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COMPREHENSIVE ASSESSMENT OF CURB-65 SCORE IN RESPIRATORY DISTRESS: PREDICTIVE INSIGHTS INTO CLINICAL OUTCOMES AND MORTALITY RISK

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Abstract

Background: Community-acquired pneumonia (CAP) remains a major public health concern globally, with a significant impact on mortality, particularly in developing nations such as India.

Aim: This study prospectively evaluates the predictive efficacy of blood lactate levels and the CURB-65 score in Community-Acquired Pneumonia (CAP) patients upon Emergency Department admission., filling a critical gap in understanding CAP prognosis in the Indian population.

Methodology: This prospective observational study was conducted at a tertiary care hospital and included 90 consecutive adults (age >18 years) presenting to the emergency department with clinically diagnosed community-acquired pneumonia (CAP). Exclusions comprised individuals with hospital-acquired pneumonia, aspiration pneumonia, septic shock at presentation, chronic liver or kidney disease, or those referred/discharged pre-admission. Data encompassed comprehensive patient details, vital signs, lab results, and CURB-65 score. Admission blood lactate levels were categorized into three groups. Comparative analyses included clinical features, site of care, duration, and mortality rates, applying appropriate statistical tests. Significance was set at $P<0.05$.

Results: This study of 90 CAP patients revealed that historical features, comorbidities, and clinical parameters significantly varied across CURB-65 classes. Haemoglobin, blood sugar, and blood urea demonstrated class-specific associations. CURB-65 showed limited predictive accuracy for ICU admission but a significant correlation with mortality. Blood lactate, particularly in higher groups, exhibited strong correlations with outcomes. A blood lactate cutoff of >3.45 mmol/L predicted ICU

admission and mortality with higher sensitivity than CURB-65. These findings underscore the potential of blood lactate as a prognostic marker in CAP.

Conclusion: Incorporating blood lactate measurements, especially for those deemed low or intermediate risk by CURB-65, enhances sensitivity and risk stratification accuracy. While CURB-65 retains significance, our results endorse the combined use of blood lactate levels for a more nuanced and accurate clinical evaluation of community-acquired pneumonia patients.

Keywords: Blood lactate levels, Community-acquired pneumonia, CURB-65 severity score.

INTRODUCTION

Community-acquired Pneumonia (CAP) remains a significant contributor to mortality, particularly in developing nations like India. This respiratory infection and other acute respiratory infections account for a substantial portion of global morbidity and mortality. In India alone, lower respiratory tract infections accounted for approximately 20% of infectious disease-related deaths in 2008, highlighting the pressing need for effective management strategies.[1,2]

Despite the substantial burden of CAP in terms of mortality and morbidity, comprehensive studies investigating factors associated with adverse prognoses in CAP patients in India are relatively scarce.[3] Prognostic markers are crucial for early identification of high-risk individuals who may require intensive care interventions. The importance of assessing prognostic factors is further emphasized because CAP incidence varies significantly between developing and developed countries, ranging from 20%-30% to 3-4%, respectively.[3]

In recent years, efforts have been made to identify biomarkers that could assist in the early identification of patients at high risk of morbidity and mortality due to CAP. One such biomarker under investigation is lactate concentration, with some studies demonstrating a correlation between baseline lactate levels and mortality in CAP patients.[4]

Historically, the understanding of lactate's role in the body dates back to the 19th century, and research has evolved to reveal its association with exercise intensity, oxygen availability, and muscle contraction. Elevated blood lactate levels have been observed in various clinical conditions, including hypoxia, hypovolemia, tissue hypoperfusion, and increased tissue metabolism. The multifactorial etiology of increased blood lactate levels suggests its potential relevance in patients with CAP, where factors like decreased oxygen delivery and increased work of breathing may contribute to its elevation.[5]

Several severity scoring systems, such as the Pneumonia Severity Index (PSI) and CURB-65, have been developed to assess the severity of CAP and classify patients into different risk groups.[6] While these systems guide initial management, their limitations, such as complexity and potential underestimation of severity in specific patient populations, warrant exploration of additional prognostic markers.[7]

This prospective observational correlation study aims to assess the predictive value of blood lactate levels and the CURB-65 score in patients with CAP upon arrival at the Emergency Department. By examining the correlation between these parameters and outcomes, such as the site of care and mortality, this study seeks to contribute valuable insights into improving the prognostic assessment of CAP patients, particularly in the context of the Indian population.

METHODOLOGY

This was a prospective observational study conducted at a tertiary care hospital.

Study Population

The study population included 90 consecutive adult patients (age >18 years) presenting to the emergency department with a clinical diagnosis of community-acquired Pneumonia based on defined criteria.

Patients were excluded if they had hospital-acquired Pneumonia, aspiration pneumonia, septic shock at presentation, chronic liver disease, chronic kidney disease, or were referred/discharged before admission.

Data Collection

A detailed history, exam findings, vital signs, and lab results were documented for all patients on admission. Blood lactate levels were measured by spectrophotometry. The emergency physician calculated the CURB-65 score. Patients were admitted to the ward or ICU per CURB-65 severity class. Any changes in site of care, complications, and outcomes were recorded during hospitalization. Study Groups Patients were divided into 3 groups based on admission blood lactate levels: Group I - <2.2 mg/dL, Group II - 2.21-4 mg/dL, and Group III - >4 mg/dL.

Analysis Groups were compared for clinical features, site of care, hospital/ICU duration, and mortality rate. Subgroup analysis was performed based on the CURB-65 class. ANOVA, Chi-square, Mann-Whitney U, and ROC curve tests were applied as appropriate. $P<0.05$ was considered statistically significant.

RESULTS

Table 1 shows that 100% of CAP patients who presented to the Emergency department had a history of cough across all the classes of CURB 65. history of purulent sputum was present in about 75% of patients in Class I, 85% in Class II, and 100% in Class III; history of fever was present in about 85% of patients in Class I, 100% in Class II and 90% in class III. In comparison, a history of smoking was present in about 39% of patients in Class I, 35.7% in Class II and 38% in Class III. Over 100% of patients had a history of cough, 87% of patients had Purulent sputum, 91% of patients had a fever, and about 38% of patients had a history of smoking. In the study group of 90 CAP patients, about 33% had Diabetes Mellitus (DM), 52% had Hypertension (HTN), 17% had Bronchial Asthma (BA), 19% had Chronic Obstructive Pulmonary Disease (COPD), 21% patients had other comorbid diseases like Ischemic Heart Desease (IHD), Atrial Fibrillation, Hypothyroidism. 82% of patients had a respiratory rate of more than 30/min, about 89% had Temperatures above 40ºC, and all 90 patients had crackles.

	CURB-65			
History	**Class I (n=33)**	**Class II (n=28)**	**Class III (n=29)**	**Total (n=90)**
Cough	33(100%)	28(100%)	29(100%)	90(100%)
Purulent sputum	25(75.76%)	24(85.7%)	29(100%)	78(86.7%)
Fever	28(84.8%)	28(100%)	26(89.7%)	82(91.1%)
Smoking	13(39.4%)	10(35.7%)	11(37.9%)	34(37.8%)
Comorbidities				
Nil	10(30.3%)	1(3.6%)	8(27.6%)	19(20%)
DM	12(36.4%)	8(28.6%)	10(34.5%)	30(33.3%)
HTN	18(54.6%)	17(60.7%)	12(41.4%)	47(52.2%)
BA	3(9.1%)	8(28.6%)	4(13.8%)	15(16.7%)
COPD	6(18.2%)	7(25%)	4(13.8%)	17(18.9%)
Others	10(30.3%)	1(3.6%)	8(27.6%)	19(21.1%)
Clinical examination				
Respiratory rate >30/min	18(54.5%)	27(96.4%)	29(100%)	74(82.2%)
Temperature > 40ºC	27(81.8%)	26(92.8%)	27(93.1%)	80(88.9%)
Crackles	33(100%)	28(100%)	29(100%)	90(100%)

Table 1: Distribution of Clinical History and Examination Parameters Based on CURB-65 Classes in Patients with Community-Acquired Pneumonia

61% of patients had Haemoglobin of >12gm% and 62 % of CURB-65 class III had Haemoglobin less than 12gm%, the comparison was statistically significant. The random blood sugar was more than 150 in about 75% of the CURB-65 class III patients. About 58% of patients in class I had blood sugars less than 150 mg. The comparison was statistically significant. The blood urea was more than 23 in 34.4% of patients, and as blood urea is one of the components of CURB-65, it was significantly elevated in class III at 93.1%. It was seen to be elevated in only 6.5% of patients in Class I and II together. The statistical analysis was found to be significant shown in Table 2.

Haemoglobin (g/dl)	**CURB-65**				**p-value**
	Class I	**Class II**	**Class III**	**Total**	
<12	12(36.4%)	5(17.9%)	18(62.1%)	35(38.9%)	0.005
12-14	9(27.3%)	13(46.4%)	8(27.6%)	30(33.3%)	
>14	12(36.4%)	10(35.7%)	3(10.3%)	25(27.8%)	
Total	33(100%)	28(100%)	29(100%)	90(100%)	
Mean ± SD	12.71±2.47	13.31±2.23	11.22±2.49	12.42±2.53	
Random Blood sugar					
<150	19(57.6%)	12(42.9%)	8(27.6%)	39(43.3%)	0.001
150-300	12(36.4%)	16(57.1%)	16(55.2%)	44(48.9%)	
>300	2(6.1%)	0(0%)	5(17.2%)	7(7.8%)	
Total	33(100%)	28(100%)	29(100%)	90(100%)	
Mean ± SD	166.94±63.88	161.96±38.58	219.90±82.93	182.46±69.00	
Blood Urea					
<8	0(0%)	0(0%)	0(0%)	0(0%)	0.001
8 - 23	30(90.9%)	27(96.4%)	2(6.9%)	59(65.6%)	
>23	3(9.1%)	1(3.6%)	27(93.1%)	31(34.4%)	
Total	33(100%)	28(100%)	29(100%)	90(100%)	
Mean ± SD	16.36±4.80	17.14±3.93	27.90±3.99	20.32±6.76	

Table 2: Comparison of Haemoglobin Levels, Random Blood Sugar, and Blood Urea Based on CURB-65 Classes in Patients with Community-Acquired Pneumonia

Table 3 CURB-65 risk assessment could not predict the severity in 5 patients who belonged to Class I (3 patients) and Class II (2 patients) and were initially admitted to the ward but were later shifted to the ICU due to clinical deterioration. P-value shows that it is statistically not significant. Mortality assessment of CURB-65 has a very significant p-value, indicating that the higher the CURB-65 risk score, the higher the mortality risk.

	CURB 65				
Patients Shifted from the Ward to the ICU	**Class I**	**Class II**	**Class III**	**Total**	**P value**
No	30(90.9%)	26(92.9%)	29(100%)	85(94.4%)	0.317
Yes	3(9.1%)	2(7.1%)	0(0%)	5(5.6%)	
Mortality					
No	31(93.9%)	28(100%)	22(75.9%)	81(90%)	0.005
Yes	2(6.1%)	0(0%)	7(24.1%)	9(10%)	

Table 3: Comparison of Patients Shifted from Ward to ICU and Mortality Based on CURB-65 Classes in Patients with Community-Acquired Pneumonia

The duration of hospital stay varied in all the classes. As the CURB-65 risk score increased, the mean duration of hospital stay also increased from 5.33 days in Class I to 8.83 days in Class III, which was statistically significant. Duration of ICU stay was significantly higher in Class III as all the Class III patients were admitted to the ICU. The association is statistically significant. However, there were varied durations in all the classes and no linear correlation between CURB-65 and the duration of ward stay. The association is statistically not significant shown in Table 4.

CURB 65					
Total days of hospital stay					
1-5	19(57.6%)	13(46.4%)	11(37.9%)	43(47.8%)	0.054
6-10	13(39.4%)	11(39.3%)	12(41.4%)	36(40%)	
11-15	0(0%)	2(7.1%)	1(3.4%)	3(3.3%)	
16-20	1(3%)	1(3.6%)	3(10.3%)	5(5.6%)	
>20	0(0%)	1(3.6%)	2(6.9%)	3(3.3%)	
Mean ± SD	5.33±3.12	6.96±4.93	8.83±7.89	6.97±5.71	
ICU Stay					
0	30(90.9%)	26(92.9%)	1(3.4%)	57(63.3%)	0.001
1-5	3(9.1%)	2(7.1%)	21(72.4%)	26(28.9%)	
6-10	0(0%)	0(0%)	5(17.2%)	5(5.6%)	
11-15	0(0%)	0(0%)	2(6.9%)	2(2.2%)	
Mean ± SD	0.24±0.83	0.25±0.93	4.14±3.82	1.50±2.91	
Ward Stay					
0	0(0%)	0(0%)	8(27.6%)	8(8.9%)	0.195
1-5	20(60.6%)	13(46.4%)	12(41.4%)	45(50%)	
6-10	12(36.4%)	12(42.9%)	8(27.6%)	32(35.6%)	
11-15	0(0%)	2(7.1%)	0(0%)	2(2.2%)	
>15	1(3%)	1(3.6%)	1(3.4%)	3(3.3%)	
Mean ± SD	5.09±2.96	6.68±4.64	4.69±5.33	5.46±4.39	

Table 4: Comparison of Total Days of Hospital Stay, ICU Stay, and Ward Stay Based on CURB-65 Classes in Patients with Community-Acquired Pneumonia

Table 5 presents the correlation analysis results for blood lactate levels and CURB-65 classes in predicting clinical outcomes in patients with community-acquired pneumonia. The findings suggest that blood lactate levels, especially in Group II & III and III, show significant correlations with sensitivity, specificity, and predictive values, indicating their potential as prognostic indicators. CURB-65 Class III also demonstrates significant correlations, emphasizing its role in predicting outcomes.

	Correlation					
	Se	**Sp**	**PPV**	**NPV**	**Accuracy**	**P value**
Lactate levels						
Group I	0	45.68	0	80.43	41.11	1
Group II & III	100	54.32	19.57	100	58.89	0.001**
Group III	55.56	92.59	45.45	94.94	88.89	<0.001**
CURB 65						
Class I	22.22	63.95	6.06	88.71	60.02	0.407
Class II & III	77.78	38.27	12.28	93.94	42.22	0.343
Class III	77.78	72.84	24.14	96.72	73.33	0.002**

Table 5: Correlation of Blood Lactate Levels and CURB-65 Classes with Sensitivity (Se), Specificity (Sp), Positive Predictive Value (PPV), Negative Predictive Value (NPV), Accuracy, and P-Value in Patients with Community-Acquired Pneumonia

Figure 1 shows a blood lactate value of >3.45 predicted ICU admission with a sensitivity of 91.4% and specificity of 74.5%. While a CURB-65 score of >2 predicted ICU admission with a sensitivity of 82.9% and specificity of 100%. A blood lactate value of >3.45 predicted mortality with a sensitivity of 100% and specificity of 85.2%. While a CURB-65 value of >2 predicted mortality with a sensitivity of 77.8% and specificity of 72.8% depicted in Figure 2.

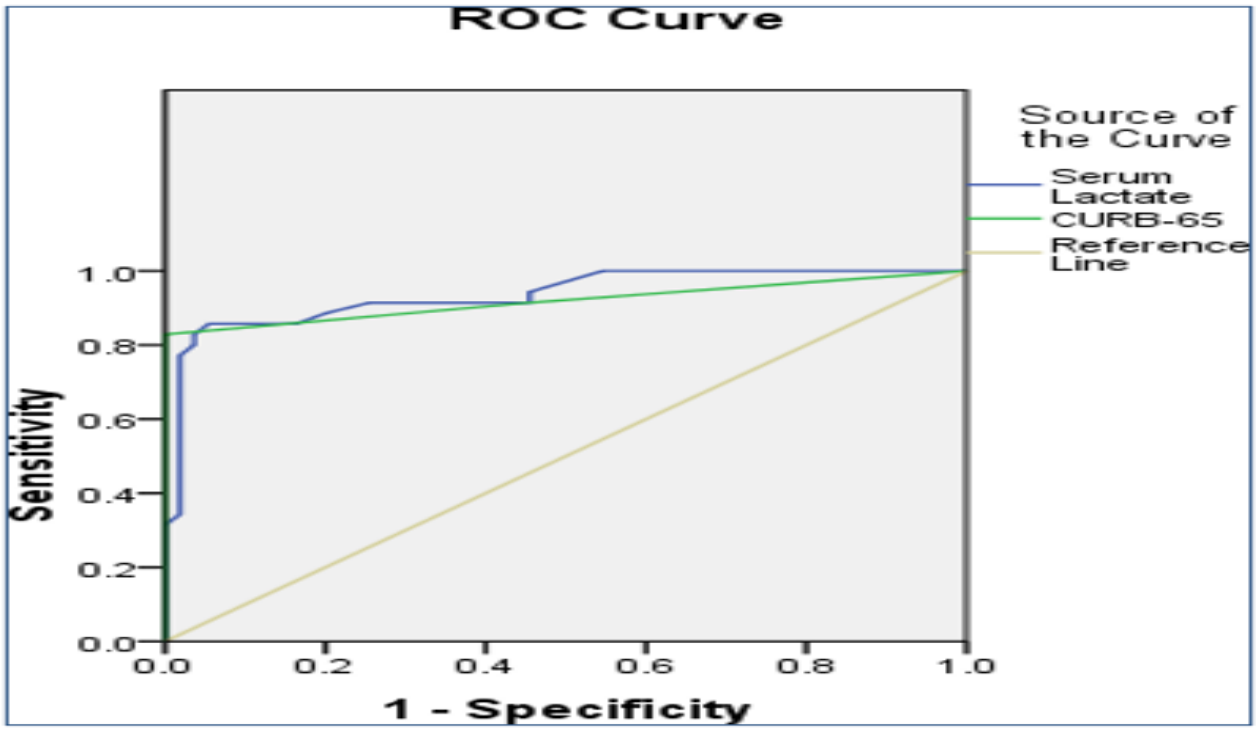

Figure 1: *ROC Curve for prediction of ICU admission from Blood Lactate and CURB65*

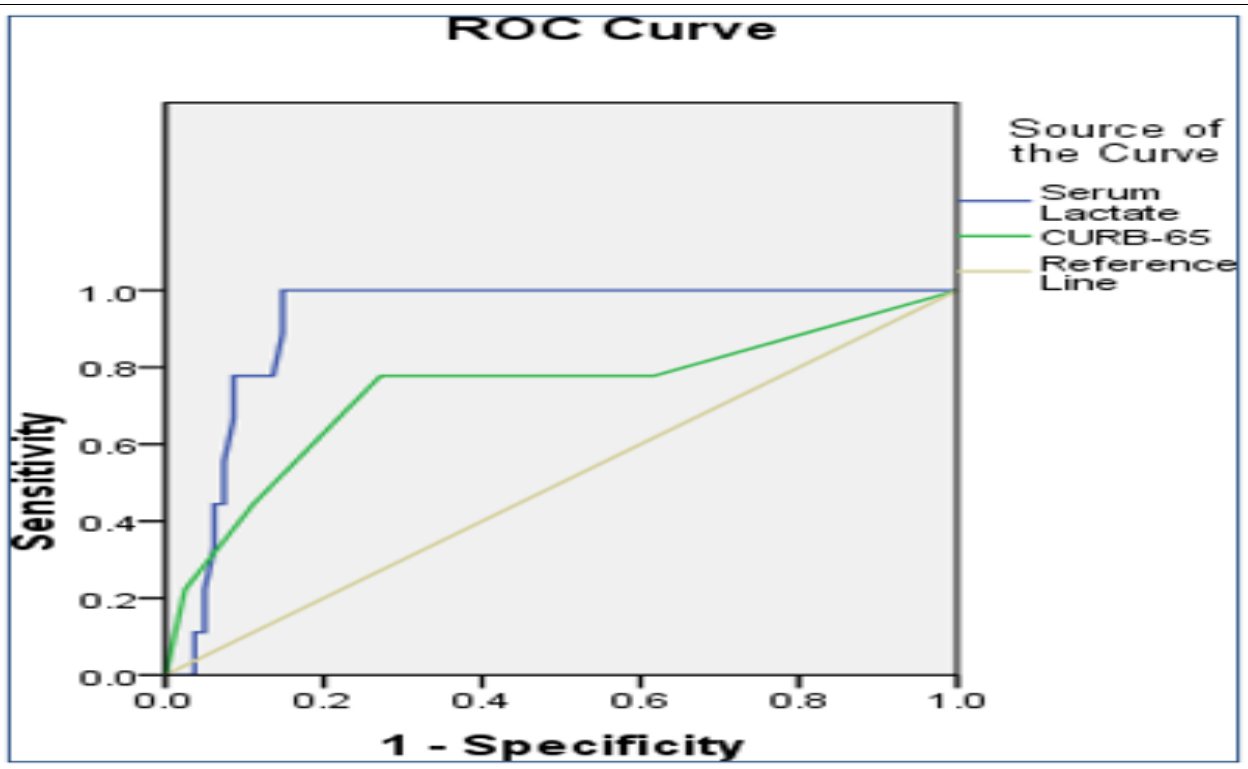

Figure 2: *ROC Curve for prediction of mortality from Blood Lactate and CURB-65*

DISCUSSION

Our study aimed to critically evaluate the effectiveness of the CURB-65 severity score compared to blood lactate levels for predicting ICU admission and mortality risk in a cohort of 90 hospitalized patients with community-acquired Pneumonia (CAP). The findings illuminate the challenges associated with using CURB-65 as a standalone tool for triaging patients and underscore the potential value of integrating blood lactate measurements into the clinical decision-making process.

Our study revealed notable limitations when relying solely on the CURB-65 score for patient triage. A striking 6% of patients classified as low or intermediate risk by CURB-65 (Class I or II) necessitated ICU transfer after initial ward admission. It echoes earlier analyses indicating that CURB-65 may lack the necessary sensitivity, particularly in younger patients where age can disproportionately contribute to the score and potentially overestimate mortality risk.[8] Despite having a specificity of 100%, the sensitivity of CURB-65 was 82.9% in predicting the need for critical care in our cohort. In contrast, admission blood lactate levels exceeding 3.45 mmol/L demonstrated superior sensitivity (91.4%) and a negative predictive value of 94.9% for identifying patients ultimately requiring ICU care. In a previous study by *Ananda-Rajah MR et al.,* out of 408 episodes studied, an overall 30-day mortality of 15.4% and ICU admission of 10.5% was observed. There were 8 deaths and 7 ICU admissions with CURB-65 scores of 0-1. Although easier to use, CURB-65 is neither sensitive nor specific for predicting mortality in CAP patients.[9] Similarly, a study by *Shah BA et al.* reported sixteen patients (10.7%) died CURB65, class II 2 (12.5%) patients died, while 14 patients from class III died.[10]

In assessing mortality risk, admission blood lactate levels above 2.2 mmol/L exhibited superior sensitivity (100%) compared to CURB-65 (77.8%). This enhanced sensitivity suggests that blood lactate measurement at admission allows for the more precise identification of patients at the highest risk of death. Furthermore, the group with higher lactate levels (>4 mmol/L) exhibited markedly better positive predictive value compared to CURB-65 Class III (45.5% vs 24.4%), which suggests that blood lactate levels, especially when elevated, may provide valuable insights for risk stratification and could be considered with CURB-65 for more accurate mortality risk assessments. These findings align with previous analyses by Shapiro et al., which emphasized the robust predictive value of admission lactate levels >4 mmol/L for mortality in infected patients.[11]
In our study, CURB-65 scores were significantly associated with increasing hospital and ICU lengths of stay, reinforcing its utility as a predictive tool. It aligns with systematic reviews concluding that CURB-65 provides accurate 30-day mortality risk stratification without underestimation in CAP cohorts.[12] However, our findings advocate for the complementary use of admission blood lactate measurements to enhance the precision of site-of-care decisions and mortality risk assessments.

CONCLUSION

In conclusion, our study underscores the challenges of relying solely on the CURB-65 severity score for ICU admission decisions and mortality risk assessments in CAP patients. The integration of blood lactate measurements, particularly for patients classified as low or intermediate risk by CURB-65, demonstrates potential benefits in improving sensitivity and risk stratification accuracy. While CURB-65 remains a valuable prognostic tool, our findings advocate for the synergistic use of blood lactate levels for a more comprehensive and precise clinical assessment of patients with community-acquired pneumonia.

REFERENCES

1. Regunath H, Oba Y. Community-Acquired Pneumonia. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing 2023.
2. Manikam L, Lakhanpaul M. Epidemiology of community acquired pneumonia. Paediatr Child Health 2012;22(7):299-306.
3. Schmedt N, Heuer OD, Häckl D, et al. Burden of community-acquired pneumonia, predisposing factors and health-care related costs in patients with cancer. BMC Health Serv Res. 2019;19:30.
4. Méndez R, Aldás I, Menéndez R. Biomarkers in community-acquired pneumonia (Cardiac and Non-Cardiac). J Clin Med 2020;9(2):549.
5. Goodwin ML, Harris JE, Hernández A, Gladden LB. Blood lactate measurements and analysis during exercise: a guide for clinicians. J Diabetes Sci Technol Online 2007;1(4):558-69.

6. Bradley J, Sbaih N, Chandler TR, et al. Pneumonia severity index and curb-65 score are good predictors of mortality in hospitalized patients with SARS-CoV-2 community-acquired pneumonia. Chest 2022;161(4):927-36.
7. Niederman MS. Making sense of scoring systems in community acquired pneumonia. Respirology. 2009;14(3):327-35.
8. Chalmers JD, Singanayagam A, Hill AT. Predicting the need for mechanical ventilation and/or inotropic support for young adults admitted to the hospital with community-acquired pneumonia. Clin Infect Dis Off Publ Infect Dis Soc Am 2008;47(12):1571–4.
9. Ananda-Rajah MR, Charles PGP, Melvani Set al. Comparing the pneumonia severity index with CURB-65 in patients admitted with community acquired pneumonia. Scand J Infect Dis 2008;40(4):293-300.
10. Shah BA, Ahmed W, Dhobi GN, et al. Validity of pneumonia severity index and CURB-65 severity scoring systems in community acquired pneumonia in an Indian setting. Indian J Chest Dis Allied Sci 2010;52(1):9-17.
11. Shapiro NI, Howell MD, Talmor D, et al. Serum Lactate as a Predictor of Mortality in Emergency Department Patients with Infection. Ann Emerg Med. 2005;45(5):524-8.
12. Chalmers JD, Taylor JK, Mandal P, et al. Validation of the Infectious Diseases Society of America/American Thoratic Society minor criteria for intensive care unit admission in community-acquired pneumonia patients without major criteria or contraindications to intensive care unit care. Clin Infect Dis Off Publ Infect Dis Soc Am 2011;53(6):503-11.