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ORIGINAL ARTICLE

PREDICTING THE ROLE OF ADMISSION BLOOD PRESSURE PARAMETERS FOR SHORT-TERM CLINICAL OUTCOME IN COMMUNITY-ACQUIRED PNEUMONIA AT A TERTIARY CARE HOSPITAL IN BANGLADESH

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Abstract:

Background: *Community-acquired pneumonia (CAP) remains a life-threatening condition, especially in developing countries. On admission, blood pressure parameters can be crucial in assessing disease severity. The aim of the study was to identify hemodynamic predictors of for* short-term Clinical Outcome *in patients in CAP.* ***Methods:*** *This prospective observational study was conducted in the Department of Medicine at Dhaka Medical College Hospital from September 2022 to August 2023 and included 150 patients diagnosed with CAP. Blood pressure measurements were taken within four hours of admission. All patients received standard treatment as per hospital protocol. The attending physician decided to initiate inotropic support and need for mechanical ventilation. The primary outcomes assessed were 30-day mortality and the requirement for inotropic support or mechanical ventilation. Follow-up assessments were conducted on days 3 and 7 or at discharge, whichever occurred earlier. An additional follow-up was performed via telephone on day 30. Data were recorded on a structured data collection sheet. Multivariate logistic regression was performed to identify independent predictors. Moreover, receiver operating characteristic (ROC) curve analysis was conducted to evaluate predictive performance.* ***Results:*** *Fourteen percent of 150 patients died on admission and 23.3% needed ventilation/inotropes. At 30 days, mortality was 22.6% and 34.7% needed ventilation/inotropes. sBP<90 mmHg, dBP d"60 mmHg, pulse pressure ≤40 mmHg, and MAP <70 mmHg were significant for both outcomes (p<0.001). On multivariate analysis, systolic BP <90 mm Hg (OR 5.439; CI 1.565–18.895) and MAP <70 mm Hg (OR 4.465; CI 1.280–15.579) were found to be predictors of 30-day mortality. These also were predictive of the need for ventilation/inotrope (ORs 2.958 and 2.807). ROC analysis showed very good predictive power of systolic BP (AUC 0.852–0.922) and MAP (0.835–0.914), good-to-moderate of diastolic BP and pulse pressure.* ***Conclusion:*** *Upon admission, systolic blood pressure and MAP are strong predictors of short-term mortality and requirement of advanced support in CAP patients.*

On admission, Systolic and mean arterial pressure are key predictors of 30-day mortality and the need for mechanical ventilation or inotropic support in community-acquired pneumonia patients.

Keywords: *Blood Pressure Parameters,* Community-acquired Pneumonia,

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Introduction:

The morbidity and mortality in community-acquired pneumonia (CAP) is a vital issue till now. Epidemiological studies suggest that the incidence of CAP is approximately 20% to 30% in developing countries, compared to 3% to 4% in developed nations.[1-3]

Hemodynamic status is a core component of widely accepted pneumonia severity scoring systems, such as the Pneumonia Severity Index (PSI)[4] and CURB-65.[5] The PSI designates systolic blood pressure (SBP) <90 mm Hg as a high-risk feature, while the CURB-65 and CRB-65 criteria consider either SBP <90 mm Hg or diastolic blood pressure (DBP) d"60 mm Hg as indicators of severity.[6]

Previous research has indicated that low DBP is independently associated with mortality, irrespective of SBP. Consequently, elevated pulse pressure (PP) may also be linked with poorer outcomes, as British et al. and the Public Health Laboratory Service reported in 1987. A subsequent study by Chalmers et al.[7] further investigated this association.

Chalmers et al.[7] conducted an extensive prospective observational study in Edinburgh, UK, involving 1,007 patients with CAP. The study compared various hemodynamic parameters at admission—including SBP, DBP, mean arterial pressure (MAP), and PP—and assessed their associations with 30-day mortality and the requirement for mechanical ventilation and/or inotropic support. Their findings demonstrated that admission SBP <90 mm Hg, DBP ≤60 mm Hg, MAP <70 mm Hg, and PP ≤40 mm Hg were significantly associated with increased mortality and the need for advanced supportive measures. Their study also suggested that the CURB-65 score could be simplified to a modified CRB-65 by omitting the DBP criterion without compromising prognostic accuracy.

In another prospective observational study conducted by Aziz et al. in a similar setting, mortality in CAP was significantly associated with low DBP (P = 0.04)[8].

These findings demand incorporating hemodynamic indicators into severity assessment tools to guide timely and appropriate clinical interventions. Prior studies have consistently shown that SBP <90 mm Hg or DBP ≤60 mm Hg correlates with adverse outcomes, and decreased MAP is also a predictor of mortality in acutely ill patients.

However, inconsistencies remain regarding the relative predictive value of different blood pressure indices. Moreover, to our knowledge, no study has yet been conducted in Dhaka Medical College Hospital (DMCH) or any other major hospital in Bangladesh to compare various blood pressure parameters with CAP outcomes directly.

Therefore, the present study evaluated the association between admission blood pressure measurements and 30-day outcomes—including mortality and the need for mechanical ventilation or inotropic support—in patients with CAP admitted to a tertiary care hospital in Bangladesh. The findings may contribute to refining existing risk stratification models or developing a simplified, locally applicable severity scoring tool for CAP.We therefore hypothesized that admission blood pressure parameters—particularly systolic blood pressure and mean arterial pressure—would serve as independent predictors of short term mortality and the need for inotropic or ventilatory support in CAP patients.

Methods:

This prospective cohort study was conducted in the Department of Medicine, Dhaka Medical College Hospital (DMCH), Dhaka, from September 2022 to August 2023, primarily identifying hemodynamic predictors of short term clinical outcomes in patients with community-acquired pneumonia (CAP). Blood pressure measurements—including systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and pulse pressure (PP)—were recorded within four hours of hospital admission, prior to intravenous fluid administration or inotropic agents, except for patients who had received prehospital resuscitation. The following cut-off values, derived from previous studies, were used to define increased risk: SBP <90 mm Hg, DBP ≤60 mm Hg, MAP <70 mm Hg, and PP <40 mm Hg. All patients received standard CAP treatment per hospital protocol, and the attending physicians made decisions regarding inotropic or ventilatory support based on clinical judgment.

Although a larger sample size would have improved the power and external validity, the present sample of 150 patients was determined based on feasibility within the study period. Nonetheless, this cohort was sufficient to detect significant associations between blood pressure parameters and 30-day outcomes, as reflected in the narrow confidence intervals of our multivariate models. Inclusion criteria were age above 18 years, new infiltrates on chest radiographs, and at least three clinical features of pneumonia (e.g., cough, fever, dyspnea, or chest pain). Patients with hospital-acquired pneumonia, active malignancy, immuno-suppression, pulmonary embolism, or those under palliative care were excluded. Baseline demographic data—including age, sex, comorbidities, and smoking status—were recorded. The study objectives were to compare admission blood pressure parameters with

disease severity and to evaluate their prognostic value in predicting 30-day mortality and the need for mechanical ventilation or inotropic support.

Patients were followed up on day 3, day 7, or at discharge, whichever occurred earlier. The need for inotropic support and/or mechanical ventilation was documented during these visits. Patients referred to intensive care units (ICU) or high-dependency units (HDU) were also included in outcome analyses.

A 30-day follow-up was conducted via telephone to assess post-discharge mortality, readmission, or the need for further inotropic support. If patients were unreachable, text messages were sent, and alternative contact numbers were attempted. The case was considered censored if no response was obtained for three consecutive days. All data were recorded using a structured data collection sheet.

Continuous variables were expressed as mean ± standard deviation (SD) for normally distributed data and median with interquartile range (IQR) for skewed data. Categorical variables were presented as frequencies and percentages. The chi-square test was used to compare qualitative variables between groups.Logistic regression analysis was employed because the primary outcomes—30-day mortality and the need for mechanical ventilation—were binary in nature. Multivariate logistic regression allowed adjustment for potential confounders and identification of independent hemodynamic predictors.

Receiver Operating Characteristic (ROC) curve analysis was used to quantify the discriminatory power of systolic, diastolic, mean arterial, and pulse pressure in predicting outcomes. Area under the curve (AUC) values with 95% confidence intervals were reported. This analytic strategy was chosen to align directly with the study objective of determining the predictive value of admission blood pressure parameters. Statistical analysis was performed by Windows based software named as Statistical Package for Social Science (SPSS), versions 24.0All analyses were performed at a 95% confidence interval, and a p-value <0.05 was considered statistically significant

Results:

The mean age of participants was 53.93 ± 11.03 years, with most patients (77.6%) falling within the 45–65 age range. Males constituted 61.2% of the study population, while females comprised 38.8%. More than half of the participants (58.8%) were smokers. Regarding comorbidities, cardiovascular disease (26.3%) and chronic obstructive pulmonary disease (COPD) (23.8%) were the most prevalent, followed by diabetes mellitus (16.3%) and chronic kidney disease (6.3%), reflecting a complex clinical profile among the study cohort. (Table I)

The majority of patients had systolic blood pressure (SBP) in the 61–90 mmHg range (56.0%), followed by 28.7% with SBP ≤60 mmHg and 15.3% with SBP >90 mmHg. The mean SBP was 75.73 ± 14.48 mmHg, ranging from 61 to 90 mmHg. Most participants exhibited diastolic blood pressure (DBP) between 41 and 60 mmHg (85.3%), with fewer patients at the extremes (d”40 mmHg, 10.0%; ≥61 mmHg, 4.7%). Pulse pressure (PP) was predominantly below 30 mmHg in 89.3% of subjects, with a reported interquartile range (IQR) of 8 to 31 mmHg (IQR = 23). Mean arterial pressure (MAP) was mainly distributed between 50 and 69 mmHg (63.3%), with a mean of 62.61 ± 8.47 mmHg, ranging from 54 to 71 mmHg. (Table II)

Table I

Demographic and Clinical Characteristics of the Study Participants (n = 150)

Variable	Subgroup	Frequency (n)	Percentage (%)	Mean ± SD
Age (years)	35–45	34	22.5	
	45–55	39	26.0	
	55–65	43	28.8	
	≥65	34	22.5	53.93 ± 11.03
Sex	Male	92	61.2	
	Female	58	38.8	
Smoking Status	Smoker	88	58.8	
Comorbidities	Diabetes Mellitus	24	16.3	
	Chronic Kidney Disease	9	6.3	
	Chronic Cardiac Failure	9	6.3	
	Cardiovascular Disease	39	26.3	
	COPD	36	23.8	
	Bronchial asthma	8	5.0	

Table II

Distribution of Blood Pressure Measurements Among Study Participants (n = 150)

Blood Pressure Parameter	Category (mmHg)	Frequency (n)	Percentage (%)	Mean ± SD / IQR	Range (mmHg)
Systolic Blood Pressure	≤60	43	28.7		
	61–90	84	56.0	75.73 ±14.48	61–90
	>90	23	15.3		
Diastolic Blood Pressure	≤40	15	10.0		
	41–60	128	85.3	56.03 ± 6.89	49–62
	≥61	7	4.7		
Pulse Pressure	<30	134	89.3	IQR = 23 (8–31)	
	31–40	11	7.3		
	41–60	5	3.3		
	61–80	0	0		
	>80	0	0		
Mean Arterial Pressure	≤50	17	11.3		
	50–69	95	63.3	62.61 ± 8.47	54–71
	≥70	38	25.3		

Most patients (86%) were discharged from the hospital, with varying lengths of stay: 13.3% were discharged within 24 hours, 26.0% within 3 days, 30.0% within 7 days, and 16.7% after more than 7 days. A notable proportion of patients required critical care interventions, with 23.3% needing mechanical ventilation—16.7% during hospitalization and 6.7% after discharge but within 30 days. Similarly, 24.0% required inotropic support, with 22.7% receiving it during hospitalization and 8.0% after discharge but within 30 days. The overall mortality rate was 22.7%, including 14.0% who died during hospitalization and 8.7% who died after discharge but within 30 days. (Table III)

Table III

Distribution of Hospital Outcomes Among Study Participants (N = 150)

Outcome	Subgroup	Frequency (n)	Percentage (%)
Discharge	Within 24 hours	10	13.3
	Within 3 days	39	26.0
	Within 7 days	45	30.0
	More than 7 days	35	16.7
	Total discharged	129	86.0
Need for Mechanical Ventilation	During hospital stay	25	16.7
	After discharge (within 30 days)	10	6.7
	Total	35	23.3
Need for Inotropic Support	During hospital stay	34	22.7
	After discharge (within 30 days)	12	8.0
	Total	36	24.0
Death	During hospital stay	21	14.0
	After discharge (within 30 days)	13	8.7
	Total	34	22.7

Participants with systolic blood pressure (SBP) below 90 mmHg demonstrated a striking 91.2% 30-day mortality rate, revealing a highly significant association ($p < 0.001$). Similarly, all participants with diastolic blood pressure (DBP) ≤60 mmHg or pulse pressure (PP) ≤40 mmHg experienced 30-day mortality, with these associations also reaching statistical significance ($p < 0.001$). Additionally, 91.2% of participants with mean arterial pressure (MAP) below 70 mmHg succumbed within 30 days, emphasizing the critical prognostic value of blood pressure parameters in community-acquired pneumonia (CAP). These findings underscore the importance of vigilant monitoring and management of blood pressure to reduce mortality risk and improve clinical outcomes in CAP patients (Table IV).

Remarkably, participants with systolic blood pressure (SBP) below 90 mmHg demonstrated a substantial need for mechanical ventilation and/or inotropic support, with a prevalence of 94.2%, supported by a highly significant p-value (<0.001). Similarly, those with diastolic blood pressure (DBP) ≤60 mmHg and pulse pressure (PP) below 40 mmHg showed an even higher prevalence of 98.1% and 100%, respectively, requiring such critical interventions, both with highly significant p-values (<0.001). Furthermore, participants with mean arterial pressure (MAP) below 70 mmHg also exhibited a notable need for ventilation and inotropic support at 94.2%, again with strong statistical significance ($p < 0.001$). These findings underscore the crucial role of blood pressure parameters as early predictors of the need for critical care interventions in patients with community-acquired pneumonia (CAP), emphasizing the importance of early detection and management of hemodynamic instability to improve patient outcomes Table V.

Multivariate logistic regression analysis demonstrated significant associations between blood pressure parameters and adverse outcomes in community-acquired pneumonia (CAP) patients. Specifically, systolic blood pressure (SBP) below 90 mmHg and mean arterial pressure (MAP) below 70 mmHg were independently associated with increased odds of 30-day mortality, with odds ratios (OR) of 5.44 (95% CI: 1.57–18.90, $p = 0.004$) and 4.47 (95% CI: 1.28–15.58, $p = 0.012$), respectively, highlighting their prognostic value in identifying high-risk patients. Similarly, low SBP and MAP were significantly linked to higher odds of requiring mechanical ventilation with ORs of 2.96 (95% CI: 1.01–8.69, $p = 0.018$) and 2.81 (95% CI: 1.00–8.22, $p = 0.025$), respectively. In contrast, diastolic blood pressure and pulse pressure did not show statistically significant associations with either 30-day mortality or the need for mechanical ventilation Table VI.

Table IV

Association of Blood Pressure Parameters with 30-Day Mortality (n = 34)

Blood Pressure Parameter	30-Day Mortality Frequency (n)	Percentage (%)	p-value
Systolic Blood Pressure < 90 mmHg	31	91.2	< 0.001
Diastolic Blood Pressure ≤60 mmHg	34	100	< 0.001
Pulse Pressure ≤40 mmHg	34	100	< 0.001
Mean Arterial Pressure < 70 mmHg	31	91.2	< 0.001

Table V

Association of Blood Pressure Parameters with Mechanical Ventilation at 30-Day Follow-Up (n = 52)

Blood Pressure Parameter	Frequency (n)	Percentage (%)	p-value
Systolic Blood Pressure < 90 mmHg	49	94.2	< 0.001
Diastolic Blood Pressure ≤60 mmHg	51	98.1	< 0.001
Pulse Pressure < 40 mmHg	52	100	< 0.001
Mean Arterial Pressure < 70 mmHg	49	94.2	< 0.001

Table VI

Multivariate Logistic Regression Analysis of Blood Pressure Parameters and 30-Day Outcomes in CAP Patients (N = 150)

Outcome	Blood Pressure Parameter	OR	95% Confidence Interval	p-value
30-day mortality	Systolic blood pressure < 90 mmHg	5.439	1.565 to 18.895	0.004
	Diastolic blood pressure < 60 mmHg	0.871	0.336 to 2.256	0.775
	Pulse pressure < 40 mmHg	0.756	0.090 to 6.377	0.797
	Mean arterial pressure < 70 mmHg	4.465	1.280 to 15.579	0.012
Ventilation	Systolic blood pressure < 90 mmHg	2.958	1.007 to 8.691	0.018
	Diastolic blood pressure < 60 mmHg	0.301	0.035 to 2.567	0.246
	Pulse pressure < 40 mmHg	0.939	0.225 to 3.917	0.931
	Mean arterial pressure < 70 mmHg	2.807	1.000 to 8.220	0.025

OR: Odds Ratio; CI: Confidence Interval; p-values obtained from multivariate logistic regression; significant values indicated.

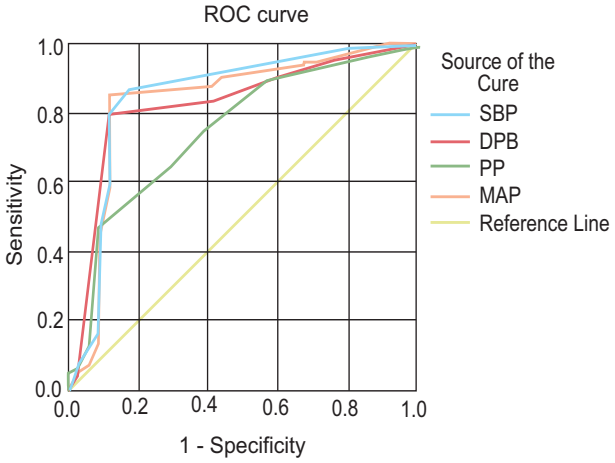

Fig.-1: Receiver Operating Characteristic (ROC) showing different blood pressure and prediction of 30-day mortality (N=150)

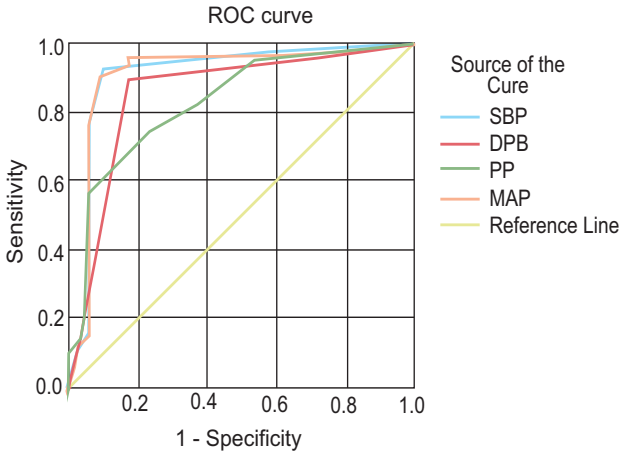

Fig.-2. Receiver Operating Characteristic (ROC) showing different blood pressure and prediction of 30-day ventilation (N=150)

In Figure 1, ROC curve analysis showed that the area under the curve for systolic blood pressure was 0.852, diastolic blood pressure was 0.826, pulse pressure was 0.746, and mean arterial pressure was 0.835. In this study, systolic pressure, diastolic pressure, and mean arterial pressure had good discriminatory values, and pulse pressure had a moderate discriminatory value for predicting 30-day mortality.

In Figure 2, ROC curve analysis showed that the area under the curve for systolic blood pressure was 0.922, diastolic blood pressure was 0.856, pulse pressure was 0.831, and mean arterial pressure was 0.914. In this study, systolic pressure and mean arterial pressure had excellent discriminatory values, and diastolic pressure and pulse pressure had good discriminatory values for predicting 30-day need for ventilation

Discussion:

Assessment of disease severity is a crucial component in managing community-acquired pneumonia (CAP). Most validated clinical scoring systems that predict 30-day mortality in CAP—such as CURB-65, PSI, and CRB-65—incorporate blood pressure measurements as key prognostic indicators. Hypotension is often a clinical manifestation of systemic inflammatory response and sepsis, which are associated with increased morbidity and mortality in CAP.

This prospective observational study evaluated the prognostic significance of early hemodynamic parameters in hospitalized CAP patients. We found that systolic blood pressure (SBP) <90 mmHg and mean arterial pressure (MAP) <70 mmHg, when measured within the first four hours of admission—prior to fluid or inotropic therapy—were independent predictors of adverse 30-day outcomes, including mortality and the need for mechanical ventilation or inotropic support.

In univariate analysis, all four parameters—SBP, diastolic blood pressure (DBP), pulse pressure (PP), and MAP—showed statistically significant associations with 30-day mortality and critical care interventions. However, in multivariate logistic regression, only SBP <90 mmHg and MAP <70 mmHg remained independently significant. This finding highlights the importance of early hypotension, particularly involving SBP and MAP, as strong indicators of poor prognosis in CAP.

A key strength of our study was the timing of the hemodynamic assessment, which was performed within four hours of hospital admission and before any therapeutic intervention. This methodology likely provides a more accurate representation of the patient's initial physiological derangement.

Our findings align with Chalmers et al.[7], who reported that SBP is superior to other hemodynamic parameters (including MAP and PP) in predicting 30-day mortality in CAP. In their study, an SBP <90 mmHg was associated with an increased risk of death and a need for invasive support (Chalmers JD et al., 2008). Our observed rate of mechanical ventilation and inotropic support (34.7%) was notably higher than in the Chalmers study (10.2%), possibly reflecting differences in patient acuity, population characteristics, or healthcare system capacity.

In addition, Schulte-Hubbert et al.[9] emphasized the prognostic importance of blood pressure drops within the first 24 hours after admission. Their retrospective

cohort study found that BP decline significantly increased the likelihood of requiring mechanical ventilation or vasopressor support (MVVS). Incorporating BP variability into existing scores improved predictive performance.[9]

Our study further supports the prognostic value of BP metrics. We observed a significant association ($p < 0.001$) between low SBP (<90 mmHg), DBP (≤60 mmHg), PP (<40 mmHg), and MAP (<70 mmHg) with both increased 30-day mortality and need for critical care interventions. On multivariate analysis, SBP <90 mmHg increased the odds of 30-day mortality by more than fivefold, and MAP <70 mmHg by over fourfold. Both parameters also significantly raised the risk of needing ventilation and inotropic support, underscoring their role as independent predictors of adverse outcomes.These findings are consistent with evidence from systematic reviews and meta-analyses of COVID-19 pneumonia, where hypertension and hemodynamic instability were strongly associated with increased mortality and disease severity.[10,11] This reinforces the prognostic importance of blood pressure abnormalities across different forms of pneumonia

Our study's receiver operating characteristic (ROC) curve analysis revealed high predictive accuracy for mortality prediction in SBP, MAP, and DBP (AUC 0.852, 0.835, and 0.826, respectively). PP also demonstrated a moderate predictive value (AUC 0.746). SBP and MAP again demonstrated the highest AUC values for critical care needs, suggesting excellent discriminatory power.

While Chalmers et al.[7] reported only moderate predictive value for SBP and lower predictive value for MAP and PP, these differences may reflect population-specific characteristics or evolving standards of care. Our study population, drawn from a tertiary care hospital in Bangladesh, may present later or with more severe illness than cohorts in high-income countries.

Taken together, our findings, in conjunction with existing literature, reinforce the utility of early blood pressure assessment—particularly SBP and MAP—as a simple, rapid, and non-invasive tool to stratify risk and guide the management of CAP. Incorporating these parameters into early warning systems or clinical decision-making algorithms could enhance patient triage and resource allocation.In addition to respiratory failure, CAP has also been associated with extrapulmonary complications, including cardiovascular events. Another study[12] demonstrated that cardiac complications are common in CAP and independently contribute to short-term mortality. This underscores the systemic impact of hemodynamic compromise and strengthens the rationale for close monitoring of cardiovascular function in pneumonia patients presenting with hypotension

Conclusion:

Our study demonstrates that early systolic blood pressure and mean arterial pressure are strong, independent hemodynamic predictors of short term mortality and the need for advanced support in community-acquired pneumonia. These findings reinforce the prognostic value of basic vital signs and underscore their importance in early clinical decision-making, particularly in resource-limited settings.

Limitations of the Study:

However, several limitations should be acknowledged. Although a larger sample size would improve precision and external validity, our study included 150 patients based on feasibility within the study period. Nevertheless, this sample was adequate to demonstrate statistically significant associations, as evidenced by the multivariate models. Second, we excluded patients with hospital-acquired pneumonia and those with significant immunosuppression, which may affect external applicability. Third, we did not evaluate biomarkers such as serum lactate or procalcitonin, which could have added further depth to outcome prediction.

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Conflict of Interest:

No author has any conflict of interest to disclose for this manuscript. The authors themselves are responsible for their ideas and views expressed in this article, which do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated.

Ethical Approval:

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Institutional Review Board of the Dhaka Medical College. Written informed consent was taken from all the patients before taking part of the study.

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