

Cover Page

Official Study Title: Cost of Emergency Department Boarding for Hospitalized Patients in a Statewide Medical System

ClinicalTrials.gov Identifier (NCT): NCTXXXXXXX (pending)

Document Type: Study Protocol

Version: 1.0

Document Date: April 9, 2026

1. Background and Rationale

Emergency department (ED) boarding—defined as the practice of holding admitted patients in the ED while awaiting inpatient bed placement—has reached crisis levels in the United States. Prolonged boarding is associated with increased mortality, longer hospital length of stay, impaired quality of care, and reduced access for non-admitted patients through crowding effects. Despite this, boarding remains common, in part because its operational and economic consequences are incompletely understood.

Most prior studies have relied on billing charges or small-scale time-driven activity-based costing, both of which have important limitations for system-level decision-making. This study leverages a large, integrated clinical-operational-financial data warehouse within the University of Maryland Medical System (UMMS) to quantify the scope, predictors, and cost consequences of ED boarding using direct variable cost data—metrics familiar to hospital administrators and reflective of real resource utilization.

Understanding how patient factors affects risk of boarding, how boarding affects costs for admitted patients, and how boarding environments affect all ED patients, is critical to informing hospital throughput strategies and policy decisions, particularly within Maryland's global budget environment.

2. Study Objectives and Specific Aims

Overall Objective

To characterize the scope of ED boarding and quantify its financial and system-level impacts across a multi-hospital academic health system.

Aim 1: Define the scope and burden of ED boarding

Research Question: What patient, clinical, and system-level factors are associated with longer ED boarding times across UMMS hospitals?

Aim 2: Quantify the effect of ED boarding on hospitalization costs for admitted patients

Research Question: How does ED boarding time affect total and daily direct variable hospitalization costs among admitted patients?

Aim 3: Determine the impact of ED boarding on patients exposed to crowded ED environments

Research Question: How do boarding-heavy ED environments affect care processes, resource utilization, and outcomes for non-admitted ED patients?

3. Study Design

This is a retrospective, multi-site observational cohort study using administrative, clinical, operational, and cost data from UMMS emergency departments between 2022 and 2025.

4. Study Setting

The study will include ED encounters across multiple UMMS hospitals, including academic, community, suburban, and rural sites. UMMS hospitals vary in size, capacity, and specialty services, allowing examination of boarding across heterogeneous practice environments. Single site studies at the flagship academic medical center may serve as pilots for system-wide analysis.

5. Study Population

Inclusion Criteria

- Adults aged ≥ 18 years
- ED encounters resulting in inpatient or observation admission
- Admission to services that routinely assume clinical responsibility for boarding patients

Exclusion Criteria

- Pediatric patients

- Transfers from outside facilities
 - Admissions directly to ICU or intermediate care units when boarding responsibility does not remain with the ED
 - Admissions to specialty services that do not manage boarded patients
-

6. Definitions and Key Variables

Boarding Time

Time (hours) from placement of the admission order to physical departure from the ED.

Boarding Categories

- <4 hours (reference, consistent with Joint Commission recommendation)
- 4–12 hours
- 12–24 hours
- > 24 hours

Primary Cost Measures

- Total direct variable cost per hospitalization
- Daily direct variable cost (total cost divided by hospital length of stay)

Boarding Environment Metrics (Aim 3)

- Boarding Density Ratio: Proportion of ED beds occupied by boarders during a patient's ED stay
- Boarding-to-Census Proportion: Ratio of boarded patients to total ED census

Additional outcomes for exploratory analysis

- Boarding Percentage: Proportion of hospitalization time spent as ED boarder
-

7. Data Sources

- **Epic Electronic Health Record:** timestamps, diagnoses, procedures, demographics
- **Health Performance Manager (HPM):** direct variable cost data and cost subcomponents
- **ED Universe Data Warehouse:** integrated, curated, relational clinical and operational data

- **Epic Clarity Queries:** supplementary social, behavioral, and comorbidity variables
-

8. Outcomes by Aim

Aim 1

- Boarding duration (continuous and categorical)
- Proportion of encounters exceeding boarding thresholds
- Proportion of hospitalization spent boarding

Aim 2

- Total direct variable hospitalization costs
- Daily direct variable hospitalization costs

Aim 3

- ED length of stay
 - ED direct variable costs
 - Care quality metrics (e.g., door-to-provider time)
 - Downstream utilization (e.g., 30-day ED revisits)
-

9. Ethical Considerations

This study has IRB approval (UMB IRB #HP-00112665) with a waiver of informed consent for secondary analysis of existing clinical data. The study qualifies as minimal risk. All analyses will be conducted on secure institutional servers with access restricted to authorized study personnel.

10. Dissemination

Results will be disseminated through peer-reviewed journals, academic conferences, and presentations to UMMS leadership and policy stakeholders. Only aggregate, de-identified data will be reported.