Research Article

Evaluation of Two different Scores in Assessing the Severity of Community Acquired Pneumonia: a cross-sectional study in Ismailia, Egypt

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Abstract
Background and Aim of study: Several severity scores have been proposed to predict patient outcome and to guide initial management of patients with community acquired pneumonia (CAP). Most have been derived as predictors of mortality. A study was undertaken to compare the predictive value of these tools using different clinically meaningful outcomes as constructs for ''severe pneumonia''. **Patients and Methods:** This is a descriptive study (cross sectional) was carried out at emergency department of Suez Canal University hospitals and outpatient clinic on 76 patients with a diagnosis of CAP. Clinical and laboratory features at presentation were used to calculate severity scores using the CURB65 score and the SMARTCOP score. The sensitivity and specificity were compared for two different outcomes (mortality, need for ICU admission). The scores were compared based on sensitivity, specificity, and area under the curve (AUC) of the receiver operating characteristic. **Results:** 76 patients were included in the analysis; 17 (22.4%) died, 1 (1.3%) has developed empyema and 59 (77.9%) have returned to normal activity. When the outcome was evaluated for CURB65 score as regard to mortality Sensitivity was: 82.4% and Specificity was: 79.7% and as regard need for ICU admission, Sensitivity was: 94% and Specificity was: 83%. And when the outcome was evaluated for SMARTCOP score as regard to mortality Sensitivity was: 94.1% and Specificity was: 59.3% and as regard need for ICU admission Sensitivity was: 100% and Specificity was: 70%. So the best predictor was SMARTCOP. **Conclusion:** SMART-COP is a new, relatively simple and variable tool that appears to identify accurately patients with CAP who will require intensive respiratory or vasopressor support (IRVS). Our findings suggest that SMART-COP is likely to be a useful advance for clinicians in the accurate prediction of disease severity among patients with CAP. SMART-COP score was better than CURB65 score in predicting risk of mortality and risk of ICU admission in community acquired pneumonia. So SMART-COP score was better in assessing the severity of community.
Key words: Pneumonia severity scores; predictive value of scores; outcome of pneumonia

Introduction
Pneumonia always refers to a syndrome caused by acute infection, usually bacterial, characterized by clinical and /or radiographic signs of consolidation of a part or parts of one or both lungs. However, the use of the term has been greatly extended to include non-bacterial infection of the lungs caused by a wide variety of micro-organisms. It is a common cause of infection related mortality and is one of the most important challenges in clinical medicine.[1]

Clinically it is a constellation of symptoms and sings. Pneumonia which develops outside the hospital is considered as community acquired pneumonia. Pneumonia developing 72 hours or more after hospitalization is Nosocomial or Hospital Acquired. [2]

Community-acquired pneumonia (CAP) is one of the most common serious infective diseases, accounting for nearly 1% of all medical admissions. [3].

Community acquired pneumonia (CAP), which is a very common reason for hospital admission, represents a potentially life-threatening condition. CAP is the first infectious cause of death in developed countries, with an estimate of 10% - 25% of CAP patients do not cure in a timely manner.[4].

The (British Thoracic Society) BTS criteria includes 5 easily measurable factors. Indicators

of increased mortality: confusion (based on a specific mental test or disorientation to person, place, or time), body urea and nitrogen (BUN) level ≥7 mmol/L (20 mg/dL), respiratory rate ≥30 breaths/min, low blood pressure (systolic, <90 mm Hg; or diastolic, ≤60 mm Hg), and age ≥65 years; this gave rise to the acronym CURB-65. Mortality was higher when 3, 4, or 5 factors were present and was reported as 14.5%, 40%, and 57%, respectively. Patients with a CURB-65 score of 0–1 will be treated as outpatients, that those with a score of 2 will be admitted to the wards, and that patients with a score of ≥3 often will require ICU care.[4]

A new score summarized by the acronym SMART-COP (systolic blood pressure, multi-lobar chest radiography involvement, albumin, respiratory rate, tachycardia, confusion, pulse oximetry, and arterial pH) and its simplified version SMART-COP were developed to specifically predict the need for intensive respiratory or vasopressor support. [5]

To evaluate between SMART-COP and CURB65 scores in assessing the severity of community acquired pneumonia by applying the 2 scores on the patients to improve the outcome of the disease in suez canal university hospitals.

As this research hasn't done in Egypt before to compare these 2 scores as we used to work by CURB 65 score.

To improve the outcome of community acquired pneumonia at Suez Canal University hospitals by better assessing its severity.

Patients and Methods

This is a descriptive study (cross sectional) was carried out at emergency department of Suez Canal University hospitals and outpatient clinic on 76 patients with a diagnosis of CAP. Clinical and laboratory features at presentation were used to calculate severity scores using the CURB65 score and the SMARTCOP score. The sensitivity and specificity were compared for two different outcomes (mortality, need for ICU admission). The scores were compared based on sensitivity, specificity, and area under the curve (AUC) of the receiver operating characteristic.

All patients were subjected to full history taking and examination. Following data were recorded including history of contact with patients, number and duration of previous admissions, symptoms and smoking.

Chest x-ray was done to every patient and Laboratory investigations such as Arterial blood gases, CBC, Kidney function tests, Liver function tests, CRP, ESR, Blood culture and sensitivity if needed.

Microbiological Tests were done such as sputum examination: for staining and culture and sensitivity. Sputum specimens were collected and processed immediately in blood agar, chocolate agar, and MacConkey agar media. And antibiotic susceptibility was done [6]

Diagnosis of pneumonia was based on chest radiography within 24 hours of hospital presentation demonstrating features consistent with acute pneumonia and had ≥3 of the following symptoms or signs: cough, sputum production, breathlessness, pleuritic chest pain, hemoptysis, fever (temperature ≥37.8C), headache, and signs consistent with pneumonia on chest auscultation.

The analyzed severity scores were the CURB65 score:

1. Confusion (based on a specific mental test or disorientation to person, place, or time).
2. BUN level ≥7 mmol/L (20 mg/dL).
3. Respiratory rate ≥30 breaths/min.
4. Low blood pressure (systolic, <90 mm Hg; or diastolic, ≤60 mm Hg).
5. Age ≥65 years.

This gave rise to the acronym CURB- 65.

And the SMART-COP:

1. Systolic blood pressure.
2. Multi-lobar chest radiography involvement.
3. Albumin level.
4. Respiratory rate.
5. Tachycardia.
6. Confusion.
7. Oxygenation.
8. Arterial PH.

This was recently described by Charles et al., [7] and was specifically designed to predict the need for intensive respiratory and/or vasopr-essor support. Low and intermediate risk is rated 0–2 on the CURB65 score. High risk is rated ≥3 on the CURB65 score. Low risk is rated 0–2 on the SMART-COP score. High risk is rated >2 on the SMART-COP score.

Ethics

The study was approved by the Ethics Committee of Suez Canal University Faculty of

Medicine. Written, informed consent was obtained from each patient included in this study.

Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0 (Armok, NY: IBM Corp). Qualitative data were described using number and percent. Qualitative data were described using range (minimum and maximum), mean, standard deviation and median. Significance of the obtained results was judged at the 5% level.

Results

Table 1: shows demographic data of the studied patients:

		Studied patients N= 76 patients	
Age	**mean±SD**	59.32±11.05	
	Median	60	
	Range	22 – 80	
Age subgroups	**Youth ≤24**	1	1.3%
	Adults 25-64	49	64.5%
	Seniors ≥65	26	34.2%
Gender	**Male**	42	55.3%
	Female	34	44.7%
History of current Smoking		41	53.9%

This table showed that mean age of studied patients was 59.3 years old, most of them were males and 53.9% of our patients were current smokers.

Table 2: shows symptoms and signs of the studied patients:

	Studied patients N= 76 patients	
Duration of symptoms (days)	6.38±2.25	
Confusion	16	21.1%
Cyanosis	6	7.9%
L.L edema	5	6.6%
Pulse (beat / minute)	96.30±12.25	
Systolic pressure (mmHg)	114.21±16.26	
Diastolic pressure (mmHg)	74.21±10.48	
Temprature (c)	38.34±0.61	
Respiratory rate (Breathe/minute)	31.42±4.98	

This table showed that mean duration of symptoms was 6.3 days. Most of our patients were presented conscious with low proportions of them had been cyanosis and L.L edema.Mean pulse was 96.3 bpm, Systolic blood pressure was 114.2 mmHg, Diastolic blood pressure was 74.2 mmHg, Temprature was 38.3^{o} C, R.R was 31.4 bpm.

Table 3: shows laboratory results of the studied patients:

		Studied patients N= 76 patients	
TLC		13056.5±6917.6	
Urea		53.5±25.8	
S.creat		1.78±1.65	
Na^+		136.07±5.69	
K^+		3.88±0.74	
AST		82.09±264.9	
ALT		80.5±342.8	
Bilirubin		1.33±2.33	
Albumin		2.82±0.59	
CRP		87.9±39.2	
ESR		75.9±31.05	
Sputum culture	**E.Coli**	26	34,2%
	Staph aureus	24	31,6%
	Strept. Pneumonia	18	23.7%
	Klebsiella	4	5,3%
	Staph aureus+ Strept. Pneumonia	2	2,6%
	TB pneumonia	2	2,6%

This table showed that mean TLC was slightly higher than normal 13065.5, S.creat also showed higher value 1.78 mg/dl, urea was elevated 53.5 mg/dl, liver enzymes were slightly elevated, S.albumin was lower than normal 2.8 gm/dl, CRP was elevated 87.9 and additionally ESR was severely high. Most common detected organism in sputum culture was E.coli.

Table 4: differences between survived and died patients regarding laboratory data:

	Died patients N=17		**survived patients n= 59**		**p-value**
	Mean	**±SD**	**Mean**	**±SD**	
Age	64.7	11.30	57,7627	10,56889	0.001*
TLC	15888,2	9706,8	12240,6	5732,4	0.101 NS
S.creat	1,87	0,62	1,75	1,85	0.019*
NA	137,7	5,6	135,6	5,6	0.295 NS
S.albumin	2,55	0,47	2,90	0,60	0.021*
CRP	102,47	22,23	83,75	42,08	0.059 NS
ESR	93,52	19,02	70,83	32,08	0.004*

This table showed that died patients were significantly older, had higher S.ceat, lower Albumin level, and had higher ESR value compared to survived group.

Table 5: differences between survived and died patients regarding sputum culture:

	Died patients N=17		**survived patients n= 59**		**p-value**
	n	**%**	**n**	**%**	
E.Coli	4	23.5	22	39.3	0.113 NS
Staph aureus	10	58.8	14	25	
Strept. Pneumonia	2	11.8	16	27.1	
kebsiella	0	0	4	7.1	
Staph aureus+ Strept. Pneumonia	1	5.9	1	1.8	
TB pneumonia	0	0	2	3.6	

This table showed that no significant differences between both subgroups regarding detected organism in sputum culture.

Table 6: differences between inpatients and ICU patients regarding sputum culture:

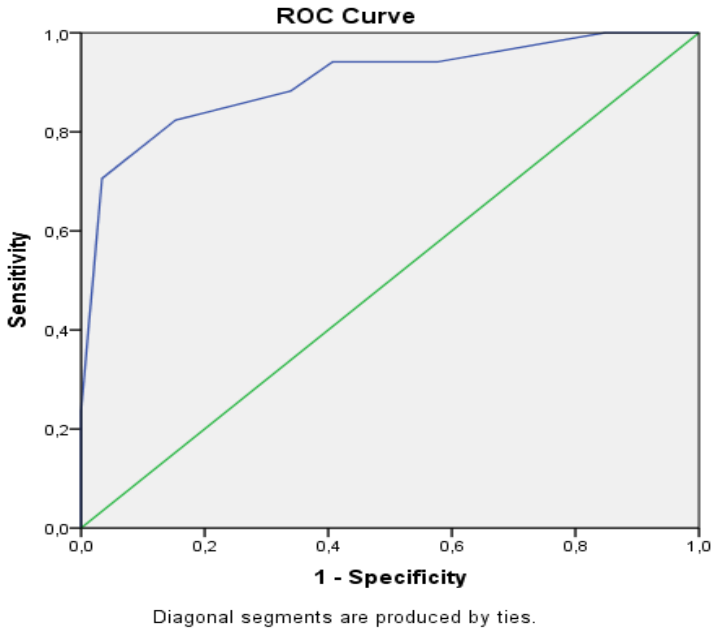
	In patients N=27		ICU patients n= 17		p-value
	n	%	n	%	
E.Coli	8	29.6	5	29.4	0.045 *
Strept. Pneumonia	7	25.9	1	5.9	
Staph aureus	10	37	10	58.8	
Staph aureus+ Strept. Pneumonia	1	3.7	1	5.9	
Tb pneumonia	2	7.4	0	0	
kebsiella	1	3.7	0	0	

This table showed that Staph aureus was associated significantly with ICU admitted patients.

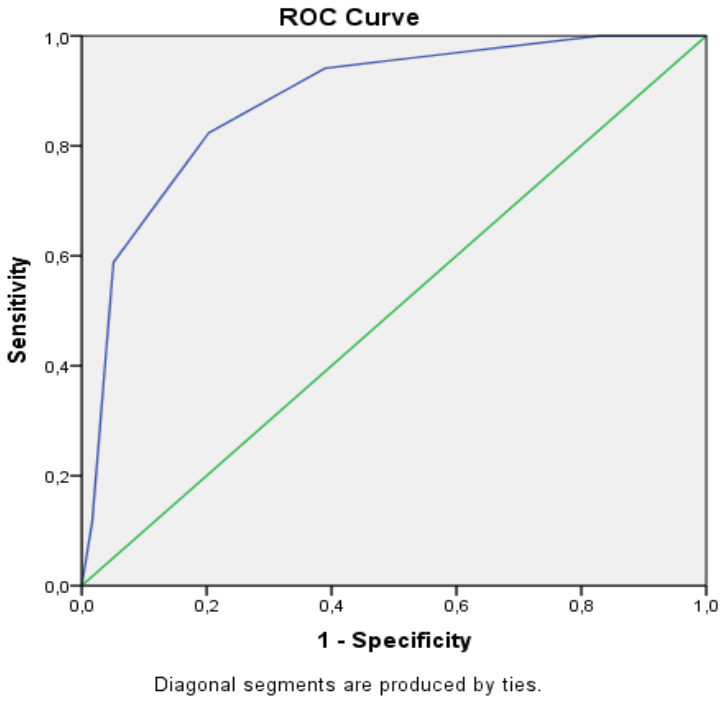
Table 7: shows fate of the studied patients:

	Studied patients N= 76 patients	
Length of hospital stay (days)	4.88±5.5	
Range	0 – 30	
Median	2.5	
Death	17	22.4%
Empyema	1	1.3%
Whether patient return to normal activity	59	77.6%

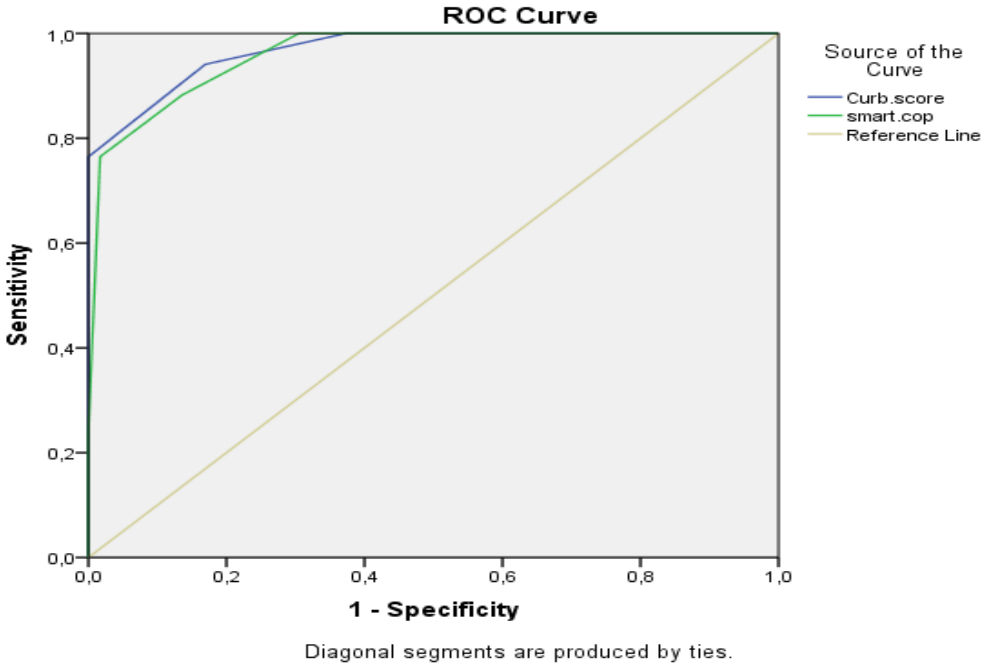
This table showed that mean LOS was 4.88 days, mortality rate was 22.4% with 1 patient who develop empyema. More than two third of our patients had returned to normal activity after treatment.



Roc curve for predicting risk of mortality using SMARTCOP score:
AUC: 0.903
Cut-off value: ≥2.5
Sig: 0.000
Sensitivity: 94.1%
Specificity: 59.3%



Roc curve for predicting risk of mortality using CURB-65 score:
AUC: 0.882
Cut-off value: ≥2.5
Sig: 0.000
Sensitivity: 82.4%
Specificity: 79.7%



Roc curve for predicting risk of ICU admission using both scores:

Score	AUC	Cut-off value	Sig	Sensitivity	Specificity
CURB-65	0.969	≥2.5	0.000	94%	83%
SMART-COP	0.961	≥3.5	0.000	100%	70%

According to CURB65 score:

	Death	Survived
ICU	14	12
Non-ICU	3	50

OR is 19.45 and this means that patients in ICU according to CURB65 score are 19.45 times higher than Non-ICU patients that will die due to severity of infection.

According to SMARTCOP score:

	Death	Survivved
ICU	15	20
Non-ICU	2	39

OR is 14.63 and this means that patients in ICU according to SMARTCOP score are 14.63 times higher than Non-ICU patients that will die due to severity of infection.

According to CURB65 score:

	Death	Survived	Empyema
Cut-off value: ≥2.5	14	11	1
Cut-off value: <2.5	3	49	0

OR is 20.8 and this means that patients with cut-off value: ≥2.5 according to CURB65 score are 20.8 times higher than patients with cut-off value: <2.5 will die due to severity of infection.

According to SMARTCOP score:

	Death	Survived	Empyema
Cut-off value: ≥2.5	16	22	1
Cut-off value: <2.5	1	36	0

OR is 26.2 and this means that patients with cut-off value: ≥2.5 according to SMARTCOP score are 26.2 times higher than patients with cut-off value: <2.5 will die due to severity of infection.

Table 8: shows fate of patients at ER:

	Studied patients N= 76 patients		Acccording to CURB65 score N= 76 patients		Accoring to SMARTCOP score N= 76 patients	
outpatient	30	39.5%	37	48.7%	30	39.5%
Inpatient	29	28.2%	13	17.1%	20	26.3%
ICU admission	17	22.4%	26	34.2%	26	34.2%

This table showed that 22.4% of our patients were admitted ICU from ER, 28.2% had been admitted to inpatient.

Discussion

Severe community-acquired pneumonia (CAP) remains a frequent reason for admission to hospital. It is the most common cause of septic shock requiring escalation to treatment within an intensive care unit (ICU). Despite earlier recognition and recent advances in supportive care, severe CAP is still associated with substantial morbidity and mortality, more often seen in the elderly and those with considerable comorbidities. [8]

Community-acquired pneumonia (CAP) is a common and serious infection that has a reported annual hospitalization rate of 2.75–2.96 per 1000, and an in-hospital mortality rate of up to 14%. However, the mortality of severe CAP is reported to rise to 20%–50%. CAP can induce lung and systemic inflammation, severe sepsis, and acute respiratory distress syndrome (ARDS). [9]

This study evaluated two different scores (SMART-COP and CURB65) in assessing the severity of community acquired pneumonia.

This was a descriptive study (cross sectional) which included 76 patients; most of them were males (42) and (34) females and 41 of our patients were current smokers. Their mean age was 59.32±11.05.

SMART-COP score was better than CURB65 score in:
1- Predicting risk of mortality in community acquired pneumonia.
2- Predicting risk of ICU admission in community acquired pneumonia.
So SMART-COP score was better in assessing the severity of community acquired pneumonia than CURB65 score.

When a Receiver Operating Characteristic curve (ROC curve) was constructed in our study for predicting risk of mortality using CURB-65 score it was found that at a cut-off value of ≥2.5 the sensitivity was 82.4% and the specificity was 79.7% with p-value of 0.000.

Another ROC curve for predicting risk of mortality using SMART-COP score had been drawn considering a cut-off value of ≥2.5 the sensitivity was found 94.1% and the specificity was 59.3% with p-value of 0.000.

Another ROC curve was constructed for predicting risk of mortality using CURB65 and SMARTCOP scores with a cut-off value of >2 The sensitivity was 97% and 100% respectively and the specificity was 16% and 2.8% respectively.[10] This could be explained due to lower cut-off value in that study.

Another ROC curve for predicting risk of ICU admission using both scores :
1- In CURB-65 was with a cut-off value of ≥2.5 the sensitivity was 94% and the specificity was 83% with p-value of 0.000.
2- In SMART-COP was with a cut-off value of ≥3.5 the sensitivity was 100% and the specificity was 70% with p-value of 0.000.

Another ROC curve was constructed for predicting risk of ICU admission using CURB65 and SMARTCOP scores with a cut-off value of 3 and ≥3 respectively the sensitivity was found 38.5% and 92.3% respectively and the specificity was 74.2% and 62.3% respectively. [11]

This is could be explained by lower cut-off value in our study.
In this study we found that 22.4% (17) of our patients were admitted to ICU from ER, 28.2% (29) had been admitted to inpatient and 39.5% (30) of our patients were treated on outpatient basis.

In the current study there was low proportion of patients had been confused 21.1%, cyanosis 7.9% and had lower limb oedema 6.6%. Patients with pulse ≥ 125 beat/minute were 3.9%, systolic blood pressure < 90mmHg were 6.6%, diastolic blood pressure ≤ 60 mmHg were 6.6%, with tachypnea were 57.9% and pulse oximetry < 90% were 50%.

As in our study the results of Patrick G. P. Charles and his colleagues who reported that low proportion of patients had been confused 10.2% while 46% were cyanosed. Patients with pulse ≥ 125 beat/minute were 16.3%, systolic blood pressure < 90mmHg were 5.3%, diastolic blood pressure ≤ 60 mmHg were 32.8%, with tachypnea were 26% and pulse oximetry < 90% were 26.2%.[12]

Most common detected organism in sputum culture was E.coli then Staph aureus then Strept. Pneumonia and last Klebsiella. This

result disagree with Niclas Johansson and his colleagues who reported that streptococcus pneumonia is the most common organism detected. [13]
This may be due to emergence of multi-drug resistant organism due to antibiotic abuse by patients or their doctors.

In this study we found that died patients were significantly older, had higher Serum creatine, lower Albumin level and had higher ESR value compared to survived group with mean of each as 64.7 years old, 15888,2 in TLC, 1,87 mg/dl in Serum creatine, 2,55 mg/dl in Serum albumin and 93,52 in ESR.

As regard to the results of Eric M. and his colleagues who reported pneumonia related mortality; acute physiological or laboratory derangements, such as, hypothermia, decreased white blood cell count, elevated serum urea nitrogen level and hypoxemia were independent predictors of mortality. For pneumonia unrelated mortality, systolic hypotension was the only acute physiological derangement associated with mortality. Increasing age and evidence of aspiration were the only risk factors associated with pneumonia related and pneumonia unrelated mortality. Increasing age is a significant risk factor for mortality after community acquired pneumonia. [14]

This study showed that survived patients were 59 patients and 17 died patients and also showed that no significant differences between both subgroups regarding detected organism in sputum culture. However most common detected organism in sputum culture in survived patients was E.coli with 22 patients and most common detected organism in sputum culture in died patients was Staph. aureus in 10 died patients. This result is in accordance with Ewig S. And his colleagues who reported that the most detected organisms that cause death is staph. Aureus. [15]

This study showed that Staph aureus was associated significantly with ICU admitted patients with p-value of 0.045 with 58.8% of patients who admitted to ICU and also was 37% in patients who admitted to Inpatient. So Staph. aureus was the most detected organism in community acquired patients who admitted to Hospital much more in ICU patients. This result is in accordance with Kollef Mh. and his colleagues who reported that MRSA is the most common organism in patients who needed ICU.[16]

In this study we found that no differences between smokers and non-smokers regarding detected organisms in sputum culture. With most detected organism in sputum culture in Non-smoker patients is Staph. aureus with 41.2% and in smoker patients is E.coli with 35.9%. this result disagree with Jacups Sp. and his colleagues who reported that the risk of bacteraemic pneumococcal pneumonia in adults was significantly higher in current smokers than in those who have never smoked or are not currently smoking. [17]

This discrepancy in results of sputum culture and sensitivity could be explained to many factors:

1- Our people usually seek medical advice late after a transient time during which they received empirical antibiotics through pharmacists (without medical prescriptions).
2- Also, The unavailability of drugs (either due to unavailability in pharmacy or due to low income of many) patients can't receive proper treatment in the proper time and patients got many attacks of infection ill become seriously ill and lastly visit hospital for treatment.
3- May if this study has been done on large number of patients, Results could have been changed.

Conclusion

SMART-COP is a new, relatively simple and variable tool that appears to identify accurately patients with CAP who will require intensive respiratory or vasopressor support (IRVS). Our findings suggest that SMART-COP is likely to be a useful advance for clinicians in the accurate prediction of disease severity among patients with CAP. SMART-COP score was better than CURB65 score in predicting risk of mortality and risk of ICU admission in community acquired pneumonia. So SMART-COP score was better in assessing the severity of community.

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