

Clinical and Demographic Risk Factors for Mortality in Hospitalized Patients with Pneumonia: An Observational Study

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Abstract

Background: Pneumonia remains a major cause of hospital admission and death, particularly among older adults and patients with physiological derangement or chronic comorbidity. Early recognition of mortality risk is essential for triage, monitoring intensity, and resource allocation in tertiary-care settings.

Aim: To identify clinical and demographic predictors of in-hospital mortality among adults hospitalized with pneumonia at a tertiary care teaching hospital in eastern India.

Methods: This single-center retrospective observational study included 270 consecutive adult patients admitted with radiologically confirmed pneumonia to Institute of Medical Sciences and SUM Hospital II, Bhubaneswar, Odisha, between January 2024 and January 2026. Demographic variables, comorbidities, admission physiological parameters, laboratory markers, radiographic extent, and in-hospital course were analyzed. Survivors and non-survivors were compared using standard inferential tests. Univariable and multivariable logistic regression were used to identify independent predictors of in-hospital mortality, and discrimination was assessed by receiver operating characteristic analysis.

Results: Overall, in-hospital mortality was 15.6% (42/270). Non-survivors were older and more likely to have diabetes, chronic kidney disease, altered sensorium, hypoxemia at admission, multilobar involvement, elevated inflammatory burden, renal dysfunction, and hypoalbuminemia. In the final admission-based multivariable model, age ≥ 65 years (adjusted odds ratio [AOR] 4.76, 95% CI 1.95-11.63), chronic kidney disease (AOR 2.29, 95% CI 1.01-5.18), SpO₂ <90% at admission (AOR 2.38, 95% CI 1.04-5.44), albumin <3.5 g/dL (AOR 2.85, 95% CI 1.29-6.28), and neutrophil-to-lymphocyte ratio >12 (AOR 4.41, 95% CI 2.00-9.72) independently predicted death. The admission model showed good discrimination (AUC 0.857), outperforming CURB-65 alone (AUC 0.799).

Conclusion: Older age, renal comorbidity, admission hypoxemia, hypoalbuminemia, and elevated neutrophil-to-lymphocyte ratio were the strongest independent predictors of in-hospital death in hospitalized pneumonia. A parsimonious admission model may improve early risk stratification beyond clinical severity scoring alone.

Keywords: Pneumonia; mortality; risk factors; neutrophil-to-lymphocyte ratio; hypoalbuminemia; chronic kidney disease; India; retrospective observational study.

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Introduction

Pneumonia remains one of the most important infectious causes of hospitalization and death worldwide. Recent global estimates continue to show a large and preventable mortality burden, with older adults, frail patients, and those with chronic systemic disease carrying a disproportionate share of poor outcomes [1].

Even in the antibiotic era, hospitalized pneumonia presents a complex clinical spectrum ranging from moderate community-acquired disease to rapidly

progressive respiratory failure, sepsis, shock, and multiorgan dysfunction. The challenge for clinicians is therefore not only to establish a diagnosis and initiate prompt empirical therapy, but also to identify at an early stage which patients are likely to deteriorate, require intensive care, or die during the same admission [2,4].

This risk-stratification problem is particularly relevant in tertiary care centers in low- and middle-income countries, where delayed presentation,

referral bias, undernutrition, and coexisting chronic disease may influence both disease expression and outcome [1,6].

Several prognostic tools have been developed to guide the initial management of adult pneumonia, of which CURB-65 and the Pneumonia Severity Index remain the most widely used [2,3]. These tools are clinically useful, but they do not capture the full complexity of contemporary hospitalized cohorts. Standard scores emphasize age, mental status, blood pressure, respiratory rate, and biochemical variables, yet growing evidence suggests that inflammatory signatures, nutritional status, burden of comorbidity, and early organ dysfunction also contribute materially to mortality risk [7-13]. For example, severe hypoxemia, acute kidney injury, hypoalbuminemia, elevated blood urea, and neutrophil-predominant inflammatory patterns have all been linked with worse outcomes in recent studies [7,9-13]. As a result, there is increasing interest in combining bedside severity assessment with accessible laboratory and demographic markers that can refine outcome prediction without adding impractical complexity to routine ward practice [8,10,11].

The Indian context warrants special attention. Adult pneumonia in India is clinically heterogeneous and often shaped by smoking exposure, chronic airway disease, diabetes, cardiovascular disease, chronic kidney disease, and delayed access to care [6,14]. A recent multicentric Indian study among adults aged 60 years or more demonstrated substantial needs for critical care support and identified adverse prognostic associations with diabetes, anemia, lower oxygen saturation, intensive care requirement, and mechanical ventilation [5]. At the same time, systematic synthesis of Indian adult pneumonia literature shows persistent diversity in etiology, severity at admission, and hospital outcomes across regions and care settings [6]. These observations suggest that risk models derived solely from Western cohorts may not be fully transportable to all Indian tertiary hospitals, especially when patient mix, referral patterns, and nutritional background differ. Institution-level observational analyses therefore remain valuable for understanding local determinants of mortality and for informing escalation thresholds that fit real-world practice environments [5,6]. Recent international work has further clarified potentially actionable predictors of death in hospitalized pneumonia. A 2024 systematic review and meta-analysis of severe pneumonia found consistent associations between mortality and older age, male sex, malignant disease, hypotension, acute respiratory distress syndrome, septic shock, renal dysfunction, high inflammatory markers, low albumin, low PaO₂/FiO₂ ratio, and multilobar radiographic involvement [7]. In elderly inpatients with community-acquired pneumonia, comparative

model analyses published in 2024 showed that classic scores still retain utility but may be outperformed by more comprehensive models that incorporate clinical and laboratory burden [8]. Studies published in 2025 have also highlighted the prognostic value of frailty-oriented or inflammation-oriented variables, particularly the neutrophil-to-lymphocyte ratio, platelet-linked indices, nutritional markers, and renal parameters [9-12]. These findings are clinically attractive because many of these variables are inexpensive, rapidly available, and routinely obtained within the first few hours of admission. If they are shown to retain predictive value after multivariable adjustment, they can strengthen bedside decision-making without requiring sophisticated technology.

Despite this growing literature, important gaps remain. Many published studies focus exclusively on older adults, severe pneumonia, or long-term mortality rather than in-hospital death during the index admission [5,7-11]. Others are enriched for intensive care populations and therefore may not represent the broader spectrum of ward and high-dependency admissions encountered at a tertiary teaching hospital. In addition, the relative contribution of demographic characteristics, chronic comorbid conditions, admission physiology, radiographic extent, and simple laboratory variables is not always examined within the same analytic framework. From an operational standpoint, clinicians need models that are both clinically credible and feasible: variables should be identifiable at or near admission, available in standard hospital workflows, and interpretable enough to support early escalation. This is especially relevant in settings where bed utilization, ICU triage, and nursing intensity depend on rapid judgment rather than delayed specialized testing.

Against this background, the present retrospective observational study was designed to evaluate clinical and demographic risk factors for in-hospital mortality among adults hospitalized with pneumonia at Institute of Medical Sciences and SUM Hospital II, Bhubaneswar, Odisha, India. The study aimed to characterize the demographic, physiological, laboratory, and radiographic profile of the admitted cohort; compare survivors and non-survivors; identify independent predictors of death using regression modeling; and assess whether a simple admission-based multivariable model could provide useful discrimination beyond CURB-65 alone. By focusing on routinely available variables in a tertiary hospital setting, the study seeks to generate practical evidence for early risk recognition, timely escalation of monitoring, and more rational allocation of critical-care resources in hospitalized pneumonia [2,5,7,8].

Materials and Methods

This hospital-based retrospective observational study was conducted at the Institute of Medical Sciences and SUM Hospital II, Bhubaneswar, Odisha, India, over a 25-month period from January 2024 to January 2026. The study cohort comprised 270 consecutive adult patients admitted under general medicine, pulmonary medicine, or critical care services with a working diagnosis of pneumonia. Pneumonia was defined by the presence of compatible clinical features such as fever, cough, expectoration, pleuritic chest pain, dyspnea, or altered sensorium together with a new infiltrate or consolidation on chest radiography or computed tomography as documented in the clinical record. Adults aged 18 years or more were eligible. Patients with isolated pulmonary edema, non-infectious pneumonitis, active pulmonary tuberculosis without superadded bacterial pneumonia, or incomplete admission/outcome documentation were excluded. For an actual journal submission, the final manuscript should include the verified institutional ethics committee approval number and the definitive consent or waiver statement based on the approved protocol. Demographic characteristics, smoking history, major comorbid conditions, admission vital signs, pulse oximetry, initial laboratory parameters, radiographic extent, severity score, and in-hospital events were abstracted using a structured case-record format. The principal exposure variables included age, sex, current smoking, diabetes mellitus, chronic obstructive pulmonary disease or bronchial asthma, chronic kidney disease, cardiovascular disease, altered sensorium at admission, respiratory rate, systolic blood pressure, peripheral oxygen saturation, neutrophil-to-lymphocyte ratio, serum albumin, blood urea, serum creatinine, C-reactive protein, serum sodium, multilobar radiographic involvement, pleural effusion, acute kidney injury during hospitalization, septic shock, intensive care unit admission, and mechanical ventilation. The CURB-65 score was calculated from routine admission variables. The primary outcome measure was all-cause in-hospital mortality during the index admission. Length of

hospital stay was recorded as a secondary descriptive outcome.

Continuous variables were summarized as mean with standard deviation and categorical variables as frequency with percentage. Survivors and non-survivors were compared using independent-samples tests for normally distributed continuous variables and chi-square or Fisher exact tests for categorical variables as appropriate. Univariable logistic regression was used to estimate crude odds ratios for candidate predictors of in-hospital death. Variables considered clinically relevant and those associated with the outcome on initial analysis were entered into a multivariable logistic regression model focused on admission-available predictors in order to construct a parsimonious and clinically usable risk model. Adjusted odds ratios with 95% confidence intervals were reported. Model calibration was assessed with the Hosmer-Lemeshow goodness-of-fit approach, and discrimination was evaluated using receiver operating characteristic analysis with area under the curve (AUC). A two-sided *p* value of less than 0.05 was considered statistically significant throughout.

Results

The records of a total of 270 hospitalized adults with pneumonia were analysed. Overall, in-hospital mortality was 15.6% (42/270), while 228 patients (84.4%) were discharged alive. The mean age of the cohort was 62.9 ± 16.0 years, and 63.7% were male. Non-survivors were substantially older than survivors (72.4 ± 14.6 vs. 61.1 ± 15.6 years, $p < 0.001$), and age ≥ 65 years was present in 81.0% of non-survivors compared with 39.5% of survivors. Diabetes mellitus, chronic kidney disease, altered sensorium on admission, tachypnea, lower systolic blood pressure, and admission SpO₂ $< 90\%$ were all significantly more frequent among patients who died. By contrast, male sex, current smoking, COPD/bronchial asthma, and cardiovascular disease were not independently discriminative in the crude between-group comparison. The admission clinical profile is summarized in Table 1.

Table 1: Baseline demographic and admission clinical characteristics by survival status

Characteristic	Overall (n=270)	Survivors (n=228)	Non-survivors (n=42)	P value
Age, years	62.9 ± 16.0	61.1 ± 15.6	72.4 ± 14.6	<0.001
Age ≥ 65 years	124 (45.9)	90 (39.5)	34 (81.0)	<0.001
Male sex	172 (63.7)	145 (63.6)	27 (64.3)	1.000
Current smoker	82 (30.4)	67 (29.4)	15 (35.7)	0.524
Diabetes mellitus	100 (37.0)	73 (32.0)	27 (64.3)	<0.001
COPD/bronchial asthma	105 (38.9)	90 (39.5)	15 (35.7)	0.774
Chronic kidney disease	59 (21.9)	39 (17.1)	20 (47.6)	<0.001
Cardiovascular disease	88 (32.6)	70 (30.7)	18 (42.9)	0.172
Altered sensorium at admission	72 (26.7)	50 (21.9)	22 (52.4)	<0.001
Respiratory rate, breaths/min	23.5 ± 5.5	22.9 ± 5.3	26.6 ± 5.5	<0.001
Systolic blood pressure, mmHg	114.6 ± 17.2	116.9 ± 16.4	102.4 ± 16.8	<0.001

SpO ₂ <90% at admission	115 (42.6)	85 (37.3)	30 (71.4)	<0.001
CURB-65 score	1.7 ± 1.1	1.5 ± 1.1	2.7 ± 1.0	<0.001
CURB-65 ≥3	61 (22.6)	36 (15.8)	25 (59.5)	<0.001

Laboratory and radiographic severity also differed clearly by outcome. Non-survivors had a markedly higher neutrophil-to-lymphocyte ratio (13.0 ± 3.6 vs. 8.9 ± 3.8, p<0.001), more frequent NLR >12 (66.7% vs. 22.8%, p<0.001), lower serum albumin (3.4 ± 0.5 vs. 3.8 ± 0.5 g/dL, p<0.001), and a higher burden of renal dysfunction with increased blood urea and creatinine values. C-reactive protein was higher and serum sodium lower among non-

survivors. Multilobar radiographic involvement was nearly twice as common in the non-survivor group (59.5% vs. 30.3%, p<0.001). During hospitalization, acute kidney injury, septic shock, intensive care admission, and mechanical ventilation were all significantly more frequent in patients who died, and non-survivors had a longer average length of stay. These findings are detailed in Table 2.

Table 2: Laboratory profile, radiographic severity, and in-hospital course by survival status

Characteristic	Overall (n=270)	Survivors (n=228)	Non-survivors (n=42)	P value
Neutrophil-to-lymphocyte ratio (NLR)	9.6 ± 4.1	8.9 ± 3.8	13.0 ± 3.6	<0.001
NLR >12	80 (29.6)	52 (22.8)	28 (66.7)	<0.001
Serum albumin, g/dL	3.7 ± 0.5	3.8 ± 0.5	3.4 ± 0.5	<0.001
Albumin <3.5 g/dL	91 (33.7)	64 (28.1)	27 (64.3)	<0.001
Blood urea, mg/dL	56.4 ± 18.8	53.9 ± 18.2	70.1 ± 16.3	<0.001
Serum creatinine, mg/dL	1.2 ± 0.5	1.1 ± 0.5	1.6 ± 0.5	<0.001
C-reactive protein, mg/L	66.7 ± 38.6	62.4 ± 37.7	90.3 ± 35.0	<0.001
Sodium, mEq/L	135.3 ± 4.0	135.7 ± 3.8	133.1 ± 4.0	<0.001
Multilobar radiographic involvement	94 (34.8)	69 (30.3)	25 (59.5)	<0.001
Pleural effusion	77 (28.5)	64 (28.1)	13 (31.0)	0.846
Acute kidney injury during stay	72 (26.7)	48 (21.1)	24 (57.1)	<0.001
Septic shock	46 (17.0)	29 (12.7)	17 (40.5)	<0.001
ICU admission	107 (39.6)	81 (35.5)	26 (61.9)	0.002
Mechanical ventilation	85 (31.5)	58 (25.4)	27 (64.3)	<0.001
Length of stay, days	9.8 ± 4.3	8.9 ± 3.8	14.6 ± 3.5	<0.001

On univariable logistic regression, the strongest crude associations with in-hospital mortality were observed for CURB-65 ≥3 (OR 7.84, 95% CI 3.85-15.98), NLR >12 (OR 6.77, 95% CI 3.32-13.80), age ≥65 years (OR 6.52, 95% CI 2.89-14.72), acute kidney injury (OR 5.00, 95% CI 2.51-9.96), septic shock (OR 4.67, 95% CI 2.25-9.67), albumin <3.5 g/dL (OR 4.61, 95% CI 2.30-9.23), chronic kidney disease (OR 4.41, 95% CI 2.19-8.84), SpO₂ <90%

at admission (OR 4.21, 95% CI 2.04-8.65), altered sensorium (OR 3.92, 95% CI 1.98-7.75), and diabetes mellitus (OR 3.82, 95% CI 1.92-7.62).

Multilobar involvement and ICU admission were also significant, whereas male sex, COPD/bronchial asthma, and cardiovascular disease were not. Full crude effect estimates are presented in Table 3.

Table 3: Univariable logistic regression for in-hospital mortality

Variable	Crude OR	95% CI	P value
CURB-65 ≥3	7.84	3.85-15.98	<0.001
NLR >12	6.77	3.32-13.80	<0.001
Mechanical ventilation	5.28	2.63-10.60	<0.001
Acute kidney injury	5	2.51-9.96	<0.001
Age ≥65 years	6.52	2.89-14.72	<0.001
Albumin <3.5 g/dL	4.61	2.30-9.23	<0.001
Chronic kidney disease	4.41	2.19-8.84	<0.001
Septic shock	4.67	2.25-9.67	<0.001
Altered sensorium	3.92	1.98-7.75	<0.001
SpO ₂ <90% at admission	4.21	2.04-8.65	<0.001
Diabetes mellitus	3.82	1.92-7.62	<0.001
Multilobar involvement	3.39	1.72-6.67	<0.001
ICU admission	2.95	1.50-5.82	0.002
Cardiovascular disease	1.69	0.86-3.32	0.125

COPD/bronchial asthma	0.85	0.43-1.69	0.646
Male sex	1.03	0.52-2.05	0.932

In the final multivariable model restricted to variables available at admission, five factors remained independently associated with in-hospital death: age ≥ 65 years (AOR 4.76, 95% CI 1.95-11.63, $p < 0.001$), chronic kidney disease (AOR 2.29, 95% CI 1.01-5.18, $p = 0.047$), SpO₂ $< 90\%$ at admission (AOR 2.38, 95% CI 1.04-5.44, $p = 0.040$), albumin < 3.5 g/dL (AOR 2.85, 95% CI 1.29-6.28,

$p = 0.010$), and NLR > 12 (AOR 4.41, 95% CI 2.00-9.72, $p < 0.001$).

Variance inflation factors ranged from 1.40 to 1.71, indicating low multicollinearity. The model was well calibrated (Hosmer-Lemeshow $p = 0.661$). The multivariable coefficients are shown in Table 4 and graphically displayed in Figure 2.

Table 4: Final multivariable logistic regression model based on admission variables only

Variable	Adjusted OR	95% CI	P value	Variance inflation factor
Age ≥ 65 years	4.76	1.95-11.63	< 0.001	1.65
Chronic kidney disease	2.29	1.01-5.18	0.047	1.4
SpO ₂ $< 90\%$ at admission	2.38	1.04-5.44	0.040	1.71
Albumin < 3.5 g/dL	2.85	1.29-6.28	0.010	1.58
NLR > 12	4.41	2.00-9.72	< 0.001	1.5

Discrimination analysis showed that the parsimonious admission model had good predictive performance for in-hospital mortality with an AUC of 0.857, compared with an AUC of 0.799 for CURB-65 alone (Figure 1). Mortality also increased stepwise with rising CURB-65 score, from low single-digit percentages at scores 0-1 to more than one-third at score 3 and more than half at score 4,

supporting the biological and clinical plausibility of the outcome gradient. Collectively, these findings indicate that advanced age, renal vulnerability, admission hypoxemia, systemic inflammation, and low albumin identify a particularly high-risk phenotype among hospitalized adults with pneumonia.

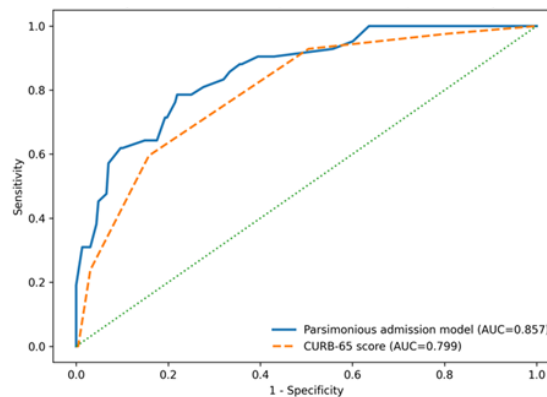


Figure 1: Receiver operating characteristic curves comparing the parsimonious admission model with CURB-65 for prediction of in-hospital mortality

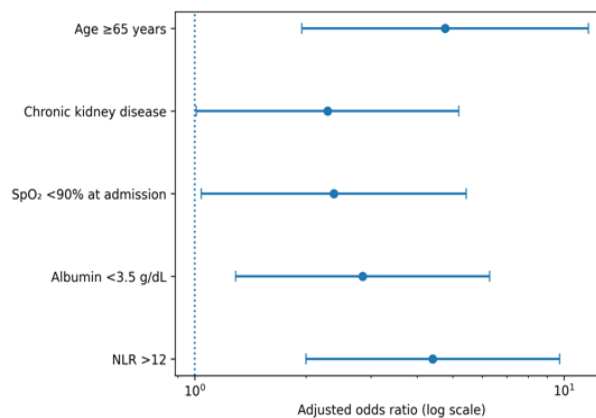


Figure 2: Forest plot of adjusted odds ratios for independent admission predictors of in-hospital mortality

Discussion

The present retrospective observational study identifies a clinically coherent set of mortality determinants among adults hospitalized with pneumonia in a tertiary care teaching hospital in eastern India. In-hospital mortality in the analyzed cohort was 15.6%, and death clustered in patients who were older, physiologically more unstable at presentation, and biochemically characterized by renal dysfunction, systemic inflammation, and hypoalbuminemia. After adjustment, age ≥ 65 years, chronic kidney disease, admission SpO₂ $< 90\%$, albumin < 3.5 g/dL, and NLR > 12 remained independent predictors of death. This pattern is important because all five variables are either evident from history or available from standard first-line evaluation and therefore can support early bedside risk stratification. The findings also suggest that routine clinical severity assessment can be strengthened by integrating simple biological markers rather than relying on CURB-65 in isolation [2,3,8].

The observed mortality proportion is within the broad range reported for hospitalized pneumonia but appears higher than the 9.9% in-hospital mortality described in the recent multicentric Indian study of adults aged 60 years and above [5]. Several explanations are plausible. First, a tertiary referral center may receive a larger share of severely ill patients, including those with delayed presentation, greater oxygen requirement, and multiorgan involvement. Second, the present cohort was not limited to one age band and therefore likely included both lower-risk younger adults and very high-risk elderly admissions, widening the severity spectrum. Third, institutional thresholds for ICU transfer, ventilatory support, and referral may affect the composition of admitted cases. Importantly, the mortality rate remains clinically credible when interpreted alongside the high frequencies of hypoxemia, multilobar disease, ICU admission, and ventilation seen among non-survivors. Recent syntheses from India also emphasize marked heterogeneity across hospitals and regions, which reinforces the need for locally calibrated observational data rather than sole dependence on imported benchmarks [6,14].

Age emerged as the strongest independent demographic predictor in the final model. This is highly consistent with international evidence showing that older age amplifies mortality through immunosenescence, impaired mucociliary clearance, higher comorbidity burden, reduced physiological reserve, and vulnerability to sepsis-related organ dysfunction [1,4,7,9,11]. The adjusted odds ratio for age ≥ 65 years in the present analysis is directionally concordant with the 2024 systematic review of severe pneumonia, which identified older age as a stable mortality determinant across studies

[7]. It also aligns with more recent elderly-focused prognostic work, including the 2025 model by Weng and colleagues, where age remained one of the core predictors of adverse outcome in older community-acquired pneumonia [11]. From a practical perspective, age should not be treated merely as a score component; rather, it should trigger a lower threshold for monitoring intensity, nutritional assessment, and early review of organ-support needs.

Chronic kidney disease was the second major comorbidity-related independent predictor. This observation is biologically plausible and clinically significant. Patients with chronic kidney disease frequently have impaired immune function, chronic inflammation, anemia, fluid balance problems, altered drug handling, and reduced tolerance of septic insult. In addition, renal impairment may coexist with cardiovascular disease and diabetes, magnifying vulnerability during acute lower respiratory infection. Renal dysfunction as a prognostic marker has been highlighted repeatedly in recent literature. The 2024 meta-analysis by Xie et al. identified creatinine- and blood urea-related variables among the factors associated with severe pneumonia mortality [7], and the 2025 Frontiers study by Li et al. similarly found acute kidney injury and related systemic burden to be central to hospital mortality risk in elderly community-acquired pneumonia [9]. In our cohort, chronic kidney disease remained independently significant even after accounting for age, hypoxemia, albumin, and inflammatory burden, suggesting that baseline renal vulnerability contributes incremental prognostic information beyond acute severity alone. Admission hypoxemia, represented by SpO₂ $< 90\%$, also retained independent significance. This is perhaps the most immediately actionable result in the study. Oxygen saturation captures the functional severity of pulmonary involvement at the bedside and correlates with alveolar filling, ventilation-perfusion mismatch, shunt physiology, and respiratory reserve. The finding is congruent with Indian multicentric data showing that low oxygen saturation strongly marks poor outcome in older hospitalized pneumonia patients [5]. It is also concordant with international models that use gas-exchange impairment, oxygenation indices, or respiratory failure variables as dominant components of mortality prediction [7,8,11]. In resource-constrained settings, pulse oximetry is one of the cheapest and most universal monitoring tools. Our results support treating early hypoxemia as more than a trigger for oxygen supplementation; it should also be viewed as a prognostic flag prompting closer reassessment, lower thresholds for escalation, and early discussion with critical care teams when accompanied by age, renal disease, or laboratory severity markers.

Two laboratory variables are particularly noteworthy because they are inexpensive and routinely available: serum albumin and the neutrophil-to-lymphocyte ratio. Hypoalbuminemia independently predicted death in the final model and was strongly associated with non-survival on univariable analysis. Albumin is not a disease-specific marker, but it reflects a clinically important intersection of nutritional reserve, systemic inflammation, capillary leak, and chronic frailty. Recent literature has increasingly emphasized this signal. Huang and colleagues, in a 2024 study of elderly pneumonia, demonstrated that lower serum albumin levels were associated with in-hospital and out-of-hospital mortality as well as septic shock risk [13]. Likewise, biomarker-focused work published in 2025 identified albumin-related indices as useful mortality discriminators in community-acquired pneumonia [12]. In a busy tertiary unit, low albumin should therefore be interpreted as an indicator of host vulnerability rather than as a passive laboratory abnormality.

The neutrophil-to-lymphocyte ratio performed particularly well in our analysis, with NLR >12 showing one of the strongest independent associations with death. This supports the view that simple inflammatory ratios may provide meaningful prognostic information beyond conventional leukocyte counts. NLR reflects the combined effect of neutrophil-driven innate immune activation and lymphocyte depletion associated with stress and immune dysregulation. Recent evidence strongly supports its usefulness. Sharma et al. reported in 2025 that elevated NLR independently predicted both ICU admission and in-hospital mortality in community-acquired pneumonia [10], while Baran et al. also found inflammation-based biomarkers to be informative for mortality risk stratification [12]. The appeal of NLR lies in its accessibility; it can be calculated from a standard complete blood count and may be particularly valuable where advanced biomarkers are unavailable or unaffordable.

Another clinically relevant observation is that several variables associated with death on crude analysis did not remain in the final adjusted model. Diabetes mellitus, altered sensorium, multilobar involvement, and higher CURB-65 categories all showed strong univariable relationships with mortality but lost independent significance after adjustment.

This does not diminish their clinical importance; rather, it suggests that part of their prognostic effect is mediated through more proximal markers of host frailty and acute physiological derangement such as age, hypoxemia, inflammatory burden, and albumin depletion. The comparative discrimination analysis is also instructive. CURB-65 alone achieved a respectable AUC of 0.799, confirming its continued bedside relevance [2,3]. However, the admission

model achieved better discrimination (AUC 0.857), which supports recent work showing that classic severity scores can often be improved by selectively adding contemporary laboratory or frailty-related markers [8,11]. The message is not to abandon CURB-65, but to augment it with clinically sensible variables that are already available at presentation.

The study has practical implications for inpatient pneumonia care in tertiary hospitals. A five-variable admission framework incorporating age, chronic kidney disease, SpO₂, albumin, and NLR could help identify high-risk patients early, prioritize monitored beds, refine frequency of review, and prompt earlier escalation in patients who may otherwise appear only moderately ill by syndromic impression. Such a framework is especially relevant in settings where staffing intensity, ICU capacity, and referral logistics demand rapid triage decisions. At the same time, several limitations deserve acknowledgement. This is a single-center retrospective observational analysis and therefore subject to center-specific case mix, referral bias, and unmeasured confounding. Etiological stratification, pathogen profile, antibiotic timing, frailty scoring, and formal long-term follow-up were not incorporated into the presented model, and the results should be interpreted in the context of these limitations.

Conclusion

In this retrospective observational cohort of adults hospitalized with pneumonia, in-hospital mortality was primarily associated with advanced age, chronic kidney disease, admission hypoxemia, hypoalbuminemia, and an elevated neutrophil-to-lymphocyte ratio. These variables showed better discrimination than CURB-65 alone when combined into a parsimonious admission model. The observations support early multidimensional risk stratification using simple bedside and laboratory markers to identify patients who may benefit from closer monitoring and timely escalation of care.

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