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Pulmonary Medicine

"UTILITY OF SMARTCOP IN COMMUNITY AQUIRED PNEUMONIA" –A PROSPECTIVE STUDY IN A TERTIARY CARE TEACHING HOSPITAL IN SOUTHERN INDIA.

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ABSTRACT

Objectives:

1.To investigate the utility of SMARTCOP in effectively stratifying pneumonia patients.

2.To evaluate the necessity for advanced respiratory support based on SMARTCOP categorization.

3.To prognosticate the outcomes of pneumonia cases utilizing the SMARTCOP score.

Materials And Methods: "A prospective study was conducted on patients presenting at a tertiary care hospital in Southern India over a two-year period. These patients were diagnosed with pneumonia based on a hospital -based inclusion criteria notably abnormal chest X-rays, clinical symptoms, and laboratory investigations. **Results:** "The SMARTCOP score was utilized to assess pneumonia patients with high severity and their need for intensive care support. A total of 368 patients presented with community acquired pneumonia during the study period and through a comprehensive analysis 80 patients were finally included in the study after exclusion criteria. The SMARTCOP helped in stratifying the patients in -to groups based on their scores the majority 29/80 patients (36.25%) fell into the very high-risk category; SMARTCOP scores (7+) compared to low -risk group of 11/80(13.8%); SMARTCOP SCORE (0-2). This classification aided in identifying individuals who required immediate and intensive medical intervention vis a vis Assisted ventilation or Inotrope support, highlighting the score's effectiveness in clinical decision-making. Finally, the patient outcome was categorized in to 3 groups a) Recovered b) Morbidity (requiring home oxygen or NIV at discharge) and c) Expired. Statistical analysis, specifically using the Chi-square test, revealed a significant association ($p = 0.030$) between SMARTCOP scores and patient outcomes, underscoring the score's utility as a predictive tool in managing pneumonia cases of varying severity. " **Conclusion:** "The SMARTCOP score proved to be beneficial tool in a)risk stratifying b)identifying need for intensive respiratory support c)determine the prognosis vis a vis recovered, morbidity or expired. "

KEYWORDS : SMARTCOP, Pneumonia, Intensive Respiratory Support, Severity, Prognosis

INTRODUCTION

"Community-acquired pneumonia (CAP)[1-4] is characterized by an acute infection of the pulmonary parenchyma in individuals who acquire the infection within the community. The prevalence of pneumonia is increasing among elderly patients with associated comorbidities. Increased prevalence is seen with risk factors such as smoking, alcoholism, and advancing age[5-9]. In this observational, prospective study, SMARTCOP SCORE was used, a multivariate scoring system, for the stratification and prognosis assessment of diagnosed cases of community-acquired pneumonia. This approach was chosen due to limitations observed using CURB-65 (Confusion, Uremia, Respiratory rate, Blood pressure), PSI (Pneumonia severity index) scores especially in assessing younger individuals where the CURB-65 score's age criterion could underestimate severity. SMARTCOP, encompassing multiple variables, offers a more comprehensive evaluation independent of age, potentially replacing other scoring systems. "

"Guidelines advocate for the utilization of a validated clinical prediction tool alongside clinical judgment to guide the hospitalization decisions for patients with CAP. Among these scoring systems, SMARTCOP[10] stands out as a straightforward tool applicable across all age groups.". The 'SMART-COP (systolic blood pressure, multi-lobar chest radiography involvement, albumin level, respiratory rate, tachycardia, confusion, oxygenation, and arterial pH) is a simple tool that was the result of an extensive study on CAP called the Australian CAP Study (ACAPS). The Australian Community-Acquired Pneumonia Study (ACAPS) was a prospective, multicenter, observational study that assessed the etiology, severity markers, and treatment outcomes of a large population of patients with CAP defined by strict criteria[10]. They used these data to develop a new tool to identify patients with CAP who require Intensive respiratory or vasopressor support (IRVS). The tool was designed to overcome the limited ability of PSI and CURB 65 to predict, which patients will require Intensive Respiratory or Vasopressor Support (IRVS). SMART-COP is a simple, practical clinical tool for accurately predicting the need for IRVS and helps determine CAP severity[10-15]

S-systolic blood pressure <90mmhg	2 points
M-multi-lobar chest X-ray involvement	1 point
A-albumin <3.5g/dl	1 point
R-respiratory rate high age<50yrs >_25breaths/min; Age >50yrs >_30 breaths/min	1 point
T-Tachycardia >125/min	1point
C-confusion	1point
O-oxygen low age<_50yrs o2 saturation <93%; age >_50yrs <90%	2 points
PH<7.35	2points

Interpretation:

0-2 points –low risk
3-4 points-moderate risk
5-6 points-high risk
7+ points very high risk

MATERIALS AND METHODS

Source Of Study:

The current study was done to the patients who were attending to Respiratory Medicine OPD prospectively for a period of 2 years in NRI institute of medical sciences, a 1000 bedded Tertiary care teaching hospital in southern India after obtaining the informed consent from patients and approval from Ethics committee.

Design Of Study: Prospective, observational study;

Period Of Study: 2years (2022-2024)

Sample Size: 80 patients;

Place Of Study: NRI institute of Medical Sciences, Visakhapatnam, India.

Target Population:
All patients with pneumonia attending Respiratory out- patient department, satisfying inclusion and exclusion criteria were included in study after informed consent was obtained.

Inclusion Criteria:
Hospital based criteria for Community acquired pneumonia was formulated which includes the following

1. New or increased cough with/without sputum production
2. Fever (>37.8*c) or hypothermia (<35.6*C)
3. Abnormal white blood cell count (either leukocytosis >11000 or leukopenia <4000 cells).
4. Abnormal chest radiology.
5. Age >18 years.

Exclusion Criteria:
Patients who meet at least one of the following were excluded from the study:

1. Known case of lung cancer
2. AGE < 18years
3. Unstable psychiatric or psychological condition rendering the subject unlikely to be cooperative or to complete the study requirements.
4. Severe immunosuppression (AIDS, chemotherapy, immuno suppressive drugs e.g.: oral corticosteroid>/10 mg prednisone or equivalent per day for at least two weeks prior to hospitalization)
5. Pregnant women
6. History of hospitalization 2 weeks prior to the present presentation.

Considering the prevalence
Using SPSS and Epi info Software, the sample size was calculated as per the population survey model; It is as follows: n = sample size population proportion, p = Expected prevalence of the event in the study = 28% q = 1- p = 72%, Expected absolute allowable error in the p is 5% will be taken, E = precision = 5%. Value of the normal deviate at considered level of confidence = z_{1-T2},Confidence level =95%

$$n = \frac{\left|\left(z_{1-\frac{\alpha}{2}}\right)^2 \cdot p \cdot q\right|}{22} = \varepsilon$$

n =77;77is the minimum sample size. Total 368 patients were screened. Among them 80 patients were found to be eligible.

RESULTS
The study was conducted in a tertiary care teaching hospital in southern India. A total of 368 patients with community acquired pneumonia presented during the study period out of which 80 patients were finally selected as after implementing the exclusion criteria. Out of 80 patients 53.8(%) were male and 46.3(%) were female. The mean age of study population was 58.1 years. (Table 1; pie chart 1).

The patients were stratified into risk groups based on SMART COP score (Table 2; Bar diagram 1). The majority of study population were high risk 24/80(30%)-SMART COP 5-6 points and very high risk 29/80(36.3%)- SMART COP 7+ points.

The length of stay in hospital was categorized as less than 2 weeks and more than 2 weeks (Table 3; Bar diagram 2). All the low -risk patients 11/11(100%) required less than 2 weeks of stay, whereas 16/29(55%) patients of very high- risk group had hospital stay > 2 weeks.

The Need for Respiratory support was further divided in to 2 groups, one requiring Non -Invasive ventilator support (continuous positive airway ventilation (CPAP), Bi-level positive airway ventilation (BIPAP), High flow nasal oxygen(HFNO) or Mechanical ventilation (Table 4a; bar diagram 3). None of the low- risk groups required any form of ventilator support 0/11(0%) in contrast all the very high -risk group required some sort of ventilator support 29/29 (100%).The need for inotropes also showed similar trend with none of the low -risk group required any inotropes and all the very high- risk groups required some sort of inotropes support during the hospital stay (Table 4b; bar diagram 4).

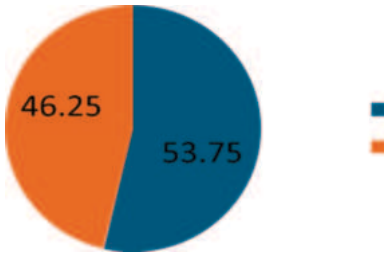
The outcome was categorized in to 3 categories namely a) Recovered (those who were discharged without any o2 or NIV support to home, b) Morbidity –Those who were discharged but on home oxygen (Long term oxygen therapy LTOT) or NIV support's) Expired- Those who died during treatment at hospital (Table 5; bar diagram 5). It was observed that mortality was zero and morbidity was one among low-risk groups 0/11(0%), in contrast in very high- risk group the morbidity 12/29(41%) and mortality 4/29(13%) were significant.

Finally, the 30 -day mortality was documented in (bar diagram 6), mortality was seen within only high risk 5/24(20.8%) and very high risk groups4/29(13.7%) suggesting the validity of SMARTCOP in prognosis.

Gender Wise Distribution Of patients table1:

Gender

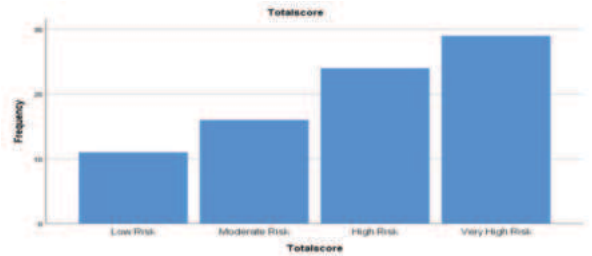
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	43	53.8	53.8	53.8
	FEMALE	37	46.3	46.3	100.0
	Total	80	100.0	100.0	



Gender Distribution of Patients(Pie chart 1)

Table2 SMARTCOP Total score GRADING

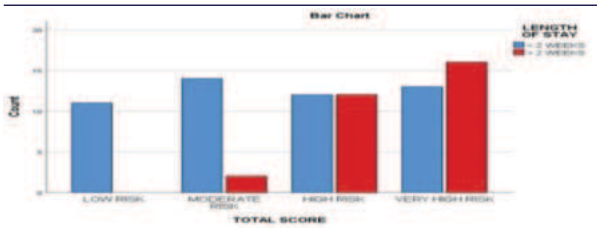
	Frequency	Percent	Valid Percent	Cumulative Percent
Low Risk	11	13.8	13.8	13.8
Moderate Risk	16	20.0	20.0	33.8
High Risk	24	30.0	30.0	63.7
Very High Risk	29	36.3	36.3	100.0
Total	80	100.0	100.0	



BARDIAGRAM 1

Table 3: Length Of Stay

		LENGTH OF STAY		Total	p - Value
		< 2 WEEKS	> 2 WEEKS		
TOTAL SCORE	LOW RISK	11	0	11	.001
	MODERATE RISK	14	2	16	
	HIGH RISK	12	12	24	
	VERY HIGH RISK	13	16	29	
Total		50	30	80	
		P < 0.05 (Significant)			



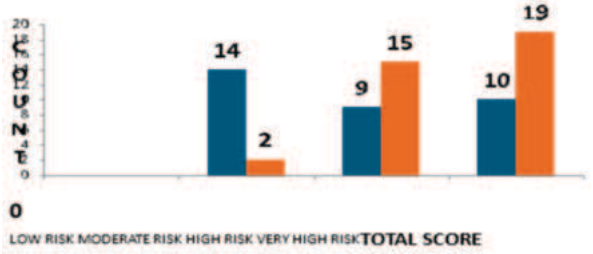
BARDIAGRAM2

Table 4a:TOTAL SCORE vs ASSISTED VENTILATION

		ASSISTED VENTILATION		Total	p - Value
		NIV	MV		
TOTAL SCORE	LOW RISK	0	0	0	0.001
	MODERATE RISK	14	2	16	
	HIGH RISK	9	15	24	
	VERY HIGH RISK	10	19	29	
Total		33	36	69	
		P < 0.05 (Significant)			

Table 4b:TOTAL SCORE vs NEED FOR INOTROPES

		NEED FOR INOTROPES		Total	P - Value
		NO	YES		
TOTAL SCORE	LOW RISK	11	0	11	.0000
	MODERATE RISK	6	10	16	
	HIGH RISK	0	24	24	
	VERY HIGH RISK	0	29	29	
Total		17	63	80	
		P < 0.05 (Significant)			



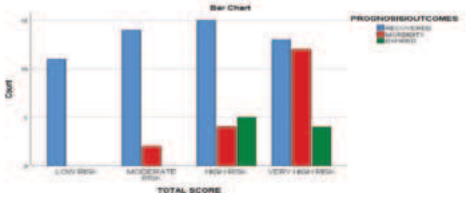
BARDIAGRAM 3
TOTAL SCORE VS ASSISTED VENTILATION

BARDIAGRAM 4

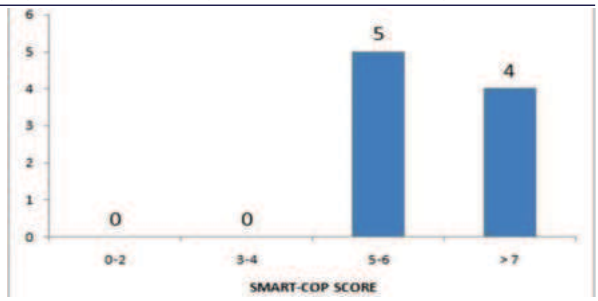
Table 5: TOTAL SCORE * PROGNOSIS/OUTCOMES

		PROGNOSIS/OUTCOMES				P - Value
		RECOVERED	MORBIDITY	EXPIRED	Total	
TOTAL SCORE	LOW RISK	11	0	0	11	.005
	MODERATE RISK	14	2	0	16	
	HIGH RISK	15	4	5	24	
	VERY HIGH RISK	13	12	4	29	
Total		53	18	9	80	
		P < 0.05 (Significant)				

BARDIAGRAM 8



BARDIAGRAM 5



BARDIAGRAM 6

DISCUSSION

Community-acquired pneumonia (CAP) is a frequently encountered respiratory condition leading to hospitalization, emphasizing the importance of risk stratification and management to lower treatment expenses and optimize hospital resources, all while safeguarding patient health[10-15]. In the United states of America, the annual cost of pneumonia is around 8.4 million dollars and 95% of this cost was for patients who were admitted at hospitals. In our study the utility of SMARTCOP as a smart tool is established. We have focused on the utility of SMARTCOP in

a) Risk stratification b) need for Intensive respiratory support (assisted ventilation and or Ionotropic support) and c) Prognosis.

a) Risk stratification

In this study, SMART COP was used to categorize patients into four risk groups among 80 participants: 11 (13.8%) classified as low risk, 16 (20.0%) as moderate risk, 24 (30.0%) as high risk, and 29 (36.3%) as very high risk. Notably, the combined high and very high -risk categories accounted for 66.3% of patients, reflecting the center's tertiary care focus and its referral of severe cases from surrounding hospitals. This trend aligns with a study by **Ehsaanpoor et al**[12], where out of 143 patients with community-acquired pneumonia, 107 (74.8%) had a SMART COP score >3, demonstrating a predominance of higher-risk cases in both studies.

In a study by **PATRICKS G.P. CHARLES et al**[10,] a SMART-COP score of >/3 points accurately identified 84 (92.3%) out of 91 patients who required intensive respiratory or vasopressor support (IRVS). Certain challenging tomeasure parameters like serum albumin, pH, and PaO2 were excluded from this analysis. The majority of patients (92.3%) were categorized as moderate, high risk, or very high risk, consistent with previous research indicating a notable prevalence of high-risk individuals among those needing intensive respiratory or vasopressor support (IRVS)as well as longer hospital stay.

b) Intensive Respiratory support(Assisted ventilation and /or Inotropes)

In this study, the utility of SMART-COP in predicting the need for intensive respiratory support was established, with high-risk (score 5-6) and very high-risk (7+) patients requiring assisted ventilation and ionotropic support more frequently than moderate and low-risk groups. Among those requiring assisted ventilation, patients were divided into two categories: those needing non-invasive ventilation (NIV) such as CPAP, BiPAP, or HFNO, and those requiring intubation and mechanical ventilation. Notably, none of the low-risk group patients (0/11, 0%) required any form of assisted ventilation, whereas all patients in the high-risk (24/24, 100%) and very high-risk (29/29, 100%) groups needed some level of assistance. Similarly, none of the low-risk patients required ionotropic support (0/11, 0%), whereas all high-risk and very high-risk patients required this intervention.

These findings are consistent with **UPHAR GUPTA's et al**.[16] study, where among patients categorized by risk scores, none in the low-risk category required inotropic or invasive ventilatory support. In contrast, a higher percentage of moderate-risk (28.5%) and high-risk (44.5% inotropic support, 66.67% ventilatory support or both) patients needed these interventions. Among very high-risk patients, the need for inotropic support was 68.5%, and 75% required ventilatory support or both.

In **PATRICK'S G.P et al**[10]**. study,** a significant SMART-COP scores and the requirement for intensive respiratory support were identified. Among those directly admitted to the ICU, 98.1% received intensive ventilatory support. A SMARTCOP score >/3 points identified 92% of

patients needing intensive respiratory support.

Ehsaanpoor Et al study[12], they included 143 patients, with 38.5% of them requiring ICU admission and 30.8% of those needing assisted ventilation or vasopressor support. A SMARTCOP score >/3 identified 92% of patients needing intensive respiratory or vasopressor support (IRVS). These findings are consistent with previous research, indicating that patients with SMARTCOP scores >/5 typically require both assisted ventilation and inotropic support. Additionally, patients initially stable with SMARTCOP scores >/3 often experienced clinical deterioration and required ventilatory and inotropic support, demonstrating the predictive value of the SMARTCOP scoring system in identifying patients at risk of worsening clinical outcomes.

c) SMARTCOP as a utility tool for prognosis/outcome:
SMARTCOP serves as a valuable tool for predicting prognosis and outcomes in patients with community acquired pneumonia (CAP). The study categorized outcomes into three groups: Recovered (discharged without oxygen or NIV support), Morbidity (discharged with home oxygen or NIV support), and Expired (deceased during hospital treatment).

Among the low-risk group (SMARTCOP score 0-2), there were no cases of morbidity or mortality observed. In contrast, the very high-risk group (SMARTCOP score >7) exhibited significant morbidity (41%) and mortality (13%).

In the current study, SMARTCOP scores ranging from 0 to 7 were divided into four groups. Chi-square testing revealed a significant association (p=0.030) between SMARTCOP scores and prognosis, with higher scores correlating with increased mortality. Among the patient distribution:

SMARTCOP Score 0-2(low risk): None of the cases required assisted ventilation, and there was no mortality.

SMARTCOP Score 3-4(Moderate risk): All cases required assisted ventilation, with some needing inotropic support, but no mortality was observed.

SMARTCOP Score 5-6(High risk): All patients needed both assisted ventilation and inotropic support, with a 5/24;20.8% mortality rate.

SMARTCOP Score >7(very high risk): All patients required invasive ventilation and inotropic support, with a 4/29;13.7% mortality rate.

In other studies, like **UPHAR GUPTA et al**[16], mortality rates increased linearly with higher SMARTCOP scores, while **PATRICK G.P. CHARLES et al**.[10] found similar correlations between higher SMARTCOP scores, increased need for intensive respiratory and hemodynamic support, and higher mortality rates. The trend suggests that increasing SMARTCOP scores indicate a greater likelihood of requiring intensive respiratory support and are associated with higher mortality rates.

Length of stay:
Finally, when analyzing the length of stay (LOS) and SMARTCOP we could infer that all low- risk group (11/11 100%) had LOS < 2 weeks whereas majority (16/29,55%) of very high -risk group had LOS> 2 weeks. In the study by **Patrick G.P. CHARLES et al**[10], among patients with scores >3, 52 (57.14%) out of 91 patients required a longer length of stay. In a study by **Ehsanpoor et al**[12], which included 143 patients. The mean hospital length of stay was 13.49 ± 5.62 days. Patients with scores >5 had a longer length of stay and a higher need for intensive respiratory or vasopressor support (IRVS).

CONCLUSION:
In conclusion, the SMART-COP scoring system demonstrates significant utility in predicting outcomes and guiding management decisions for patients with community-acquired pneumonia (CAP). Higher SMART-COP scores, particularly >5, are associated with increased morbidity, mortality, and prolonged hospital stays. Patients categorized as high or very high risk based on SMART-COP scores often require intensive respiratory support, including assisted ventilation and inotropic support. These findings align with previous research, highlighting the predictive value of SMART-COP in identifying patients at higher risk of clinical deterioration and the need for intensive care interventions. Implementing the SMART-COP score in clinical practice can facilitate early risk stratification, optimize resource allocation, and improve patient outcomes in CAP management.

Limitations:
1. In this study, the sample size was 80, indicating that the study sample was small, and the primary limitation was the interpretation of results.
2. Results for small studies were less reliable compared to larger studies. Larger studies with more subjects produce narrow confidence intervals (95% to 99%) and more accurate results.
3. Data obtained from this study may not truly reflect the clinical profile of patients in other tertiary care centers as there is unequal distribution of age and gender, which may cause age and gender related bias.

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