

Severe Acute Respiratory Infections in an LMIC Intensive Care Unit: A Retrospective Cohort Study of Epidemiology, Outcomes, and Resource Utilization

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Abstract

Background

Severe acute respiratory infections (SARI) are a leading cause of critical illness worldwide and remain central to pandemic threats such as influenza and COVID-19. Data from low- and middle-income countries (LMICs) are limited, particularly regarding ICU burden, mortality, and resource utilization.

Methods and findings

We conducted a retrospective cohort study of adult patients admitted to a tertiary care ICU in an LMIC between 1 January and 31 December 2025. Data were extracted from the Pakistan Registry of Intensive Care (PRICE).

Outcomes included the proportion of ICU admissions attributable to respiratory infections, illness severity (APACHE II), predicted mortality (eTropICS), organ support utilization, ICU length of stay, and observed mortality.

Among 915 ICU discharges, respiratory infections accounted for 33.5% of ICU admissions. Among patients with respiratory infections, pneumonia was the predominant diagnosis (62.4%), followed by acute respiratory distress syndrome (ARDS) (26.6%) and other respiratory conditions (11.1%). The median APACHE II score was 11 (IQR 8–15), with a predicted mortality of 16.06%. Mechanical ventilation was required in 35.52% of patients, while 6.56% required vasopressor support. Median ICU length of stay was 3 days (IQR 2–5), and observed ICU mortality was 7.43%.

Conclusion

Respiratory infections represent a substantial ICU burden in this LMIC setting, requiring significant organ support resources. These findings highlight the need for strengthened ICU capacity, ventilator preparedness, and integrated surveillance systems to improve resilience against future respiratory pandemics.

Keywords

Respiratory infections; Severe acute; Illness severity; Predominant diagnosis; Epidemiology.

Introduction

Severe acute respiratory infections (SARI) remain a major cause of global morbidity and mortality, disproportionately affecting populations in low- and middle-income countries (LMICs) [1,2]. Clinical conditions such as pneumonia and acute respiratory distress syndrome (ARDS) frequently progress to critical illness requiring intensive care unit (ICU) admission and advanced organ support. These conditions impose a substantial burden on healthcare systems, particularly in resource-limited settings where ICU capacity, workforce, and infrastructure are often constrained [3,10,11].

The coronavirus disease 2019 (COVID-19) pandemic further exposed critical gaps in healthcare systems worldwide, particularly in LMICs. Limited availability of ventilators, shortages of trained personnel, and inadequate ICU infrastructure highlighted the vulnerability of these systems during surges of critically ill patients [9,12]. Despite this, there remains limited published data describing the burden, severity, and outcomes of respiratory infections in LMIC ICUs.

Accurate estimation of ICU burden and outcomes associated with respiratory infections is essential for optimizing healthcare delivery and guiding resource allocation. Registry-based data provide valuable real-world insights into patient characteristics, disease severity, and outcomes, enabling benchmarking and quality improvement [6].

This study aimed to assess the burden of severe acute respiratory infections in a tertiary care ICU in an LMIC, evaluate associated severity and mortality, and examine patterns of resource utilization.

Methods

Study design and setting

This retrospective cohort study was conducted in the tertiary care intensive care unit (ICU) of South City

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Hospital, Karachi, Pakistan, representing a resource-limited LMIC setting. The study included ICU admissions between 1 January and 31 December 2025.

Data source

Data were extracted from the Pakistan Registry of Intensive Care (PRICE), a validated, standardized ICU registry capturing demographic, clinical, and outcome data.

Study population

All adult patients (≥ 18 years) admitted to the intensive care unit (ICU) and subsequently discharged during the study period were evaluated for inclusion in the study. Patients with respiratory infections were identified using standardized registry diagnostic categories, including pneumonia, acute respiratory distress syndrome (ARDS), and other respiratory conditions.

Inclusion criteria

Adult patients (≥ 18 years) admitted to the ICU at South City Hospital between 1 January and 31 December 2025 with documented respiratory infections recorded in the Pakistan Registry of Intensive Care (PRICE) were included in the analysis.

Exclusion criteria

Patients with incomplete registry records or missing outcome data were excluded from the analysis.

Study variables and outcomes

Illness severity was assessed using the Acute Physiology and Chronic Health Evaluation II (APACHE II) score, while predicted mortality was estimated using the e-Tropical Intensive Care Score (eTropICS). Resource utilization was evaluated based on the requirement for organ support, including mechanical ventilation and vasopressor use. Length of stay was defined as the total duration of ICU admission in days. The primary outcome measure was ICU mortality.

Statistical analysis

Descriptive statistics were used to summarize the data. Continuous variables were reported as medians with interquartile ranges (IQR), while categorical variables were expressed as percentages. Comparisons between predicted and observed mortality were descriptive.

Ethical considerations

The study was approved by the Institutional Review Board (IRB) of South City Hospital. As this was a retrospective analysis of anonymized registry data, the requirement for informed consent was waived. Confidentiality and data protection were maintained throughout.

Results

A total of 915 ICU discharges were included in the analysis. Respiratory infections accounted for a substantial proportion of admissions, representing 33.5% of ICU admissions (Figure 1). Among these, pneumonia was the predominant diagnosis (62.4%), followed by acute respiratory distress syndrome (ARDS) (26.6%) and other respiratory conditions (11.1%) (Figure 2).

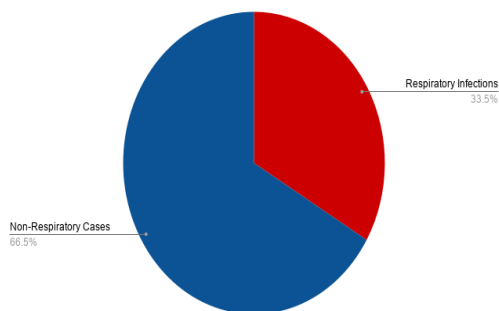


Figure 1: Proportion of ICU Admissions Attributable to Respiratory Infections.

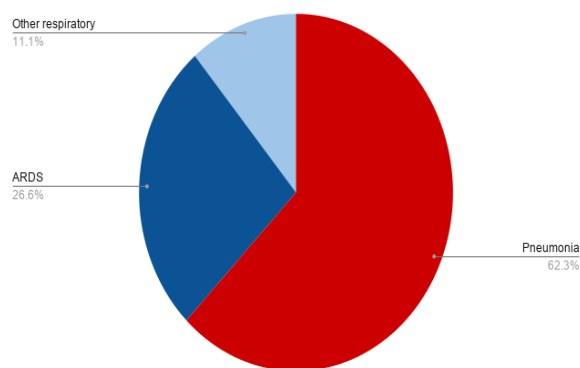


Figure 2: Distribution of Respiratory Diagnoses Among ICU Patients with Respiratory Infections.

The median APACHE II score among patients with respiratory infections was 11 (interquartile range [IQR] 8–15), indicating moderate illness severity. The median predicted mortality, as estimated by the eTropICS score, was 16.06%.

A considerable proportion of patients required advanced organ support. Mechanical ventilation was required in 35.52% of cases, while vasopressor support was required in 6.56% (Figure 3), reflecting the resource-intensive nature of respiratory illnesses in the ICU setting.

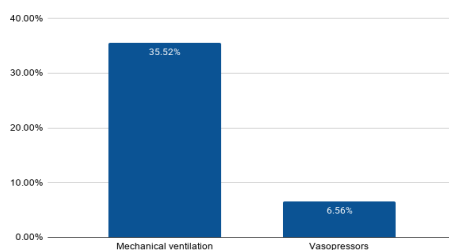


Figure 3: Organ Support Utilization in Patients with Respiratory Infections.

The median ICU length of stay was 3 days (IQR 2–5). The observed ICU mortality rate was 7.43%, which was notably lower than the mortality predicted by severity scoring systems.

Discussion

This study demonstrates that severe acute respiratory infections (SARI) constitute a substantial proportion of ICU admissions in a resource-limited setting, accounting for one-third of ICU admissions. These findings are consistent with global estimates indicating that respiratory infections remain a leading cause of critical illness, particularly in LMICs [1,3]. Importantly, this burden persists beyond pandemic periods, underscoring the ongoing strain placed on ICU resources by respiratory diseases.

In this cohort, the observed ICU mortality was lower than that predicted by severity scoring systems. This discrepancy may reflect differences in case-mix, effectiveness of clinical management, or limitations in prognostic models such as eTropICS when applied in LMIC populations. Previous studies have demonstrated variability in the performance of severity scoring systems across different healthcare settings, particularly in resource-constrained environments [5]. These findings highlight the need for local validation and calibration of predictive models to improve their accuracy and clinical utility.

The high proportion of patients requiring mechanical ventilation reflects the resource-intensive nature of respiratory infections in ICU settings. Similar findings have been reported in international studies, where respiratory failure remains a major indication for ICU admission and organ support [8]. In LMICs, where critical care capacity is often limited, this demand can place considerable strain on healthcare systems [10,11].

Strengths and Limitations

This study has several strengths. It utilizes data from a standardized ICU registry, ensuring consistency and reliability of data collection. The inclusion of real-world clinical data enhances the generalizability of findings to similar LMIC settings. However, certain limitations must be acknowledged. The single-center design may limit external validity, and the retrospective nature of the study introduces potential for missing or incomplete data. Additionally, the lack of microbiological and etiological data precludes pathogen-specific analysis, and long-term patient outcomes beyond ICU discharge were not assessed.

Conclusion

Severe acute respiratory infections contribute significantly to ICU admissions and resource utilization in LMIC settings. These findings underscore the importance of strengthening critical care infrastructure and optimizing resource allocation to improve patient outcomes in resource-limited settings.

Author contributions

Shireen Shah conceptualized the study, contributed to study design, performed data extraction and analysis, and drafted the manuscript. Muhammad Nasir Khoso supervised the study, contributed to study design, and provided critical revisions. Maroosha Imran assisted with the literature review and manuscript drafting. Ayesha Malik contributed to data collection and manuscript review. Anma Ansari contributed to clinical input and data interpretation. Umama Shakeel Ahmed contributed to data collection and manuscript editing. Ronald Nweackah contributed to methodological input and critical review of the manuscript. All authors reviewed and approved the final version of the manuscript.

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Conflicts of interest

The authors declare no conflicts of interest.

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