

Original Research Article

EVALUATION OF THE SMART-COP SCORE FOR PREDICTING DISEASE SEVERITY IN COMMUNITY-ACQUIRED PNEUMONIA

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ABSTRACT

Background: The aim is to predict the severity of outcomes in patients with community-acquired pneumonia (CAP) using the SMART-COP scoring system.

Materials and Methods: A total of 100 patients diagnosed with CAP were evaluated through general and chest examinations, and pneumonia severity indices including PSI, CURB-65, and SMART-COP scores.

Results: The mean age of the patients was 57.4 years, with a male predominance (62%). Smoking was the most frequent associated habit (32%). The predominant presenting symptoms were shortness of breath (61%) and cough. Common comorbidities included hypertension, diabetes mellitus, and COPD. Based on the SMART-COP severity classification, 57% of patients were in the low-risk group, 13% in the moderate-risk group, 15% in the high-risk group, and 15% in the very high-risk group. Among these, 7 high-risk and 15 very high-risk patients required vasopressor support. ICU admission was required for 1 patient in the low-risk group, 3 patients in the moderate-risk group, 12 patients in the high-risk group, and 15 in the very high-risk group. Fourteen out of fifteen very high-risk patients required ventilatory support, whereas none in the low-, moderate-, or high-risk groups did. The mean hospital stay was 12.14 ± 7.63 days. A SMART-COP score ≥ 7 showed both sensitivity and specificity of 93.55% in predicting ICU admission. Additionally, the mean duration of antibiotic therapy increased with rising SMART-COP scores. A cutoff value >4.5 yielded a positive predictive value of 93.33%, negative predictive value of 100%, sensitivity of 100%, and specificity of 98.83% for predicting the need for intubation or invasive respiratory support.

Conclusion: The SMART-COP score is a reliable and practical tool for predicting disease severity and the need for intensive care in patients with community-acquired pneumonia. It provides clinicians with a robust method for early risk stratification and management planning.

Keywords: SMART-COP score, community-acquired pneumonia.

INTRODUCTION

Community-Acquired Pneumonia (CAP) is defined as the occurrence of acute lower respiratory tract symptoms lasting less than one week, accompanied by at least one systemic manifestation—such as fever above 37.7°C , chills, rigors, or malaise—and new focal findings on examination, without an alternative explanation for the illness.^[1] CAP remains the third leading cause of death worldwide, with an incidence ranging from 1.3 to 11.6 cases per 1,000 individuals

annually.^[2] Notably, the incidence of pneumonia increases significantly among individuals aged 75 years and older, rising from 15.4 to 34.2 cases per 1,000.^[3]

Due to its broad spectrum of clinical presentations, CAP is often considered in the differential diagnosis of nearly all respiratory illnesses.^[4-6] Patients with underlying comorbidities—such as advanced age, chronic lung disease, diabetes mellitus, and other immunocompromising conditions—have impaired pulmonary defense mechanisms, increasing their susceptibility to pneumonia.^[7,8]

An effective severity assessment tool for CAP is essential for guiding clinical decision-making, particularly in identifying patients who may require intensive care. Reliance on clinical judgment alone may lead to underestimation of disease severity and variability in hospital or ICU admission practices. In this context, validated clinical prediction rules have proven to be valuable adjuncts to clinical expertise. Several scoring systems have been developed to evaluate CAP severity, including the Pneumonia Severity Index (PSI) and CURB-65. The PSI primarily identifies low-risk patients suitable for outpatient management by emphasizing comorbidities, whereas CURB-65 incorporates physiological parameters with age-related factors, especially in patients older than 65 years.^[14,15]

The SMART-COP scoring system was introduced to overcome limitations of earlier models by focusing on predicting the need for Intensive Respiratory or Vasopressor Support (IRVS). It evaluates eight parameters: Systolic blood pressure, Multilobar infiltrates, Albumin, Respiratory rate, Tachycardia, Confusion, Oxygenation, and PH level. By emphasizing disease severity rather than solely risk factors, SMART-COP provides clinicians with a more dynamic tool for early identification of patients requiring advanced care.

Despite global research on CAP, there remains a lack of region-specific data within the Indian population regarding its incidence, clinical characteristics, and outcomes. Therefore, the present study aims to evaluate the severity outcomes and need for IRVS in patients with CAP using the SMART-COP scoring system, while also analyzing the clinical and etiological profiles of affected individuals within our community.

MATERIALS AND METHODS

Type of Study: Hospital based cross-sectional study was conducted till discharge among patients admitted with community acquired pneumonia.

Ethics: Prior to the study, the protocol was approved by the institutional ethical committee & all patients gave their informed consent to participate.

Study population: A total of 250 patients showing symptoms of cough, cold, & fever indicative of pneumonia were randomly screened to identify cases of community-acquired pneumonia (CAP) based on established inclusion criteria. Among these, 100 cases were confirmed as CAP & underwent clinical evaluations, laboratory tests, & scoring systems for thorough characterization. Risk factors were analyzed & correlated with the scoring system to enhance outcome measurement, thereby improving diagnostic accuracy & treatment suitability.

Study center: Both the Dept of community medicine & Dept of General Medicine were involved in this study. The study carried out at Medicine department wards, Narayana Medical College & Hospital, Nellore, Andhra Pradesh.

Study period: 18 months.

Sample size: 100.

Based on the specificity of SMART-COP score in the previous study, the calculated sample size is 77.18, but for statistically significant inference we undertaken 100 sample size in our study.

Sampling method: simple Random sampling method.

Based on this, we included 100 patients diagnosed with acute exacerbation of COPD.

Sampling technique: Consecutive patients fulfilling inclusion criteria were included in study, Consecutive sampling method used to select the patient.

Inclusion criteria

1. Age > 18 years.
2. Patients diagnosed with community acquired pneumonia.
3. Chest radiograph within 24 h after hospital admission demonstrating features consistent with acute pneumonia; & at least 2 symptoms consistent with pneumonia (e.g., fever or hypothermia, rigors, sweats, new cough [with or without sputum], chest discomfort, or new-onset of dyspnea.)

Exclusion criteria

1. Pregnant females.
2. Patients with history of hospitalisation 2 weeks prior to presentation.
3. Severely immunocompromised patients.
4. Patients with other pulmonary conditions like copd, interstitial lung disease.
5. Development of symptoms 48 h after hospital admission or discharge from an acute-care facility 2 weeks before hospital admission.)
6. Active thoracic malignancy.

Patients were eligible for inclusion if they showed a new infiltrate on a chest X-ray & presented with at least three of the following symptoms: cough, sputum production, dyspnea, pleuritic chest pain, hemoptysis, fever, headache, & auscultatory signs of pneumonia.

Upon admission for Community-Acquired Pneumonia, a standardized form was filled out to record vital signs, including blood pressure, pulse, respiratory rate, & temperature.

Additionally, routine blood tests—such as a complete blood count, urea & electrolyte analysis, liver function tests, & arterial blood gas analysis—along with a chest X-ray, were performed for each patient.

The severity of the condition was evaluated using the CURB-65 score, which takes into account confusion, urea levels, respiratory rate, blood pressure (systolic or diastolic), and age (≥ 65 years), as well as the SMART-COP score, which assesses systolic blood pressure, multilobar involvement on chest X-ray, albumin levels, respiratory rate, tachycardia, confusion, oxygenation, & arterial pH.

The recorded patient information encompasses demographic details, current comorbidities, initial vital signs, & various investigative results required for calculating the CURB-65 & SMART-COP scores.

Equipment used:

1. BECKMAN -AU 480 fully automated machine used to estimate sr. Urea & sr. Albumin.
2. Instrumentation laboratory company (GEM PREMIER 3500) blood gas analyzer is used to estimate ABG.
3. Siemens 600mA X ray machine is used to obtain chest X ray.

Tests:

- Complete blood count,
- Chest X-ray & ECG
- Arterial blood gas analysis
- RFT, LFT, Serum electrolytes, Serum Urea, Serum Albumin, & Random blood sugar.
- ABG

All the patients are assessed using SMART COP.

Statistics: Descriptive & inferential analyses were performed using SPSS version 26 software. Qualitative data were presented as frequencies & percentages, and analyzed using the chi-square test or Fisher's exact test. The chi-square test was utilized to evaluate the relationship between different attributes. To compare means or distributions of variables between 2 groups, either the two-sample t-test or the Mann-Whitney U test was used. The effectiveness of the SMART-COP score in predicting severity outcomes was assessed through logistic regression & Receiver Operating Characteristic (ROC) curves. Additionally, analysis of variance (F-test for K population means), chi-square tests, & Fisher's exact tests were employed in the analysis.

RESULTS

The mean age of the patient was 57.4 years. CAP was found predominantly in males (62%). The

commonest predisposing factors associated with CAP was hypertension, diabetes mellitus, and COPD. The commonest habit associated with CAP was smoking in 32%. The commonest mode of presentation was SOB in 61% & cough. Based on smart COP severity score, 57% of CAP patients belong to low risk group, 13% patients to moderate risk group, 15% patients to high risk group, 15% patients to very high risk group. 7 patients among high risk group, and 15 patients among very high risk group required vasopressor support. Based on smart COP scale, one patient among 57 patients belong to low risk group, 3 patients among 13 patients belong to moderate risk group, 12 patients among 15 patients of high risk group, & 15 patients in very high-risk group required ICU admission. On the basis of smart COP scale, 14 cases among 15 patients belonged to very high risk group required ventilator support and no patients need ventilator support in low risk, moderate risk & high-risk patients. The mean duration of total hospital stay was 12.14 days. A smart COP score > 4.5 points identified 27 (87.09%) cases required ICU Admission, whereas Smart COP score ≤ 4.5 identified 4 (12.91%) cases required ICU Admission. Smart-COP score with cutoff of > 4.5 had a positive predictive value (PPV) of 90%, Negative Predictive Value of 94.28%, Sensitivity of 87.097%, Specificity of 95.65% to predict the ICU Admission in 31 (100%) cases. A Smart COP score > 6.5 points identified 14 (100%) cases required intubation support. SMART-COP score with cutoff of > 4.5 had a positive predictive value (PPV) of 93.33%, Negative Predictive Value of 100%, Sensitivity of 100%, specificity of 98.83% to predict the intubation or invasive respiratory support in 14 (100%) cases.

Table 1: Symptoms, complications & comorbidities of CAP

Pleural effusion		
No	69	69.0
Yes	31	31.0
SMOKING		
No	68	68.0
Yes	32	32.0
CHEST PAIN		
No	88	88.0
Yes	12	12.0
SOB		
No	39	39.0
Yes	61	61.0
COPD		
No	68	68.0
Yes	32	32.0
Altered mental status		
No	86	86.0
Yes	14	14.0
Fever or Hypothermia		
No	73	73.0
Yes	27	27.0
chest discomfort		
No	82	82.0
Yes	18	18.0

Table 2: Distribution of SMART COP score of patients

Smart COP score points		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low Risk (0-2) points	57	57.0	57.0	57.0
	Moderate Risk (3-4)	13	13.0	13.0	70.0
	High Risk (5-6)	15	15.0	15.0	85.0
	Very High Risk (≥ 7) points	15	15.0	15.0	100.0
	Total	100	100.0	100.0	

Table 3: Association between SMART COP score & SEX

			S COP Group				Total
			Low Risk	Moderate Risk	High Risk	Very High Risk	High
SEX	Female	Count	24	5	5	4	38
		% within SEX	63.2%	13.2%	13.2%	10.5%	100.0%
		% within S COP Group	42.1%	38.5%	33.3%	26.7%	38.0%
	Male	Count	33	8	10	11	62
		% within SEX	53.2%	12.9%	16.1%	17.7%	100.0%
		% within S COP Group	57.9%	61.5%	66.7%	73.3%	62.0%
Total		Count	57	13	15	15	100
		% within SEX	57.0%	13.0%	15.0%	15.0%	100.0%
		% within S COP Group	100.0%	100.0%	100.0%	100.0%	100.0%

P=0.7, Pearson Chi-Square=1.3

Table 4: Association between SMART COP score and Tachypnea

			S COP Group				Total
			Low Risk	Moderate Risk	High Risk	Very High Risk	
Tachypnea	No	Count	50	8	8	5	71
		% within Tachypnea	70.4%	11.3%	11.3%	7.0%	100.0%
		% within S COP Group	87.7%	61.5%	53.3%	33.3%	71.0%
	Yes	Count	7	5	7	10	29
		% within Tachypnea	24.1%	17.2%	24.1%	34.5%	100.0%
		% within S COP Group	12.3%	38.5%	46.7%	66.7%	29.0%

P<0.0001, Pearson Chi-Square=20.9

Table 5: Association between SMART COP score and Confusion (onset)

			SMART COP Group				Total
			Low Risk	Moderate Risk	High Risk	Very High Risk	
Confusion (onset)	No	Count	54	6	8	8	76
		% within Confusion (onset)	71.1%	7.9%	10.5%	10.5%	100.0%
		% within S COP Group	94.7%	46.2%	53.3%	53.3%	76.0%
	Yes	Count	3	7	7	7	24
		% within Confusion (onset)	12.5%	29.2%	29.2%	29.2%	100.0%
		% within S COP Group	5.3%	53.8%	46.7%	46.7%	24.0%

P<0.0001, Pearson Chi-Square=25.7

Table 6: Association between SMART COP score and Hypoxia

			S COP Group				Total
			Low Risk	Moderate Risk	High Risk	Very High Risk	
Hypoxia	No	Count	51	7	8	5	71
		% within Hypoxia	71.8%	9.9%	11.3%	7.0%	100.0%
		% within S COP Group	89.5%	53.8%	53.3%	33.3%	71.0%
	Yes	Count	6	6	7	10	29
		% within Hypoxia	20.7%	20.7%	24.1%	34.5%	100.0%
		% within S COP Group	10.5%	46.2%	46.7%	66.7%	29.0%

P<0.0001, Pearson Chi-Square= 23.9

Table 7: Association between SMART COP score and DBP $\leq$ 60mmHg

			S COP Group				Total
			Low Risk	Moderate Risk	High Risk	Very High Risk	
DBP $\leq$ 60mmHg	No	Count	57	13	13	5	88
		% within DBP $\leq$ 60mmHg	64.8%	14.8%	14.8%	5.7%	100.0%
		% within S COP Group	100.0%	100.0%	86.7%	33.3%	88.0%

	Yes	Count	0	0	2	10	12
		% within DBP≤60mmHg	0.0%	0.0%	16.7%	83.3%	100.0%
		% within S COP Group	0.0%	0.0%	13.3%	66.7%	12.0%

P<0.0001, Pearson Chi-Square=52.02

Table 8: Association between SMART_COP score and SBP <90 mmHg

			S COP Group				Total
			Low Risk	Moderate Risk	High Risk	Very High Risk	
SBP <90 mmHg	No	Count	57	11	6	3	77
		% within SBP <90 mmHg	74.0%	14.3%	7.8%	3.9%	100.0%
		% within S COP Group	100.0%	84.6%	40.0%	20.0%	77.0%
	Yes	Count	0	2	9	12	23
		% within SBP <90 mmHg	0.0%	8.7%	39.1%	52.2%	100.0%
		% within S COP Group	0.0%	15.4%	60.0%	80.0%	23.0%

P<0.0001, Pearson Chi-Square= 56.5

Table 9: Association between SMART_COP score and ICU admission

			S COP Group				Total
			Low Risk	Moderate Risk	High Risk	Very High Risk	
ICU admission	No	Count	56	10	3	0	69
		% within ICU admission	81.2%	14.5%	4.3%	0.0%	100.0%
		% within S COP Group	98.2%	76.9%	20.0%	0.0%	69.0%
	Yes	Count	1	3	12	15	31
		% within ICU admission	3.2%	9.7%	38.7%	48.4%	100.0%
		% within S COP Group	1.8%	23.1%	80.0%	100.0%	31.0%
Total		Count	57	13	15	15	100
		% within ICU admission	57.0%	13.0%	15.0%	15.0%	100.0%
		% within S COP Group	100.0%	100.0%	100.0%	100.0%	100.0%

P<0.0001, Pearson Chi-Square=73.3

DISCUSSION

A total of 250 patients presenting with symptoms of cough, fever, and cold were screened, of which 100 were confirmed to have community-acquired pneumonia (CAP) based on inclusion criteria, yielding a prevalence rate of 40%. The most common reason for exclusion was a normal chest radiograph. The demographic characteristics and clinical features of the confirmed CAP cases were analyzed using three scoring systems—Pneumonia Severity Index (PSI), CURB-65, and SMART-COP.

Demographic and Clinical Characteristics: The incidence of CAP was found to increase with advancing age, a finding consistent with studies by Mohanty S et al., Babu et al., and Dey et al., which reported mean patient ages of 53 and 50.6 years, respectively. Similarly, Archana Choure et al. and Jain SK et al. found that CAP was most prevalent among individuals older than 50 years, with rates of 84.28% and 68.3%, respectively.^[9-13]

Common predisposing factors included diabetes mellitus, chronic lung disease, tobacco or alcohol use, bronchiectasis, malignancy, and advanced age. These findings consistent with previous research.

Clinical Presentation: The most common presenting symptom was cough (58%), often

accompanied by expectoration, followed by breathlessness (61%) and fever (78%). Chest pain was reported in 12% of patients, while 31% experienced pleuritic chest pain. Tachypnea and hypoxia were each observed in 29% of patients, confusion in 24%, and tachycardia in 15%. Radiological examination revealed multilobar involvement in 31% of cases, and altered mental status in 14%.

Physiological parameters indicated that tachycardia was present in 15% of patients, hypotension in 20%, and fever or hypothermia in 27%.

Severity Assessment and Outcomes: When classified according to the SMART-COP scoring system, 57% of patients fell into the low-risk group, 13% into the moderate-risk group, 15% into the high-risk group, and another 15% into the very high-risk group.

Vasopressor support was required in 7 patients from the high-risk group and 15 from the very high-risk group.

ICU admission was necessary for 1 patient in the low-risk group, 3 in the moderate-risk group, 12 in the high-risk group, and all 15 in the very high-risk group.

Ventilatory support was required in 14 patients, all belonging to the very high-risk group. No patients in

the low-, moderate-, or high-risk categories required mechanical ventilation.

The average hospital stay was 12.14 ± 7.63 days. A SMART-COP score ≥ 7 demonstrated high sensitivity in predicting the need for ventilator support.

Among the 100 patients, 31% required ICU admission, and 22% required IRVS (Intensive Respiratory or Vasopressor Support). Of these, 14 underwent intubation and 17 received non-invasive ventilation. Twenty-one patients were admitted directly to the ICU from the emergency department, while ten were transferred later following clinical deterioration.

Comparative Predictive Accuracy: In this study, a SMART-COP cutoff >4.5 effectively predicted ICU admission, with a positive predictive value (PPV) of 90%, negative predictive value (NPV) of 94.3%, sensitivity of 87.1%, and specificity of 95.7%. The area under the curve (AUC) for predicting ICU admission was 0.961 for PSI, 0.919 for CURB-65, and 0.973 for SMART-COP, indicating that SMART-COP had the best discriminative power.

Furthermore, a SMART-COP score >6.5 predicted intubation support with 100% sensitivity and specificity, while a cutoff >4.5 predicted the need for IRVS with a PPV of 73.3%, NPV of 100%, sensitivity of 100%, and specificity of 89.7%. For non-invasive ventilation, the same cutoff had a PPV of 43.3%, NPV of 94.3%, sensitivity of 76.5%, and specificity of 79.5%.

These findings align with the observations of Babu et al. (2017), who demonstrated that the SMART-COP score was superior to CURB-65 and PSI in predicting the need for inotropic or ventilatory support. Importantly, SMART-COP was found to be accurate not only for patients directly admitted to the ICU but also for those initially admitted to the general ward and subsequently deteriorated.

The progressive increase in SMART-COP scores was directly correlated with greater clinical severity, ICU admission rates, and the need for IRVS. This underscores the clinical utility of the SMART-COP score as a dynamic and reliable tool for identifying high-risk CAP patients early. In contrast to PSI and CURB-65—which are influenced heavily by age and comorbidities—SMART-COP focuses on physiological derangements, making it particularly valuable in resource-limited settings for triage and management decisions.

CONCLUSION

SMART-COP scores ranging from 5 to 10 were associated with a higher frequency of ICU admissions (31%) and an increased requirement for intensive respiratory or vasopressor support (22%). The SMART-COP scoring system demonstrated

greater specificity in predicting the need for ICU admission, IRVS, and overall patient outcomes when compared with other severity assessment tools. By applying the SMART-COP criteria, clinicians can more accurately assess the severity of illness in patients with community-acquired pneumonia (CAP), leading to improved patient triage, optimized resource allocation, and more targeted treatment strategies that enhance clinical outcomes. Among the evaluated scoring systems, a SMART-COP score greater than 4.5 showed excellent predictive accuracy for identifying patients likely to require vasopressor or ventilatory support. Overall, these findings highlight that the SMART-COP score represents a significant advancement in the management of CAP, providing clinicians with a reliable and practical tool for early identification of high-risk patients and timely initiation of appropriate interventions.

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