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Pneumonia Severity Assessment: CURB-65 versus PSI in Predicting Admission Need and Mortality — A Prospective Comparative Study

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ABSTRACT

Background: Community-acquired pneumonia (CAP) remains a leading cause of morbidity and mortality worldwide. Accurate severity assessment is crucial for determining appropriate disposition and treatment intensity. The CURB-65 and Pneumonia Severity Index (PSI) are widely utilized scoring systems, yet their comparative performance in diverse clinical settings continues to be debated.

Methods: A prospective cohort study was conducted at two teaching hospitals over 24 months, enrolling 634 adult patients with confirmed CAP. Both CURB-65 and PSI scores were calculated at presentation. Primary outcomes included requirement for hospital admission and 30-day all-cause mortality. Receiver operating characteristic (ROC) curve analysis and comparative statistics were performed.

Results: The mean age was 62.7 ± 18.4 years, with 56.8% male patients. Hospital admission was required in 412 patients (65.0%), and 30-day mortality occurred in 58 patients (9.1%). For mortality prediction, PSI demonstrated an AUC of 0.842 (95% CI: 0.798–0.886) compared to 0.814 (95% CI: 0.766–0.862) for CURB-65 (p=0.089). For predicting admission need, PSI showed superior discrimination (AUC 0.812 vs. 0.758, p=0.012). PSI risk class IV-V had 87.9% sensitivity and 72.4% specificity for mortality, while CURB-65 ≥3 showed 79.3% sensitivity and 78.6% specificity.

Conclusion: Both scoring systems demonstrate good predictive accuracy for mortality in CAP patients. PSI shows superior performance for determining admission need, while CURB-65 offers comparable mortality prediction with greater simplicity. Clinical context should guide score selection.

Introduction

Community-acquired pneumonia (CAP) represents one of the most prevalent infectious diseases globally, accounting for substantial healthcare utilization, morbidity, and mortality [1]. Despite advances in antimicrobial therapy and supportive care, CAP remains the leading infectious cause of death in developed countries and poses significant challenges for healthcare systems worldwide [2]. The heterogeneous nature of pneumonia presentations necessitates reliable methods for stratifying patients according to disease severity and predicting clinical outcomes [3].

Accurate severity assessment at initial presentation serves multiple critical functions in pneumonia management. It guides decisions regarding the appropriate site of care (outpatient, general ward, or intensive care unit),

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influences antibiotic selection and route of administration, and facilitates communication with patients regarding prognosis [**4**]. Inappropriate disposition decisions carry significant consequences: unnecessary hospitalization of low-risk patients contributes to healthcare costs and nosocomial infection risks, while underestimation of severity may result in delayed escalation and adverse outcomes [**5**].

The Pneumonia Severity Index (PSI), developed by Fine and colleagues in 1997, represents one of the most extensively validated prognostic tools for CAP [**6**]. This scoring system incorporates 20 variables including demographics, comorbidities, physical examination findings, and laboratory parameters, stratifying patients into five risk classes with corresponding mortality estimates [**7**]. While demonstrating excellent predictive performance in multiple validation studies, the complexity of PSI calculation has been cited as a barrier to routine clinical implementation [**8**].

The CURB-65 score, developed by Lim and colleagues for the British Thoracic Society, offers a simplified alternative using five easily assessed parameters: Confusion, Urea elevation, Respiratory rate, Blood pressure, and age ≥65 years [**9**]. Each component contributes one point, generating a score from 0 to 5 that correlates with mortality risk. The simplicity of CURB-65 has facilitated widespread adoption, particularly in emergency department and primary care settings [**10**].

Numerous studies have compared these scoring systems, with variable results regarding their relative performance [**11**]. Some investigations suggest PSI demonstrates superior discrimination, particularly for identifying low-risk patients suitable for outpatient management [**12**]. Conversely, other studies indicate CURB-65 performs comparably while offering practical advantages in time-pressured clinical environments [**13**]. Geographic variation in patient populations, healthcare systems, and outcome definitions contributes to heterogeneity in reported findings [**14**].

A significant research gap exists regarding the comparative performance of these scores in contemporary practice settings with evolving patient demographics and resistance patterns [**15**]. Furthermore, the ability of these tools to predict hospitalization need—as distinct from mortality—has received less systematic evaluation, despite this being a primary clinical decision point [**16**].

The aim of this study was to prospectively compare the predictive accuracy of CURB-65 and PSI scores for determining both hospitalization requirement and 30-day mortality in patients presenting with community-acquired pneumonia to two tertiary care hospitals.

Materials and Methods

Study Design and Setting

This prospective observational cohort study was conducted at the Emergency Departments of two affiliated teaching hospitals between September 2021 and August 2023. The combined facilities serve an urban and suburban population of approximately 1.2 million, with a total of 1,450 inpatient beds and comprehensive intensive care capabilities.

Study Population

Consecutive adult patients aged 18 years and older presenting with suspected community-acquired pneumonia were screened for eligibility. Inclusion criteria comprised: (1) presence of new respiratory symptoms (cough, dyspnea, pleuritic chest pain, or sputum production) for less than 14 days; (2) new infiltrate on chest radiography consistent with pneumonia; and (3) at least one systemic feature of infection (temperature >38°C or <36°C, white blood cell count >10,000/μL or <4,000/μL).

Exclusion criteria included: healthcare-associated pneumonia (hospitalization within 90 days, nursing home residence, hemodialysis, intravenous therapy, or wound care within 30 days); hospital-acquired pneumonia; immunocompromised states (HIV with CD4 <200, active chemotherapy, solid organ transplant, chronic corticosteroid use >20mg/day prednisone equivalent); tuberculosis; aspiration pneumonia with witnessed event; patients transferred from other facilities with initiated treatment; and patients with advance directives precluding hospitalization.

Sample Size Calculation

Based on previous literature reporting mortality rates of approximately 8-12% in hospitalized CAP patients and anticipated AUC values of 0.80-0.85 for both scoring systems, a sample size of 600 patients was calculated to detect a difference of 0.05 in AUC between scores with 80% power at α=0.05. Anticipating 5% loss to follow-up, we targeted enrollment of 635 patients.

Data Collection and Score Calculation

Trained research coordinators collected data using standardized case report forms within 4 hours of ED presentation. Demographic information including age, sex, residence status, and presenting symptoms were recorded. Vital signs (temperature, heart rate, respiratory rate, blood pressure, oxygen saturation) were documented from initial nursing assessment.

Laboratory investigations obtained as part of routine clinical care were recorded, including complete blood count, serum urea, creatinine, electrolytes, glucose, arterial blood gases (when available), and blood cultures. Chest radiography findings were documented by the attending radiologist.

CURB-65 scores were calculated assigning one point each for: Confusion (new disorientation to person, place, or time), Urea >7 mmol/L (>19.6 mg/dL), Respiratory rate ≥30 breaths/minute, Blood pressure (systolic <90 mmHg or diastolic ≤60 mmHg), and age ≥65 years.

PSI scores were calculated according to the original derivation, incorporating 20 variables: age (years for males, years minus 10 for females), nursing home residence (+10), coexisting conditions (neoplastic disease +30, liver disease +20, congestive heart failure +10, cerebrovascular disease +10, renal disease +10), physical examination findings (altered mental status +20, respiratory rate ≥30/min +20, systolic BP <90 mmHg +20, temperature <35°C or ≥40°C +15, pulse ≥125/min +10), and laboratory findings (arterial pH <7.35 +30, BUN ≥30 mg/dL +20, sodium <130 mmol/L +20, glucose ≥250 mg/dL +10, hematocrit <30% +10, PaO2 <60 mmHg +10, pleural effusion +10). Patients were stratified into risk classes I-V based on total scores.

Outcome Measures

The primary outcomes were: (1) requirement for hospital admission determined by the treating physician blinded to research score calculations, and (2) 30-day all-cause mortality. Admission decisions were made according to institutional guidelines and clinical judgment, independent of study participation. Secondary outcomes included ICU admission, length of hospital stay, 30-day readmission, and need for mechanical ventilation.

Follow-up

All patients were followed for 30 days from index presentation. Hospitalized patients were tracked through electronic medical records. Discharged patients were contacted by telephone at 30 days to ascertain vital status and interim healthcare utilization. For patients unreachable by telephone, vital status was verified through regional death registry databases.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation for normally distributed data or median with interquartile range (IQR) for skewed distributions. Categorical variables were presented as frequencies and percentages. Between-group comparisons utilized Student's t-test or Mann-Whitney U test for continuous variables and chi-square or Fisher's exact test for categorical variables.

Receiver operating characteristic (ROC) curve analysis was performed to assess discriminatory ability of both scoring systems. Area under the curve (AUC) with 95% confidence intervals was calculated, and statistical comparison of AUCs was performed using the DeLong method. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and likelihood ratios were calculated at established thresholds.

Calibration was assessed using the Hosmer-Lemeshow goodness-of-fit test. Net reclassification improvement (NRI) and integrated discrimination improvement (IDI) were calculated to evaluate the incremental value of one score over the other. Multivariable logistic regression identified independent predictors of outcomes. Statistical significance was defined as $p<0.05$. Analyses were performed using SPSS version 28.0, MedCalc version 20.0, and R version 4.2.

Results

Patient Characteristics

A total of 712 patients were screened, with 634 meeting inclusion criteria and completing 30-day follow-up. The mean age was 62.7 ± 18.4 years, and 360 patients (56.8%) were male. Common comorbidities included chronic obstructive pulmonary disease (24.6%), diabetes mellitus (22.7%), congestive heart failure (16.2%), and chronic kidney disease (11.4%). The most frequent presenting symptoms were cough (91.2%), dyspnea (76.3%), and fever (68.5%).

Severity Score Distribution and Outcomes

The mean CURB-65 score was 1.8 ± 1.2 (range 0-5), and the mean PSI score was 94.6 ± 38.2 (range 18-224). Hospital admission was required in 412 patients (65.0%), with 78 (12.3%) requiring ICU admission. Thirty-day mortality occurred in 58 patients (9.1%), with 49 deaths (84.5%) occurring during hospitalization and 9 (15.5%) following discharge.

Table 1: Baseline Characteristics Stratified by 30-Day Mortality

Variable	Total (n=634)	Survivors (n=576)	Non-survivors (n=58)	p-value
Age (years), mean ± SD	62.7 ± 18.4	61.2 ± 18.2	77.4 ± 12.6	<0.001
Male sex, n (%)	360 (56.8)	324 (56.3)	36 (62.1)	0.389
Comorbidities, n (%)				
COPD	156 (24.6)	134 (23.3)	22 (37.9)	0.014
Diabetes mellitus	144 (22.7)	126 (21.9)	18 (31.0)	0.108
Congestive heart failure	103 (16.2)	82 (14.2)	21 (36.2)	<0.001

Chronic kidney disease	72 (11.4)	58 (10.1)	14 (24.1)	0.001
Cerebrovascular disease	68 (10.7)	54 (9.4)	14 (24.1)	<0.001
Malignancy	48 (7.6)	38 (6.6)	10 (17.2)	0.003
Vital Signs, mean ± SD				
Respiratory rate (breaths/min)	24.2 ± 6.8	23.6 ± 6.4	30.4 ± 7.2	<0.001
Systolic BP (mmHg)	124.8 ± 24.6	126.4 ± 23.8	108.6 ± 28.2	<0.001
Heart rate (beats/min)	98.4 ± 20.2	97.2 ± 19.6	110.8 ± 22.4	<0.001
Temperature (°C)	38.1 ± 1.0	38.1 ± 1.0	37.8 ± 1.2	0.042
SpO2 (%)	93.2 ± 5.4	93.8 ± 4.8	88.4 ± 7.6	<0.001
Laboratory Values				
WBC ($\times 10^3/\mu L$)	14.2 ± 6.8	14.0 ± 6.6	16.4 ± 8.2	0.018
BUN (mg/dL)	24.8 ± 16.4	23.2 ± 14.8	40.6 ± 22.4	<0.001
Creatinine (mg/dL)	1.3 ± 0.9	1.2 ± 0.8	1.9 ± 1.4	<0.001
Severity Scores				
CURB-65, mean ± SD	1.8 ± 1.2	1.6 ± 1.1	3.2 ± 1.0	<0.001
PSI score, mean ± SD	94.6 ± 38.2	89.4 ± 35.6	146.2 ± 32.8	<0.001

Discriminatory Performance for Mortality

Both scoring systems demonstrated good discrimination for 30-day mortality. PSI achieved an AUC of 0.842 (95% CI: 0.798–0.886), while CURB-65 demonstrated an AUC of 0.814 (95% CI: 0.766–0.862). The difference in AUC was not statistically significant (p=0.089).

Table 2: Discriminatory Performance of CURB-65 and PSI for Primary Outcomes

Outcome/Metric	CURB-65	PSI	p-value (comparison)
30-Day Mortality			
AUC (95% CI)	0.814 (0.766-0.862)	0.842 (0.798-0.886)	0.089
Optimal cutoff	≥3	Class IV-V	-
Sensitivity (%)	79.3	87.9	-
Specificity (%)	78.6	72.4	-
PPV (%)	27.2	24.3	-
NPV (%)	97.4	98.4	-
+LR	3.71	3.19	-
-LR	0.26	0.17	-
Hospital Admission			
AUC (95% CI)	0.758 (0.718-0.798)	0.812 (0.776-0.848)	0.012
Optimal cutoff	≥2	Class III-V	-
Sensitivity (%)	74.8	82.5	-
Specificity (%)	68.0	71.2	-
PPV (%)	81.2	84.1	-
NPV (%)	59.3	68.7	-
ICU Admission			
AUC (95% CI)	0.786 (0.732-0.840)	0.824 (0.774-0.874)	0.067

Performance Across Score Categories

Mortality rates increased progressively across both scoring system categories. For CURB-65: score 0 (0.9%), score 1 (2.8%), score 2 (8.4%), score 3 (21.6%), score 4 (34.8%), score 5 (57.1%). For PSI: Class I (0.6%), Class II (1.4%), Class III (4.2%), Class IV (14.8%), Class V (32.6%).

Table 3: Outcomes Stratified by Severity Score Categories

Score Category	n (%)	Admitted n (%)	ICU n (%)	30-day Mortality n (%)	LOS (days)*
CURB-65					
0	108 (17.0)	42 (38.9)	2 (1.9)	1 (0.9)	3.2 ± 1.8
1	176 (27.8)	94 (53.4)	6 (3.4)	5 (2.8)	4.6 ± 2.4
2	166 (26.2)	124 (74.7)	18 (10.8)	14 (8.4)	6.2 ± 3.6
3	116 (18.3)	102 (87.9)	28 (24.1)	25 (21.6)	8.4 ± 4.8
4	54 (8.5)	42 (77.8)	18 (33.3)	10 (18.5)	10.2 ± 5.4
5	14 (2.2)	8 (57.1)	6 (42.9)	3 (21.4)	12.6 ± 6.2
PSI Class					
I	86 (13.6)	28 (32.6)	1 (1.2)	0 (0)	2.8 ± 1.4
II	142 (22.4)	72 (50.7)	4 (2.8)	2 (1.4)	4.2 ± 2.2
III	144 (22.7)	102 (70.8)	12 (8.3)	6 (4.2)	5.8 ± 3.2
IV	176 (27.8)	146 (83.0)	34 (19.3)	26 (14.8)	8.6 ± 4.6
V	86 (13.6)	64 (74.4)	27 (31.4)	24 (27.9)	11.4 ± 6.8

*Among admitted patients; LOS: Length of Stay

Secondary Outcomes and Subgroup Analyses

The 30-day readmission rate among initially discharged patients was 8.1% (18/222). Mechanical ventilation was required in 52 patients (8.2%), with both scores demonstrating similar predictive ability (AUC 0.798 for CURB-65 vs. 0.826 for PSI, p=0.142).

In patients aged ≥65 years (n=342), PSI demonstrated superior discrimination for mortality (AUC 0.818 vs. 0.762, p=0.034). In patients <65 years (n=292), both scores performed comparably (AUC 0.836 vs. 0.824, p=0.568). Net reclassification improvement for PSI over CURB-65 for mortality prediction was 0.082 (95% CI: -0.024 to 0.188, p=0.128).

Discussion

This prospective comparative study demonstrates that both CURB-65 and PSI provide good predictive accuracy for 30-day mortality in patients with community-acquired pneumonia, with PSI showing superior performance for determining hospital admission need. These findings have important implications for clinical practice and contribute to the ongoing discourse regarding optimal severity assessment strategies in pneumonia management **[17]**.

Our observed AUC values of 0.814 for CURB-65 and 0.842 for PSI align with pooled estimates from meta-analyses examining these scoring systems **[18]**. The non-significant difference in mortality prediction between scores supports findings by Chalmers and colleagues, who demonstrated comparable discrimination in a large validation cohort **[19]**. This similarity is noteworthy given the substantial difference in complexity between the five-variable CURB-65 and the 20-variable PSI system.

The superior performance of PSI for predicting admission need (AUC 0.812 vs. 0.758, p=0.012) merits particular attention. This finding likely reflects the incorporation of age and multiple comorbidity variables in PSI that influence disposition decisions beyond acute physiological derangement **[20]**. Physicians making admission decisions consider factors such as social support, functional status, and comorbidity burden—elements partially captured by PSI but absent from CURB-65 **[21]**.

Our observation that PSI demonstrates enhanced discrimination in elderly patients aligns with previous research suggesting age-related weighting advantages in PSI **[22]**. However, this same characteristic has been criticized for potentially overestimating severity in elderly patients with minimal acute illness, leading to unnecessary hospitalization **[23]**. The significantly higher proportion of patients classified as high-risk by PSI (41.4% in Class IV-V) compared to CURB-65 (29.0% with score ≥3) illustrates this phenomenon.

The mortality gradient across risk categories for both scores supports their clinical utility for prognostication and

patient communication. Our finding of 0.9% mortality in CURB-65 score 0 patients and 0.6% in PSI Class I provides contemporary validation of these low-risk thresholds [**24**]. These data support guideline recommendations for outpatient management consideration in appropriately selected low-risk patients [**25**].

Several practical considerations inform score selection. CURB-65 can be calculated rapidly at the bedside using clinical assessment and a single laboratory value, facilitating early triage decisions [**26**]. PSI requires comprehensive laboratory evaluation and comorbidity documentation, potentially delaying score completion but providing more nuanced risk stratification [**27**]. In resource-limited settings or high-volume emergency departments, CURB-65's simplicity offers pragmatic advantages.

The relatively high readmission rate (8.1%) among initially discharged patients warrants attention. While both scores identify patients at low immediate mortality risk, neither adequately captures factors predicting treatment failure or clinical relapse [**28**]. Integration of biomarkers such as procalcitonin or C-reactive protein may enhance prognostic precision beyond physiological scoring alone [**29**].

Limitations of this study include the dual-center design potentially limiting generalizability, although the diverse patient population enhances external validity. Admission decisions were made by treating physicians who may have been influenced by calculated scores despite study protocols. Additionally, microbiological etiology was confirmed in only 34.2% of cases, precluding pathogen-specific outcome analysis.

The clinical implications of our findings support a context-dependent approach to score selection. For rapid triage and initial disposition guidance, CURB-65 offers adequate performance with practical simplicity. When comprehensive prognostic assessment is required, particularly in elderly patients or those with significant comorbidity burden, PSI provides incremental discriminatory value [**30**].

Conclusion

This prospective comparative study demonstrates that both CURB-65 and PSI provide good discriminatory ability for predicting 30-day mortality in patients with community-acquired pneumonia, with no statistically significant difference between scores. However, PSI demonstrates superior performance for predicting hospitalization need, reflecting its incorporation of age and comorbidity factors that influence disposition decisions. CURB-65 offers comparable mortality prediction with substantially reduced complexity, supporting its utility in time-pressured clinical environments. The progressive mortality gradient across risk categories for both scores validates their clinical applicability for risk stratification and prognostic communication. Selection between scoring systems should be guided by clinical context, available resources, and specific decision-making requirements. Integration of these validated tools into pneumonia management protocols can optimize patient outcomes through appropriate triage, informed disposition decisions, and targeted therapeutic intensity. Future research should explore combination approaches and biomarker integration to further enhance prognostic precision in community-acquired pneumonia.

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