Original Article

Extended Emergency Department Boarding (≥48 Hours) and Its Impact on Adverse Outcomes: A Prospective Observational Study from a Tertiary-Care Hospital

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Abstract

Background: Emergency Department (ED) boarding—defined as the time patients remain in the ED after the admission decision—is a major determinant of ED crowding, patient harm, and system inefficiency. Prolonged ED stays are associated with delays in definitive management, higher complication rates, and increased mortality. The objective is to determine the incidence of extended ED boarding (≥48 hours). To compare adverse events between overstayed and timely-shifted patients. 3. To identify system-level causes contributing to prolonged boarding.
Material and Methods: A prospective observational study was conducted over six weeks in the ED of a tertiary-care teaching hospital. Patients with admission decisions were enrolled through simple random sampling. Charlson Comorbidity Index (CCI) was used for stratification. Patients were grouped into ≤48 hours (timely transfers) and >48 hours (extended boarders). Adverse events were compared using Chi-square/Fisher's exact tests, and relative risks were computed. Data sources included medical records, admission files, and daily transfer logs.
Results: Among 300 patients, 96 (32%) boarded >48 hours. System-level contributors included limited bed capacity, delayed discharges, pending consultant decisions, diagnostic delays, communication gaps, delayed visibility of vacant beds, inappropriate specialty assignment, and preferential transfers. Across all CCI strata, overstayed patients experienced significantly more adverse events. Overstayed patients had higher risks of mortality (RR 3.19), ICU mortality (RR 3.54), hospital-acquired infections (RR 3.34), medication errors (RR 3.07), delayed treatment (RR 2.48), and prolonged LOS (RR 3.05). Even patients with CCI = 0 had an eight-fold higher risk of adverse events (RR 8.63).
Conclusion: Extended ED boarding is common and strongly associated with preventable clinical harm, irrespective of comorbidity burden. Systemic inefficiencies—particularly delayed discharges and bed non-availability—were major contributors. Improving discharge processes, real-time bed visibility, diagnostic turnaround, and interdepartmental coordination may significantly reduce ED boarding and improve patient outcomes.

Keywords: ED boarding; emergency crowding; Charlson Comorbidity Index; delayed transfer; inpatient flow; mortality; adverse events.

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Introduction

Emergency Department (ED) boarding refers to the period after an admission decision during which patients remain physically within the ED while awaiting an inpatient bed.[1] The American College of Emergency Physicians (ACEP) identifies ED boarding as the single most important driver of ED crowding.[2] Overcrowding impairs timely care, increases medical error rates, compromises privacy, and elevates morbidity and mortality.[3-7] Multiple studies have linked prolonged ED length of stay (LOS) with delays in critical treatment, sepsis bundle interventions, analgesia, and antibiotic administration.[8-11] Boarded patients are uniquely vulnerable as they receive care in an environment that is not structured for continued inpatient management. Evidence suggests higher rates of medication errors, infections, treatment delays, and clinical deterioration among ED boarders.[12-15] Critically ill patients awaiting ICU beds experience heightened risks, including increased mortality, invasive ventilation requirements, and need for renal replacement therapy.[16-19] Hospital-level contributors—including bed shortages, discharge delays, inefficient specialty allocation, inadequate diagnostic turnaround times, and interdepartmental coordination issues—have been consistently reported as key drivers of prolonged boarding.[20-23] International literature further links delayed inpatient discharge (particularly low 'discharge before noon' rates) to blocked ED throughput, with demonstrated improvements when structured discharge

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optimisation programs are implemented.[24-26] Given the global burden of ED crowding and the paucity of Indian data, this study aims to quantify extended boarding (≥48 hours), identify its causes, and evaluate its impact on adverse patient outcomes.

Objectives

1. To determine the incidence of extended ED boarding (≥48 hours).
2. To compare adverse events between boarded and timely-transferred patients.
3. To identify system-level causes contributing to extended ED boarding.

Materials and Methods

The study was conducted in the Emergency Department of a tertiary-care teaching hospital and designed as a prospective observational study carried out over a period of six weeks. A simple random sampling method was employed to select patients who were admitted to the observation areas following a decision for inpatient care, irrespective of their specialty. Patients who were discharged within 48 hours, referred to other institutions, or left against medical advice (LAMA) were excluded from the study. For each enrolled patient, the Charlson Comorbidity Index (CCI) was calculated to quantify the burden of pre-existing illnesses.

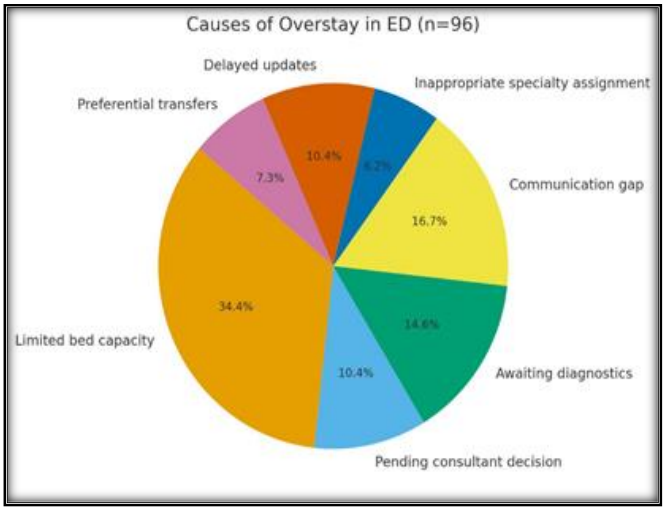
Based on the total CCI score, patients were stratified into three groups:• No comorbidity (CCI = 0)• Moderate comorbidity (CCI = 1–2)• High comorbidity (CCI ≥ 3)Within each comorbidity stratum, patients were further categorised according to their emergency department length of stay as either on-time transfers (≤ 48 hours) or extended-boarding cases (> 48 hours). Within each CCI stratum, adverse event rates were compared between overstay and on-time patients using the Chi-square and Fisher's exact test. Relative risk was calculated for adverse outcomes. Statistical significance was set at $p < 0.05$. Data were collected from medical records, admission files, and daily shifting census from the control room. Variables included area, CCI score, duration of stay, cause of delay, and occurrence of any adverse events.

Results

A total of 300 patients were included. Of these, 96 patients (32%) stayed beyond 48 hours.

Table 1: system level causes leading to delayed shifting from Emergency to inpatient units (n = 96)

Cause of Overstay	Details	Number of Cases (n)
BED NON-AVAILABILITY		
1. Limited bed capacity		33
2. Delayed discharges in receiving units	Pending & awaiting consultant decision	10
	Awaiting diagnostics/investigations	14
	Communication gap & lack of coordination between departments for multidiscipline clearance	16
3. Inappropriate specialty assignment on admission	Diagnostic uncertainty on admission leading to boarding	06
4. Delay in real-time updates from receiving units	delayed visibility of vacant beds due to staff shortages	10
5. Preferential transfers	mis prioritization	07



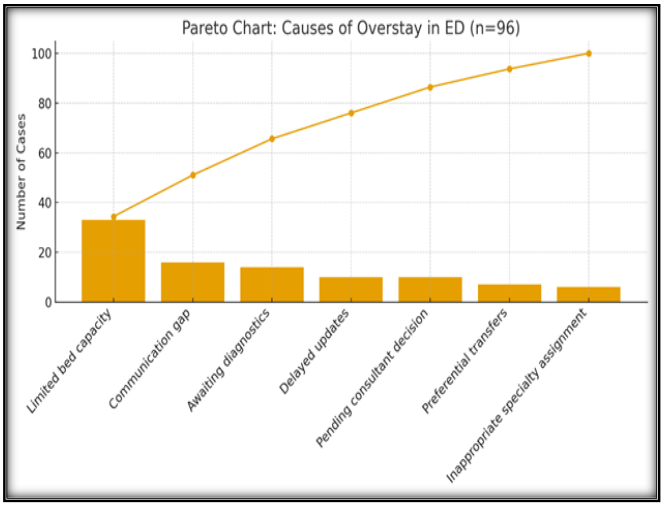


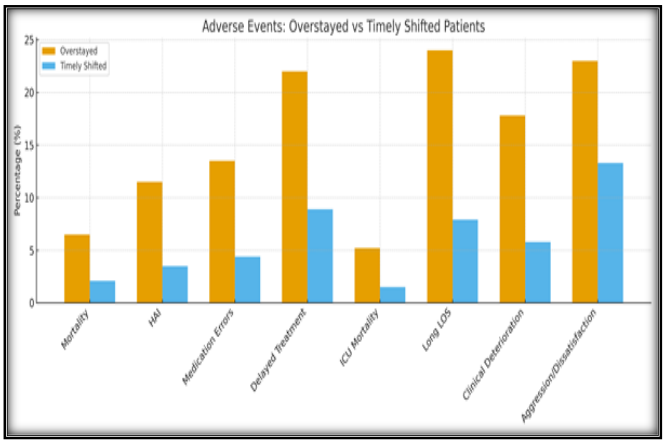
Table 2: Comparative Table of Adverse Events Overstayed (n=96) vs Timely Shifted (n=204)

Adverse Event	Overstayed (n=96)	% Overstayed	Timely Shifted (n=204)	% Timely Shifted	Incidence Difference	p-value
Mortality	6	6.3%	4	2.0%	+4.3%	0.093
Hospital-acquired infections	11	11.4%	7	3.4%	+8.0%	0.018
Medication errors	13	13.5%	9	4.4%	+9.1%	0.011

Delayed treatment	21	21.8%	18	8.8%	+13.0%	0.001
ICU mortality	5	5.2%	3	1.5%	+3.7%	0.121
Longer LOS (≥X days)	23	24.0%	16	7.8%	+16.2%	<0.001
Clinical deterioration	17	17.7%	12	5.8%	+11.9%	0.004
Patient aggression/dissatisfaction	22	22.9%	27	13.2%	+9.7%	0.039

Table 3: Relative Risk of Adverse Events (Overstayed vs Timely Shifted Patients)

Adverse Event	Overstayed (n=96)	Timely (n=204)	Risk O/S	Risk Timely	RR	P value
Mortality	6	4	0.062	0.02	3.19	0.08
Hospital-acquired infections	11	7	0.115	0.034	3.34	0.009
Medication errors	13	9	0.135	0.044	3.07	0.008
Delayed treatment	21	18	0.219	0.088	2.48	0.003
ICU mortality	5	3	0.052	0.015	3.54	0.116
Long LOS (≥X days)	23	16	0.24	0.078	3.05	0.0003
Clinical deterioration	17	12	0.177	0.059	3.01	0.0027
Aggression/dissatisfaction	22	27	0.229	0.132	1.73	0.044



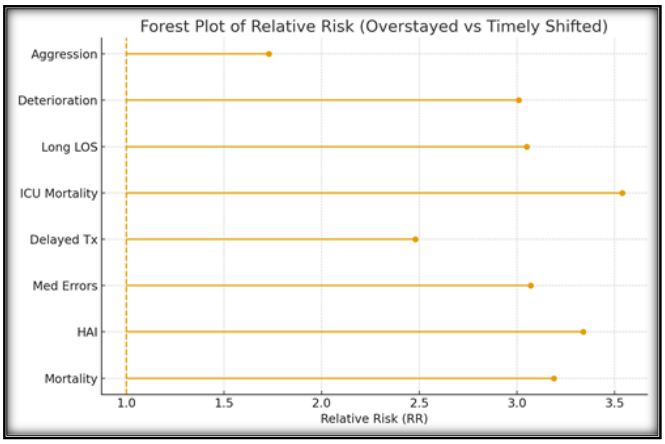
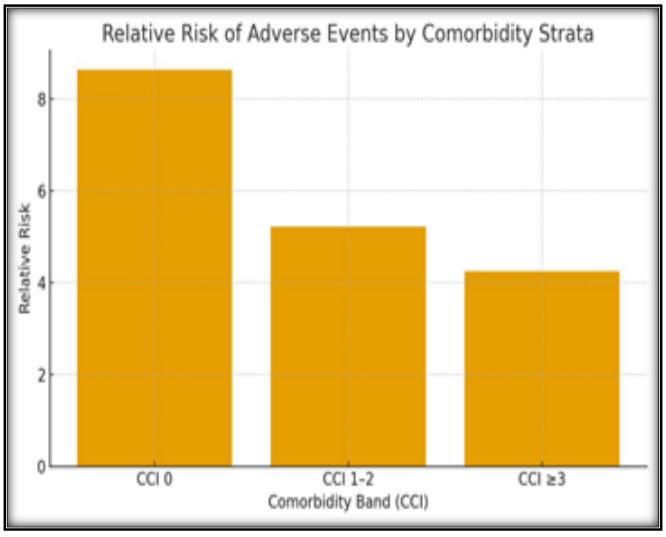


Table 4: Adverse Events by Comorbidity Strata with P Values

Comorbidity Band (CCI)	Overstay Adverse Events n (%)	Shifted Adverse Events n (%)	Relative Risk (95% CI)	P value
CCI = 0 (No Illness)	12 (31.6%)	3 (3.7%)	8.63	<0.001
CCI = 1–2 (Moderate)	15 (44.1%)	6 (8.45%)	5.22	<0.0001
CCI ≥ 3 (High)	20 (83.3%)	10 (19.6%)	4.25	<0.0001
Total	47 (49.0%)	19 (9.3%)	—	__



Discussion

This study found that nearly one-third (32%) of patients admitted to the Emergency Department overstayed for more than 48 hours. Overstays were strongly associated with higher adverse events across all comorbidity groups, confirming that prolonged ED stay itself contributes independently to patient harm. Stratification by the Charlson Comorbidity Index (CCI) revealed that even low-comorbidity patients (CCI=0) faced a higher risk of adverse events when overstaying. This suggests that systemic and process-related delays, rather than disease severity alone, drive harm.

The predominant contributors to extended ED overstay in our study, limited bed capacity, communication gaps, delays in diagnostics, pending consultant decisions, delayed updates, inappropriate specialty assignment, and preferential transfers, closely reflect patterns reported internationally in the ED boarding literature. Prior studies, including those by Hoot and Aronsky (2008) and Bernstein et al. (2009), similarly identify capacity constraints, workflow inefficiencies, interdepartmental communication failures, and delays in decision-making as key systemic drivers of overcrowding, prolonged ED LOS, and subsequent increases in preventable adverse events.[4,5] Our findings therefore align with established evidence that boarding is not merely a patient-level issue but a consequence of broader operational and coordination challenges across the hospital

continuum. Compared to patients who were shifted to inpatient wards within 48 hours, overstayed patients demonstrated consistently higher risks across all measured adverse outcomes. The risk of hospital-acquired infections was over three times higher among overstayed patients (RR = 3.34), and similar increases were observed for medication errors (RR = 3.07) and prolonged length of stay (RR = 3.05). Delayed treatment was 2.48 times more likely in the overstayed group. Mortality-related outcomes also showed substantial elevation, with overall mortality (RR = 3.19) and ICU mortality (RR = 3.54) significantly higher in those who remained in the Emergency Department. Clinical deterioration was three times more frequent in overstayed patients (RR = 3.01). Patient aggression and dissatisfaction were also higher among overstayed cases (RR = 1.73). Overall, extended Emergency Department boarding was strongly associated with increased adverse clinical and experiential outcomes.

In our study, ED patients who were waiting for ICU and inpatient beds were found to be at higher risk of mortality and adverse outcomes compared to those shifted on time. More than half of the studies involving ICU patients showed an association between EDB and IHM.[16-19] Many factors may have contributed to this association. One possible explanation is that the healthcare providers in the ED are not all trained in critical care medicine or in managing critically ill patients, and that the ED is not appropriate. Other studies also demonstrated that delayed ICU admission is associated with increased mortality.[3-7,16-18] Delayed admission increases the risk of mechanical ventilation, renal replacement therapy, and resource use. Various studies have shown that critically ill patients achieve better outcomes when treated in ICUs with continuous, close involvement by critical care physicians and when nurse-to-patient ratios in the intensive care units are accurately maintained.[16-18]

Our study identified delayed discharges in receiving units (wards and ICUs) as a major contributor to emergency boarding. When downstream units are unable to release beds promptly, admitted patients remain in the Emergency Department (ED) far beyond recommended transfer timelines. This bottleneck was reflected in our findings, where delayed discharges emerged as one of the most frequent system-level causes of overstay. We also found that patients who experienced delayed transfer out of the ED had a significantly longer overall hospital length of stay than those who were shifted on time, underscoring the cumulative downstream impact of ED boarding. These findings are consistent with published literature. Prior studies have demonstrated that when inpatient discharges are delayed—particularly when less than 10% of patients are discharged before 12 p.m.—ED admissions cannot be transferred to the wards, resulting in stalled throughput and prolonged stays. Without the early discharge of inpatients, newly admitted ED patients become ED boarders. A focus on early discharge before noon was shown to improve ED flow by reducing the number of ED boarders before the ED is at its busiest.

While our study did not directly evaluate system-level interventions, evidence from other institutions suggests that structured discharge-optimisation strategies can meaningfully reduce boarding-related delays. For instance, programs such as the Discharge Before Noon (DBN) initiative implemented comprehensive reforms—including clarifying care team roles, using checklists, and establishing geographic wards to improve coordination among physicians, nurses, case managers, and social workers. These changes enabled proactive identification of likely next-day discharges, prioritised testing and consults, and improved communication during care planning. As a result, DBN initiatives increased discharge-before-noon rates from 5% to 30% within three months, reaching 42% over five years, and reduced observed-to-expected LOS by 0.8 days, without increasing readmission rates.[26]

Conclusion

Extended ED boarding (≥48 hours) is common, system-driven, and strongly associated with preventable adverse outcomes. Improvements in ward discharge processes, real-time bed tracking, interdepartmental coordination, and diagnostic turnaround times are essential to reduce ED boarding and enhance patient safety.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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