)	0.28
Cerebrovascular disease, n (%)	26 (10.4)	22 (84.6)	4 (15.4)	0.43	16 (61.5)	10 (38.5)	0.83	14 (87.5)	2 (12.5)	0.01
Neoplastic disease, n (%)	19 (7.6)	17 (89.5)	2 (10.5)	1.00	11 (57.9)	8 (42.1)	0.9	5 (45.5)	6 (55.5)	0.75
Chronic renal disease, n (%)	15 (6)	12 (80)	3 (20)	0.21	7 (46.7)	8 (53.3)	0.42	7 (100)	0	0.01
Chronic liver disease, n (%)	2 (0.8)	2 (100)	0	1.00	1 (50)	1 (50)	1.00	0	1 (100)	0.46
Ex-smoker, n (%)	59 (23.6)	57 (96.6)	2 (3.4)	0.05	31 (52.5)	28 (47.5)	0.20	10 (32.3)	21 (67.7)	0.01
Current smoker (%)	17 (6.8)	15 (88.2)	2 (11.8)	0.70	13 (76.5)	4 (23.5)	0.20	4 (30.8)	9 (69.2)	0.14
Radiographic findings										
Pleural effusion, n (%)	32 (12.8)	29 (90.6)	3 (9.4)	1.00	27 (84.4)	5 (15.6)	0.00	13 (48.1)	14 (51.9)	0.52
Lobar opacities, n (%)	187 (74.8)	169 (90.4)	18 (9.6)	0.30	110 (58.8)	77 (41.2)	0.66	56 (50.9)	54 (49.1)	0.25
Bilateral opacities, n (%)	51 (20.4)	45 (88.2)	6 (11.8)	0.80	33 (64.7)	18 (35.3)	0.40	21 (63.6)	12 (36.4)	0.19

†Median, IQR; #mean±SD. DBP, diastolic blood pressure; COPD, chronic obstructive pulmonary disease; ALT, alanine transaminase; AST, aspartate transaminase; HCO_3, bicarbonate; AVPU, alert-verbal-pain-unresponsive; SAT O_2, oxygen saturation; pCO_2, partial pressure of carbon dioxide; pO_2, partial pressure of oxygen

and survived within 30 days of follow up. Significant difference was found in all scores (Table IV). There was a significant difference between the other parameters except age, fever, glucose, pCO_2, white blood cell (WBC), haemoglobin (Hb) and haematocrit (Hct) values with regard to 30-day mortality (Table III).

ROC curve analysis was performed for admission to the hospital for pneumonia severity scores. The highest AUC score was for NEWS-L (AUC: 0.72, CI: 0.659-0.774, cut-off value: >7.7), while the highest sensitivity was shown by NEWS (77.1%) and the highest specificity by NEWS-L score (63.4%) (Fig. 2 and Table VI). ROC curve analysis was performed to predict the need for intensive care for all scores. The highest AUC was shown by NEWS (0.86) and NEWS-L (0.86), followed by CURB-65 (0.85). NEWS-L had the highest sensitivity (90%) and CURB-65 had the highest specificity (94.7%) (Fig. 3 and Table VII).

The pneumonia severity scores of the patients admitted to the ICU and ward (non-ICU) were compared, and significant difference was detected among the scores except PSI (Table IV). The pneumonia severity scores of hospitalized patients and patients discharged home were also and a significant difference was observed between all the risk scores (Table IV).

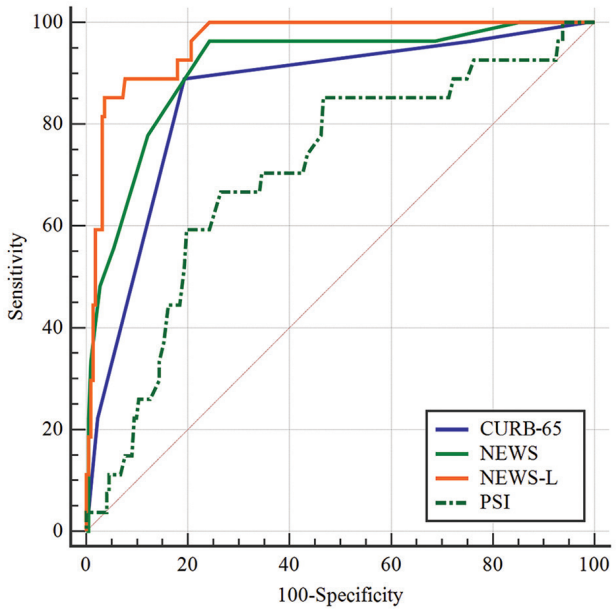

Fig 1. Comparison of pneumonia severity scores receiver operating characteristic curves for 30-day mortality. CURB-65, confusion, elevated blood urea nitrogen, respiratory rate and blood pressure plus age ≥65 yr; NEWS, national early warning score; NEWS-L, national early warning score-lactate; PSI, pneumonia severity index.

Table IV. Distribution of scores according to patient results

Scores	All	Dead (n=27)	Survived (n=223)	*P*	ICU admission (n=80)	Non-ICU admission (n=69)	*P*	Hospitalized (n=149)	Non-hospitalized (n=101)	*P*
CURB-65 (mean±SD)	2.1±0. 8	3.11±0.75	1.96±0.75	0.001	2.81±0, 79	1.76±0.54	0.001	2.32±0.86	1.73±0.63	0.001
Class 1	54 (21.6)	1 (3.7)	53 (23.8)		5 (6.3)	20 (29)		25 (16.8)	29 (28.7)	
Class 2	130 (52)	2 (7.4)	128 (57.4)		18 (22.5)	47 (68.1)		65 (43.6)	65 (64.4)	
Class 3	66 (26.4)	24 (88.9)	42 (18.8)		57 (71.3)	2 (2.9)		59 (39.6)	7 (6.9)	
PSI (mean±SD)	123.5±26.2	139.18±23.18	121.59±25.86	0.001	132.11±23.78	125.37±22.17	0.11	128.99±23.22	115.37±28.23	0.001
Class 1	14 (5.6)	1 (3.7)	13 (5.8)		2 (2.5)	2 (2.9)		4 (2.7)	10 (9.9)	
Class 2	1 (0.4)	-	1 (0.4)		-	1 (1.4)		1 (0.8)	-	
Class 3	16 (6.4)	-	16 (7.6)		5 (6.3)	5 (7.2)		10 (6.7)	6 (5.9)	
Class 4	149 (59.6)	12 (44.4)	137 (61.4)		39 (48.8)	43 (62.3)		82 (55)	67 (66.3)	
Class 5	70 (28)	14 (51.9)	56 (25.1)		34 (42.5)	18 (26.1)		52 (34.9)	18 (17.9)	
NEWS (mean±SD)	5.9±3.1	10.29±2.50	5.38±2, 73	0.001	8.62±2.63	4.85±2.13	0.001	6.87±3.05	4.49±2.61	0.001
Class 1	79 (31.6)	-	79 (35.4)		2 (2.5)	26 (37.7)		28 (18.8)	51 (50, 5)	
Class 2	61 (24.4)	1 (3.7)	60 (26.9)		11 (13.8)	26 (37.7)		37 (24.8)	24 (23.8)	
Class 3	110 (44)	26 (96.3)	84 (37.7)		67 (83.8)	17 (24.6)		84 (56.4)	26 (25.7)	
NEWS-L (mean±SD)	8.6±4.0	15.48±3.34	7.75±3.20	0.001	12.06±3.80	7.31±2.91	0.001	9.86±4.15	6.71±2.92	0.001
Class 1	16 (6.4)	-	16 (7.2)		-	3 (4.3)		3 (2)	13 (12.9)	
Class 2	38 (15.2)	-	38 (17)		-	12 (17.2)		12 (8)	26 (25.7)	
Class 3	61 (24.4)	-	61 (27.4)		8 (10)	27 (39.1)		35 (23.5)	26 (25.7)	
Class 4	135 (54)	27 (100)	108 (48.4)		72 (90)	27 (39.1)		99 (66.4)	36 (35.6)	

Score values shown as n (%)

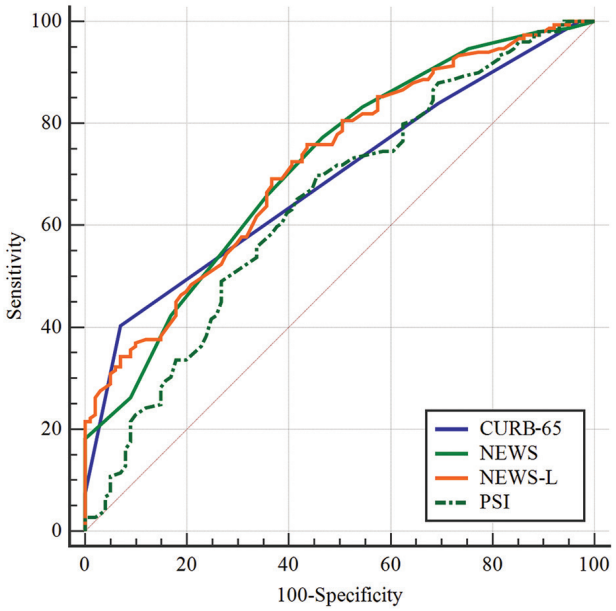

Fig 2. Comparison of pneumonia severity scores receiver operating characteristic curves for hospitalization.

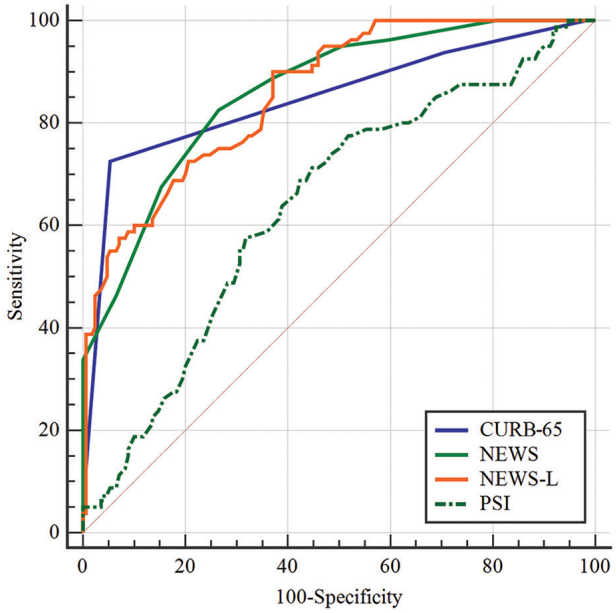

Fig 3. Comparison of pneumonia severity scores receiver operating characteristic curves for intensive care unit needs.

Table V. Receiver operating characteristic analysis for 30-day mortality forecast of pneumonia severity scores

Scores	AUC	SE	95% Cl	Sensitivity (%)	Specificity (%)	Cut-off	Youden index J	*P*
CURB-65	0.86	0.037	0.809-0.899	88.9	80.7	>2	0.6961	<0.001
NEWS	0.91	0.031	0.869-0.943	96.3	75.8	>7	0.7208	<0.001
NEWS-L	0.96	0.014	0.928-0.981	85.1	96.4	>13.7	0.8160	<0.001
PSI	0.71	0.054	0.645-0.762	66.7	73.5	>136	0.4021	<0.001

AUC, area under the curve; SE, standard error; CI, confidence interval

Table VI. Receiver operating characteristic curve analysis for hospitalization of pneumonia severity scores

Scores	AUC	SE	95% Cl	Sensitivity (%)	Specificity (%)	Cut-off	Youden index J	*P*
CURB-65	0.69	0.029	0.627-0.745	40.3	60	>2	0.3334	<0.001
NEWS	0.71	0.032	0.655-0.771	77.1	53.5	>4	0.3065	<0.001
NEWS-L	0.72	0.032	0.659-0.774	69.1	63.4	>7.7	0.3249	<0.001
PSI	0.64	0.035	0.580-0.702	69.8	54.5	>117	0.2425	0.001

Table VII. Receiver operating characteristic analysis of scores for ıntensive care needs

Scores	AUC	SE	95% Cl	Sensitivity (%)	Specificity (%)	Cut-off	Youden index J	*P*
CURB-65	0.85	0.027	0.798-0.891	72.5	94.7	>2	0.6721	<0.001
NEWS	0.86	0.023	0.812-0.901	82.5	73.5	>6	0.5603	<0.001
NEWS-L	0.86	0.023	0.809-0.699	90	62.9	>8	0.5294	<0.001
PSI	0.64	0.037	0.577-0.699	71.25	55.29	>122	0.2654	0.001

Discussion

In the ROC analysis for 30-day mortality prediction, the NEWS-L score performed the best with a value of 0.96 AUC. It was followed by NEWS and CURB-65 scores, respectively. In a study conducted by Jo *et al*[4], the NEWS-L score was found to be the first rank and the NEWS score was the second rank, consistent with our results. CURB-65 and PSI performed moderately with the latter having a better AUC than the former[4]. However, in our study, the PSI score was the weakest predictor of mortality. In the PSI score, patients with neoplastic disease history and liver disease were in high risk group[5]. It was presumed that the blood glucose, Hct and sodium levels used in the evaluation of PSI score were normal at the time of our study, which categorized the patients as low risk. Chen *et al*[12] have found that the use of the CURB-65 score alone predicts the mortality poorly. In a study by Gwak *et al*[13], the mortality rate of patients with PSI scores grades 1 and 2 was 2.4 per cent. Jo *et al*[4] found that vital signs constituted more significant effects in the NEWS and NEWS-L scores than in the PSI and CURB-65 scores, which led to better performance in predicting 30-day mortality. In our study, significant differences were found in all scores when pneumonia severity scores of patients who died in 30 days as with that who survived. Jo *et al*[4] found significant differences between the dead and survivors for NEWS, NEWS-L, CURB-65 and PSI scores. Gwak *et al*[13] also compared the PSI score in the deceased and surviving groups and found a significant difference. Our results were consistent with these studies.

In the ROC analysis for hospitalization of pneumonia severity scores, the NEWS-L score ranked first with an AUC of 0.72, followed by NEWS, CURB-65 and PSI scores, respectively. Chen *et al*[12] calculated an AUC of 0.61 for CURB-65 in ROC analysis for hospitalization. This rate was comparable with our study. These results indicated that the NEWS and NEWS-L scores predicted hospitalization better than the other scores. NEWS and NEWS-L scores ranked first in ROC analysis of all pneumonia severity scores in terms of ICU necessity. Chen *et al*[12] found that ROC analysis value for intensive care requirement of the lactate-CURB-65 combination was better than CURB-65 score alone.

There has been a significant difference between lactate levels of deceased and alive patients in studies conducted in patients with pneumonia[12-14]. Our results were consistent with these studies. All these studies indicate that lactate level plays an important role in the prognosis of patients with pneumonia. As the NEWS-L score includes lactate acid, it performs better than other score in predicting the 30-day mortality, need for hospitalization and intensive care. There was a significant difference between all the scores when the pneumonia severity scores of the patients who were hospitalized were compared with those who received medical therapy at home. These findings were consistent with the study by Chen *et al*[12] for CURB-65.

Our study had some limitations. COPD patients may need additional oxygen as part of the severity of the disease/acute exacerbation. In our study, the presence of 39 per cent COPD patients might have played a role in the success of NEWS and NEWS-L scores more than other scores (PSI and CURB-65). Most validation studies for NEWS score were single-centre studies with a short follow up of patients. Thus, external validity and long-term predictive ability of NEWS remains unknown. As in other studies, only 30-day results were evaluated in our study. Furthermore, NEWS was not designed to a single time point tool but rather a 'track-and-trigger' system in individual patients. Accuracy of NEWS may thus be different if multiple measurements at different time points are considered.

In conclusion, NEWS-L score was found to be the most successful score in predicting mortality, and requirement for ICU admission and hospitalization in our study. NEWS-L and NEWS scores thus can be helpful in determining the mortality, need for hospitalization and intensive care of the patients with pneumonia in the emergency department.

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For correspondence: Dr Seda Ozkan, Department of Emergency Medicine, Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Istanbul 34098, Turkey
e-mail: sedacil@gmail.com