Section: Respiratory Medicine

Original Research Article

DEMOGRAPHY, CLINICAL CHARACTERISTICS AND OUTCOME PREDICTORS IN RESPIRATORY INTENSIVE CARE UNIT (RICU) PATIENTS: A TERTIARY CARE HOSPITAL EXPERIENCE FROM NORTHERN INDIA

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ABSTRACT

Background: This study aimed to characterize clinical profiles, respiratory failure patterns, and predictors of mortality in patients admitted to a Respiratory Intensive Care Unit (RICU) at a tertiary care hospital in North India at Rohilkhand Medical College, Bareilly from February to july2024. **Materials and Methods:** A retrospective analysis of 76 RICU patients (68.4% male, mean age 53.8 years) was conducted. Data on demographics, comorbidities, respiratory failure types, microbiological findings, ventilation modes, and outcomes were analyzed. Severity scores (APACHE II), biomarkers, and clinical parameters were assessed using logistic regression and survival analysis. **Result:** The cohort exhibited a high prevalence of COPD exacerbations (43.4%), with Type 2 respiratory failure predominating in COPD patients (72.7%, p=0.002). Biomass fuel exposure was significantly higher in females (58.3% vs. 23.1% males, p=0.003). Non-invasive ventilation was the primary respiratory support (65.8%), while invasive ventilation was required in 13.2%. The overall mortality rate was 19.7%, with non-survivors showing markedly elevated APACHE II scores (median 30 vs. 12 in survivors, p<0.001). Each unit increase in APACHE II score raised mortality odds by 1.28-fold (95% CI:1.14–1.43). Microbiological analysis identified Staphylococcus aureus (23.7%) and Klebsiella pneumoniae (14.5%) as predominant pathogens. Survivors had shorter hospital stays (<6 days: 56.6%), while mortality showed no significant association with stay duration (p=0.909). **Conclusion:** APACHE II scores emerged as the strongest independent predictor of mortality, alongside biomass exposure and Type 2 failure in COPD patients. These findings underscore the utility of severity scoring and targeted ventilation strategies in resource-limited RICU settings. The study highlights regional environmental risk factors and provides a prognostic framework for triaging high-risk patients in North Indian critical care practice.

INTRODUCTION

Respiratory Intensive Care Units (RICUs) are specialized hospital areas equipped for the management of patients with acute or chronic respiratory failure. These units are staffed by multidisciplinary teams trained in advanced respiratory care, enabling delivery of targeted therapies such as mechanical ventilation and non-invasive respiratory support. The focused care provided in RICUs has been associated with improved survival and reduced complications compared to general ICUs.

The global burden of pulmonary diseases is substantial, with conditions like COPD, asthma, and acute lower respiratory infections among the leading

causes of death and disability. In 2020, COPD alone accounted for over 3.2 million deaths worldwide, disproportionately affecting low- and middle-income countries. India faces a particularly high burden due to the prevalence of COPD, tuberculosis, and environmental factors such as air pollution and biomass fuel exposure. Acute respiratory distress syndrome (ARDS) and severe pneumonia remain critical conditions requiring intensive care, especially during respiratory pandemics like COVID-19.

Management of RICU patients is complex, involving challenges in diagnosis, ventilatory support, infection control, and multidisciplinary coordination. Early and appropriate referral to RICUs can reduce mortality, but resource constraints and improper patient selection may limit optimal care. Previous Indian studies have highlighted high rates of nosocomial infections, antimicrobial resistance, and the importance of severity scoring systems like APACHE II for prognostication.

Despite the critical role of RICUs, there is limited Indian data on the clinical profiles, management strategies, and outcomes of patients admitted to these units. This study aims to fill this gap by analyzing the demographic and clinical characteristics, interventions, microbiological profiles, and predictors of outcome among RICU patients in a North Indian tertiary care hospital.

Aims and Objectives-

Aim

To determine the clinical profile and outcomes of pulmonary diseases in patients admitted to a Respiratory Intensive Care Unit (RICU) at a tertiary care hospital in North India.

Objectives

- To study the demographic and clinical profile of patients admitted to the RICU.
- To determine the spectrum of pulmonary diseases commonly seen in the RICU.
- To evaluate the types of respiratory failure and modes of ventilation used.
- To assess the microbiological profile of RICU patients.
- To identify predictors of mortality, including APACHE II scores and comorbidities.
- To analyze the association between APACHE II scores and patient outcomes, including duration of stay and discharge status.

MATERIALS AND METHODS

Study Design: Retrospective observational study.

Study Setting: Respiratory Intensive Care Unit, Department of Respiratory Medicine, Rohilkhand Medical College & Hospital, Bareilly, Uttar Pradesh.

Study Duration: 6 months (February 2024 – July 2024).

Sample Size: 76 consecutive patients admitted to the RICU during the study period.

Inclusion Criteria

- All patients admitted to the RICU during the study period.
- Patients (or their legal representatives) providing informed consent.

Exclusion Criteria

- Patients with known HIV-positive status.
- Patients not willing to provide informed consent.

Data Collection: Upon admission, detailed clinical history, demographic data, and exposure history were recorded. Investigations included:

- Chest X-ray (PA/AP view), ECG/ECHO and CT-thorax as indicated, Arterial blood gas analysis, Laboratory tests (CBC, KFT, serum electrolytes), Microbiological cultures (sputum, pleural fluid, blood, urine), APACHE II scoring

Patients were followed throughout their ICU stay for:

- Source of admission, Interventions (oxygen therapy, NIV, IMV), Diagnosis and comorbidities, Duration of ICU stay, Final outcomes (discharge, transfer, death, LAMA).

Statistical Analysis: Data were coded and entered in Microsoft Excel, then analyzed using SPSS v23. Descriptive statistics were used for demographic and clinical variables. Logistic regression and survival analysis were applied for outcome predictors. A p-value <0.05 was considered statistically significant.

Inclusion Criteria

- All patients admitted to the RICU during the study period.
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RESULTS

Table 1: Demographics and biomass exposure of Study population

Age groups	**Frequency (%) (N=76)**
0-20	2 (2.6)
21-40	13 (17.1)
41-60	31 (40.8)
>60	30 (39.5)
Sex	**Frequency (N=76)**
Male	52(68.4%)
Female	24(31.6%)
Smoking Status	**Frequency (%) N=76)**
Smoking	36 (47.4)
Non-smoking	20 (26.3)

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Ex-smoker		20 (26.3)		
Exposure	**Males**	**Females**	**Total**	**p-value**
Bio-mass fuel	12 (23.1)	14 (58.3)	26 (34.2)	0.003
Non-biomass fuel	40 (76.9)	10 (41.7)	50 (65.8)	
Total	52 (100)	24 (100)	76 (100)	

Table 2: Referral site

Patient transferred from	Frequency	Percentage
Emergency	50	65.8
Respiratory ward	26	34.2
Total	76	100

Table 3: Co-morbidity among patients

Co-morbidity	Non-survivor	Survivor	Total	p-value
No comorbidity	11 (73.3)	36 (59)	47 (61.8)	0.492
Hypertension	2 (13.3)	8 (13.1)	10 (13.2)	
Diabetes	2 (13.3)	17 (27.9)	19 (25)	
Total	15 (100)	61 (100)	76 (100)	

Table 4: Type of Respiratory failure and mode of ventilation

Type of Respiratory failure	Frequency	Percentage
Type 1	37	48.7
Type 2	39	51.3
Total	76	100
Mode of Ventilation	**Frequency**	**Percentage**
Non-Invasive Ventilation	50	65.8
Oxygen Inhalation	16	21.1
Invasive Ventilation	10	13.2
Total	76	100

Table 5: Diagnosis

Diagnosis	Total	Survivor	Non-Survivor
Pneumonia	11 (14.5)	8 (72.7)	3 (27.3)
COPD (AE)	33 (43.4)	29 (87.9)	4 (12.1)
Pulmonary TB	12 (15.8)	9 (75)	3 (25)
Pleural Effusion	6 (7.9)	4 (66.7)	2 (33.3)
Hydropneumothorax	5 (6.6)	5 (100)	0 (0)
Bronchiectasis	1 (1.3)	0 (0)	1 (100)
ILD	2 (2.6)	2 (100)	0 (0)
Bronchial Asthma	3 (3.9)	3 (100)	0 (0)
ARDS	3 (3.9)	1 (33.3)	2 (66.7)
Total	76 (100)	61 (100)	15 (100)

Table 6: Organisms isolated

Organism identified	Frequency	Percentage
Acinetobacter	5	6.6
Budding Yeast	1	1.3
Candida	1	1.3
Escherichia coli	3	3.9
Klebsiella pneumonia	11	14.5
Mycobacterium TB	8	10.5
None	20	26.3
Proteus mirabilis	1	1.3
Pseudomonas aeruginosa	8	10.5
Staphylococcus aureus	18	23.7
Total	76	100

The APACHE II score, a measure of illness severity, was significantly higher among non-survivors compared to survivors. The median APACHE II score for survivors was 12 (IQR 7), whereas non-survivors had a substantially elevated median score of 30 (IQR 4). Logistic regression analysis demonstrated that for every one-unit increase in the APACHE II score, the odds of mortality increased by 1.28 times (95% CI: 1.14–1.43), with a significant p-value of <0.001. These findings indicate that a higher APACHE II score is strongly associated with an increased risk of mortality in this cohort.

Table 7: Apache Score

C	Survivor (n=57)	Non-survivor (n=19)	Odds Ratio (95% CI) (Logistic regression)	p-value
Median (IQR) APACHE II Score	12 (7)	30 (4)	1.28 (1.14-1.43)	<0.001

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APACHE Score and duration of stay: The analysis of APACHE II scores in relation to the duration of stay in the RICU revealed no significant association. Patients who stayed for less than 6 days had a median APACHE II score of 14 (IQR 16), while those with a stay of 6–10 days had a median score of 16 (IQR 7). Among patients with more than 10 days of hospitalization, the median APACHE II score was 13 (IQR 11.5). Ordered logistic regression analysis yielded an odds ratio of 1.00 (95% CI: 0.94–1.06), with a p-value of 0.906, indicating no statistically significant relationship between APACHE II scores and the length of stay in the RICU.

Table 8: Apache score and duration of stay and outcome

Duration of stay	APACHE II Score Median (IQR)	Odds Ratio (95% CI) (Ordered logistic regression)	p-value
Less than 6 days	14 (16)	1.00 (0.94-1.06)	0.906
6-10 days	16 (7)		
>10 days	13 (11.5)		
Outcomes	Frequency	Percentage	
Discharged (Regular, DOPR, Referred)	56	73.7	
Left Against Medical Advice	5	6.6	
Expired	15	19.7	

DISCUSSION

The study cohort consisted of 76 patients, with a male predominance (68.4%) and a mean age of 53.8 years; 80.3% were over 40 years old. This demographic pattern is consistent with several Indian ICU studies, which report a higher proportion of middle-aged and older males among critically ill respiratory patients. The male predominance may reflect healthcare-seeking behaviours and occupational exposures rather than true disease prevalence. Comparable studies from Western India and elsewhere have similarly found that men are more likely to require ICU admission for respiratory failure, possibly due to higher rates of smoking and occupational exposures.[1,2]

A significant finding was the high rate of biomass fuel exposure among females (58.3% vs. 23.1% in males, p=0.003). This aligns with research showing that women in rural India are disproportionately exposed to biomass smoke due to traditional cooking practices, which is a recognized risk factor for chronic respiratory diseases. The prevalence of smoking (47.4% current smokers, 26.3% ex-smokers) was also high, mirroring findings from other North Indian studies where smoking is a leading risk factor for COPD and pneumonia.[3,4]

Regarding comorbidities, 61.8% of patients had no chronic illnesses, while diabetes (25%) and hypertension (13.2%) were the most common comorbidities. Notably, there was no statistically significant association between comorbidities and survival (p=0.492). This contrasts with some studies where diabetes and hypertension have been linked to worse ICU outcomes, but may reflect the predominance of acute respiratory conditions in this cohort.[5,6]

The distribution of respiratory failure types was nearly equal: 48.7% had type 1 (hypoxemic) and 51.3% had type 2 (hypercapnic) failure. COPD exacerbations were significantly associated with type 2 failure (72.7% of COPD patients, p=0.002). This pattern is consistent with the pathophysiology of COPD and matches findings from other Indian ICUs, where type 2 failure predominates among COPD admissions. In contrast, pneumonia and pleural effusion were more often associated with type 1 failure, as reported in similar cohorts.[7,8]

Non-invasive ventilation (NIV) was the most common mode of respiratory support (65.8%), followed by oxygen inhalation (21.1%) and invasive mechanical ventilation (IMV, 13.2%). The high use of NIV aligns with contemporary guidelines and studies advocating for NIV as first-line therapy in COPD exacerbations and select cases of acute respiratory failure. The relatively low rate of IMV reflects both a preference for less invasive modalities and resource considerations. Studies from North India have reported similar NIV utilization rates, with IMV reserved for severe or refractory cases. Mortality among ARDS patients requiring IMV was notably high (66.7%), paralleling findings from pediatric and adult ARDS cohorts in India and globally.[9]

Staphylococcus aureus (23.7%) and Klebsiella pneumoniae (14.5%) were the most frequently isolated pathogens, with Mycobacterium tuberculosis and Pseudomonas aeruginosa each accounting for 10.5%. This microbiological spectrum is consistent with other Indian ICU studies, where Gram-negative organisms (notably Klebsiella and Acinetobacter) and S. aureus (including MRSA) are predominant. The high prevalence of S. aureus, especially in pneumonia and COPD cases, underscores the need for empiric coverage against this pathogen in critically ill respiratory patients. The detection of M. tuberculosis in 10.5% reflects the ongoing burden of TB in India, which is less common in Western ICUs. Notably, 21.2% of COPD exacerbation cases showed no bacterial growth, suggesting a role for viral or non-infectious triggers, as highlighted in recent phenotyping studies.[10]

The APACHE II score was a robust predictor of mortality: non-survivors had a median score of 30, compared to 12 in survivors (p<0.001). Each one-unit increase in APACHE II was associated with a 28%

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increase in mortality risk (OR 1.28, 95% CI: 1.14–1.43). This finding is in line with multiple studies validating APACHE II as a reliable prognostic tool for ICU mortality, with similar odds ratios and discrimination (AUC 0.75–0.83). Indian studies have shown that APACHE II scores above 25 are independently associated with poor outcomes, and scores above 35 nearly always predict mortality. The overall mortality rate in this cohort (19.7%) is comparable to other Indian RICU studies (18–32%), though lower than some Western reports for similar case mixes.[11]

There was no significant association between APACHE II scores and ICU length of stay (p=0.906). Patients with shorter stays (<6 days) had similar APACHE II scores to those with longer stays, suggesting that severity of illness at admission does not necessarily predict prolonged ICU utilization. This finding echoes other studies where APACHE II is a strong predictor of mortality but not of resource use or length of stay. Most survivors (56.6%) were discharged within 6 days, while a similar proportion of non-survivors died early, indicating that rapid progression rather than prolonged critical illness is the norm in this setting.[12]

CONCLUSION

Early Risk Stratification: APACHE II scoring should be used to guide triage and resource allocation, especially in resource-limited RICUs.

Targeted Preventive Strategies: The high prevalence of biomass exposure among women highlights the need for public health interventions to reduce indoor air pollution.

Antibiotic Stewardship: The microbiological profile supports the use of empiric regimens covering both Gram-negative and Gram-positive pathogens, with local resistance patterns guiding therapy.

NIV Utilization: The predominance of NIV and its association with favourable outcomes in COPD and select hypoxemic respiratory failure cases should encourage its continued use, with careful patient selection.

Post-Discharge Care: While 73.7% of patients were discharged, long-term outcomes and quality of life remain unstudied and warrant structured follow-up and rehabilitation programs.

Limitations of study: Few limitations that warrant acknowledgment. Firstly, the single centre design limits the generalizability of our findings to other settings, as variations in ICU management and regional epidemiology could influence outcomes. Secondly the limited number of patients may reduce the statistical power to detect significant associations, particularly in sub group analyses. Thirdly, the study only captures in hospital outcomes, precluding insights on post discharge morbidity, functional recovery and quality of life lastly we did not study anti- microbial resistance.

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