Association Between Emergency Room Boarding Duration and Patient Outcomes for ICU Admissions at a Tertiary Government Hospital

Glaisa A. Claveria[1], Mark John F. Festin[2]

[1]Chief Resident, Department of Internal Medicine, Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium
[2]Consultant, Department of Internal Medicine, Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium

Abstract
Emergency Room (ER) boarding, defined as the time patients spend in the ER after a decision to admit them to the Intensive Care Unit (ICU), is a critical challenge in healthcare systems. This retrospective cohort study aimed to examine the impact of ER boarding duration on ICU outcomes at Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium. Using 232 patient records from January to December 2024, the study analyzed demographics, clinical characteristics, ER boarding duration, and ICU outcomes. Statistical analysis revealed that ER boarding was associated with increased risk of sepsis and nosocomial infections, but had limited power in predicting ICU stay length and mortality. The Charlson Comorbidity Index Score (CCIS) and APACHE II Score were stronger predictors of patient outcomes. Age influenced conditions like ARDS and AKI, while the Glasgow Coma Scale was not a significant predictor.

Keywords: ER Boarding, ICU Outcomes, Patient Mortality, Critical Care, Sepsis, APACHE II Score, Charlson Index

Introduction

Emergency Room (ER) boarding, the interval between the decision to admit a patient to the Intensive Care Unit (ICU) and the actual transfer, remains a critical challenge globally due to limited ICU capacity, delayed care coordination, and hospital overcrowding. This issue has been associated with higher rates of mortality, longer hospitalizations, and increased complications [1], [2]. At Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium, high patient volume and constrained ICU capacity amplify the problem, warranting focused analysis. Interventions such as refining ICU admission protocols, streamlining patient flow, and utilizing predictive models to identify at-risk patients have been introduced to mitigate ER boarding impacts [3], [4]. However, the relationship between ER boarding duration and ICU outcomes remains insufficiently understood in low-resource settings like the Philippines.

Previous research supports the adverse consequences of delayed ICU transfer. Chalfin et al. [2] found significantly increased mortality among critically ill patients with extended ER boarding, while Singer et al. [5] emphasized its role in avoidable complications. Although such studies provide useful guidance, their findings may not be directly transferable to the unique operational challenges of hospitals like Dr. Jose N. Rodriguez Memorial Hospital. This study addresses this gap by examining the association between ER boarding duration and ICU patient outcomes, including mortality, length of stay, and complication rates, to provide data-driven recommendations for enhancing critical care delivery in resource-limited environments.

Research Objective

This study primarily aims to assess the association between Emergency Room (ER) boarding duration and patient outcomes, specifically ICU length of stay, mortality rates, and complication incidence, among those admitted to the Intensive Care Unit at Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium. It also seeks to explore how patient profiles, including demographic factors (age, sex, socio-economic status) and clinical characteristics (comorbidities via the Charlson Comorbidity Index and illness severity via APACHE II scores), relate to these outcomes. The study further aims to determine the average ER boarding duration and its correlation with ICU outcomes, providing a comprehensive understanding of how both logistical and clinical factors influence critical care trajectories.

Methodology

Study Design: Retrospective cohort design

Study Setting: Department of Internal Medicine, Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium, Tala, Caloocan City, Philippines

Population and Sampling: 232 patients admitted to the intensive care unit (ICU) of Dr. Jose N. Rodriguez Memorial Hospital and Sanitarium after an initial stay in the emergency room (ER) from January 2024 to December 2024.

Inclusion criteria were adult patients (18 years and above) admitted to the ICU directly from the ER. Exclusion criteria included pediatric patients, elective ICU admissions, and patients transferred to other institutions.

Data Collection

Patient data for this study were sourced from the hospital's medical records department, focusing on individuals admitted to the ICU between January and December 2024. Data collection involved gathering demographic details (age, sex, socio-economic status) and clinical information such as primary diagnosis, comorbidities (via the Charlson Comorbidity Index), and illness severity (using APACHE II scores). The study also measured the average ER boarding duration and evaluated ICU outcomes, including mortality, length of stay, and complications such as sepsis, ARDS, ventilator-associated pneumonia, pressure ulcers, acute kidney injury, cardiac events, DVT/PE, nosocomial infections, and worsening of chronic conditions. Ultimately, the study aimed to determine how ER boarding duration affects these outcomes and to identify critical thresholds that may influence clinical deterioration.

Statistical Analysis

Descriptive statistics were used to summarize patient characteristics, ER boarding durations, and ICU outcomes. Inferential analysis, including logistic regression for binary outcomes and linear regression for continuous outcomes, was conducted to evaluate the association between ER boarding duration and ICU patient outcomes.

Table 1: Patient Outcomes

Patient Outcomes- Mortality	Frequency (n = 232)	Percent
Yes	132	56.9%
No	100	43.1%
Incidence of Complications		
Sepsis		
Yes	118	50.9%
No	114	49.1%
ARDS		
Yes	118	50.9%
No	114	49.1%
VAP		
Yes	47	20.3%
No	185	79.7%
PU		
Yes	41	17.7%
No	191	82.3%
AKI		
Yes	100	43.1%
No	132	56.9%
Cardiac Arrest/ Arrythmia		
Yes	132	56.9%
No	100	43.1%
DVP/PE		
Yes	45	19.4%
No	187	80.6%
Nosocomial Infections		
Yes	45	19.4%
No	187	80.6%
Worsening/ Pre-existing Condition		
Yes	80	34.5%
No	152	65.5%
Length of ICU stay		
Mean 11.89		
StDev 16.68		
Min 1		
Max 158		

Table 2: Regression Models Predicting Patient Outcomes

	ER Boarding		Age		GCS		CCIS		APACHE		
Outcome	*B*	*p*	*B*	*p*	*B*	*p*	*B*	*p*	*B*	*p*	R^2
ICU Stay	0.168	.16	0.105	.133	0.102	.349	1.026	.046	-0.157	.284	.051
Mortality	-0.002	.888	0.002	.864	0.021	.479	-0.184	.01	-0.066	.002	.17
Sepsis	-0.033	.043	0	.961	0.053	.211	-0.142	.048	-0.042	.067	.135

ARDS	0.014	.414	-0.024	.008	-0.006	.652	-0.034	.603	-0.042	.025	.107
VAP	-0.006	.721	-0.02	.084	0.088	.051	-0.18	.017	0.028	.278	.113
PU	0.004	.861	0.011	.361	0.07	.144	-0.317	<.001	0.001	.963	.156
AKI	-0.008	.596	0.021	.041	-0.008	.594	-0.561	<.001	-0.076	<.001	.372
CA	0.001	.956	0.003	.758	0.008	.659	-0.154	.029	-0.08	<.001	.172
DVT/PE	-0.046	.199	0.04	.323	0.178	.271	-0.19	.43	-0.022	.793	.144
NI	-0.034	.041	-0.008	.462	-0.027	.121	-0.159	.037	-0.021	.373	.1
WP	0.015	.449	0.018	.054	-0.014	.343	-0.194	.005	-0.047	.014	.103

Note. B = Unstandardized regression coefficient. CCIS = Charlson Comorbidity Index Score. Model R^2 reflects R^2 for linear regression (ICU Stay) and Nagelkerke's R^2 for logistic regression models. ER Boarding Duration, Age, GCS, CCIS, and APACHE Score were included as predictors in all models.

Findings

The average ER boarding duration was 7.69 days (SD = 9.25), with a range of 1 to 96 days. The mortality rate was 56.9%, and common complications included sepsis (50.9%), ARDS (50.9%), and AKI (43.1%). Regression analysis showed ER boarding was a significant predictor for sepsis ($p = .043$) and nosocomial infections ($p = .041$), but not for mortality or ICU stay.

The study revealed a high ICU mortality rate of 56.9% among 232 patients, indicating the severity of their health conditions and the critical challenges in managing such cases. The average ICU stay was 11.89 days, with durations ranging from 1 to 158 days, reflecting substantial variability based on illness severity and complications. Common complications included sepsis and ARDS (50.9%), AKI (43.1%), cardiac arrest or arrhythmias (56.9%), and infections such as VAP (20.3%) and nosocomial infections (19.4%). These findings underscore the complex clinical needs of critically ill patients and the importance of timely, effective interventions to reduce morbidity and mortality in ICU settings.

The predictive power of the statistical models varied across outcomes, with the linear regression model for ICU length of stay showing limited explanatory strength ($R^2 = .051$), where only the Charlson Comorbidity Index Score (CCIS) was a significant predictor. Among the logistic regression models, Acute Kidney Injury (AKI) showed the strongest predictive capacity (Nagelkerke's $R^2 = .372$), followed by cardiac arrest/arrhythmia, mortality, and pressure ulcers. Moderate predictive value was observed for sepsis, ARDS, VAP, nosocomial infections, and worsening of pre-existing conditions, while the DVT/PE model had low predictive power and no significant predictors. ER boarding duration was only significantly associated with sepsis and nosocomial infections, suggesting its limited role in forecasting broader ICU outcomes. Age was a notable predictor for ARDS and AKI, while GCS showed no significant impact. Both CCIS and APACHE scores emerged as the most consistent predictors across multiple outcomes, emphasizing the critical influence of comorbidity burden and physiological severity on patient outcomes in the ICU.

The findings of this study indicate that while ER boarding duration was statistically significant in predicting sepsis and nosocomial infections, it had limited overall predictive value for broader ICU patient outcomes such as length of stay, mortality, or most other complications. Longer ER boarding was associated with a higher likelihood of developing these two complications, suggesting a potential link between delays in care and infection risk. However, the more influential determinants of adverse outcomes were clinical variables, particularly comorbidity burden and physiological severity. This aligns with earlier studies, which emphasize that, although delays in ICU admission can contribute to deterioration, the severity of a patient's baseline health condition often plays a more decisive role in determining outcomes [6], [7].

Among these clinical factors, the Charlson Co-morbidity Index Score (CCIS) emerged as the most consistent and significant predictor across several outcomes, including ICU stay, mortality, sepsis, pressure ulcers, AKI, cardiac arrest, and worsening of chronic conditions, supporting findings by Knaus et al. [8] and Vincent et al. [9]. Similarly, the APACHE Score significantly predicted mortality, ARDS, and cardiac arrest, reinforcing its role as a reliable tool for risk stratification [8], [7]. Age was also a significant predictor of ARDS and AKI, consistent with evidence that older patients are more vulnerable due to diminished organ function and existing health issues [10]. In contrast, the Glasgow Coma Scale (GCS) did not significantly predict any outcomes, suggesting its limited utility in this context compared to broader measures of illness burden. Although GCS is predictive in specific populations like those with traumatic brain injury [11], this study supports the view that comorbidity and physiological severity are more critical in anticipating ICU outcomes.

Conclusion

In conclusion, while ER boarding duration may have a modest effect on specific complications like sepsis and nosocomial infections, it is clear that comorbidity burden and physiological severity are the most reliable predictors of critical outcomes. Addressing resource constraints, improving ICU admissions, and focusing on managing comorbidities will be essential for improving the prognosis of critically ill patients. Moreover, a personalized approach considering patient age and the severity of organ-specific complications will likely improve patient outcomes in ICU settings.

Recommendations

To improve outcomes for critically ill patients, healthcare systems should focus on early identification and management of comorbidities, streamline ICU admission processes to reduce delays, and address resource limitations in both the ED and ICU. Personalized care strategies that account for patient age and specific organ-related complications can further enhance prognosis. Additionally, the use of real-time monitoring and risk stratification tools can support timely, evidence-based clinical decisions.

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