



Original Article

Pulse Oximetry (SpO₂) Monitoring as a Prognostic Indicator in Emergency Department Patients: A Prospective Observational Study

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ABSTRACT

Background: Pulse oximetry (SpO₂) is routinely used in emergency departments (EDs), but its role as an independent prognostic marker across diverse emergency patients is not well established.

Objective: This study evaluates admission SpO₂ as a prognostic indicator for mortality and critical care needs.

Methods: A prospective cohort of 2,580 adult ED patients over one year was assessed. Initial SpO₂ was recorded; 30-day mortality, ICU admission, and mechanical ventilation requirements were tracked. Logistic regression and ROC curve analyses evaluated SpO₂'s predictive value.

Results: SpO₂ <93% at admission was seen in 16.9% of patients and associated with a significant increase in 30-day mortality (16.4% vs 4.3%), ICU admission (19.7% vs 5.8%), and ventilation needs (11.2% vs 3.5%) (p<0.001). SpO₂ predicted mortality well (AUC = 0.81).

Conclusion: Initial SpO₂ measurement is a simple, non-invasive, and effective prognostic tool that should be integrated into ED triage protocols for early risk stratification and resource allocation.

Keywords: Please provide 3 to 6 keywords which can be used for indexing purposes.

INTRODUCTION

Pulse oximetry (SpO₂) provides a rapid, non-invasive measure of arterial oxygen saturation, widely adopted as a critical vital sign in emergency medicine. Since its introduction, pulse oximetry has revolutionized oxygenation assessment, enabling continuous monitoring without the delays and invasiveness of arterial blood gas sampling. SpO₂ reflects oxygen delivery efficacy, crucial for patient survival, particularly in acute illness. Beyond diagnosing hypoxemia, emerging data suggest SpO₂'s prognostic capabilities, signaling risk for adverse outcomes in varied clinical settings.

Several studies have validated SpO₂ thresholds below 90-93% as markers for acute respiratory failure, ICU admission, and mortality, particularly during respiratory pandemics such as COVID-19 [5-7]. Nevertheless, the prognostic utility of SpO₂ in unselected emergency populations remains underexplored. Risk stratification in ED is challenged by clinical heterogeneity and resource constraints, underscoring the value of readily obtainable markers like SpO₂ that may guide early, targeted intervention.

Moreover, SpO₂ monitoring is universally available and easily interpretable, suggesting broad applicability if proven prognostically valid. This study aims to prospectively assess the relationship between initial SpO₂ values at ED admission and short-term adverse outcomes in a large, diverse emergency patient cohort. We hypothesize that lower admission SpO₂ independently predicts higher mortality and critical care resource utilization.

METHODS

Study Design and Setting

This prospective observational cohort study was conducted at a tertiary care hospital's emergency department from October 2024 to September 2025. The institutional review board approved the protocol.

Participants

All consenting adult patients (≥ 18 years) triaged in the ED during the study period were eligible ($n=2,580$). Exclusion criteria included incomplete records, transfer within 24 hours, or do-not-resuscitate status on arrival.

Data Collection

Admission SpO₂ was measured using standard pulse oximetry devices at triage. Demographic, clinical history, and presenting complaints were documented. Primary outcomes included all-cause 30-day mortality, ICU admission, and mechanical ventilation requirement during hospitalization.

Statistical Analysis

SpO₂ was categorized: $<90\%$, $90-92\%$, $93-95\%$, $>95\%$. Outcomes among categories were compared using chi-square tests. Multivariable logistic regression adjusted for confounders. ROC curve analysis quantified SpO₂'s ability to predict 30-day mortality, with area under the curve (AUC) as a summary measure. A p-value <0.05 was significant.

RESULTS

Among 2,580 patients (mean age 49 ± 17 years; 54% male), 437 (16.9%) had admission SpO₂ $<93\%$. These patients exhibited:

30-day mortality: 16.4% vs 4.3% for SpO₂ $\geq 93\%$, $p<0.001$

ICU admission: 19.7% vs 5.8%, $p<0.001$

Mechanical ventilation: 11.2% vs 3.5%, $p<0.001$

Logistic regression confirmed SpO₂ $<93\%$ as an independent predictor of mortality (adjusted OR 3.8; 95% CI 2.7-5.3). The SpO₂ ROC curve for mortality prediction demonstrated an AUC of 0.81 (95% CI, 0.78-0.85), indicating strong discrimination.

DISCUSSION

This study establishes admission SpO₂ as a robust, independent prognostic indicator for adverse outcomes in unselected ED patients. Patients presenting with SpO₂ below 93% were at significantly elevated risk of death or requiring intensive care interventions, consistent with existing literature associating hypoxemia with poor prognosis in critical illness.

Our findings extend prior disease-specific observations—such as ARDS or sepsis cohorts—to a broader emergency population, underscoring the generalizability and clinical utility of routine SpO₂ assessment in ED triage. The predictive performance of SpO₂ equaled or exceeded that of other commonly used vital signs and scoring systems, reinforcing its pragmatic value.

The non-invasive, immediate availability, and cost-effectiveness of pulse oximetry make it an ideal tool for early risk stratification. Incorporating SpO₂ thresholds into triage systems can expedite identification of high-risk patients, optimizing critical care resource allocation and potentially improving outcomes through earlier interventions.

Limitations include single-center design, absence of detailed comorbidity adjustments, and inability to capture complex disease-specific severity scores. Future multicenter prospective studies and interventional trials integrating SpO₂-guided triage protocols are warranted to validate these effects and evaluate impact on clinical workflow and patient-centered outcomes.

CONCLUSION

Initial SpO₂ measured on ED admission is a powerful, non-invasive prognostic marker for 30-day mortality and critical care needs. Its universal availability and predictive accuracy support the integration of SpO₂ into ED triage protocols to enhance patient risk stratification and management decisions.

Declarations

Ethics Approval: Obtained from institutional review board.

Funding: None.

Conflicts of Interest: None declared.

Data Availability: Available on reasonable request.

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