



Original Contribution

Increased door to admission time is associated with prolonged throughput for ED patients discharged home[☆]Scott P. Krall, MD, MBA^a, Jose Guardiola, PhD^b, Peter B. Richman, MD, MBA^{a,*}^a Department of Emergency Medicine, Texas A&M Health Science Center/Christus Spohn, Corpus Christi, TX^b Department of Mathematics, Texas A&M University-Corpus Christi, Corpus Christi, TX

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ABSTRACT

Background: Emergency Department (ED) service evaluations are typically based on surveys of discharged patients. Physicians/administrators benefit from data that quantifies system-based factors that adversely impact the experience of those who represent the survey cohort.

Objective: While investigators have established that admitted patient boarding impacts overall ED throughput times, we sought to specifically quantify the relationship between throughput times for patients admitted (EDLOS) versus discharged home from the ED (DCLOS).

Methods: We performed a prospective analysis of consecutive patient encounters at an inner-city ED. Variables collected: median daily DCLOS for ED patients, ED daily census, left without being seen (LWBS), median door to doctor, median room to doctor, and daily number admitted. Admitted patients divided into 2 groups based on daily median EDLOS for admits (<6 hours, ≥6 hours). Continuous variables analyzed by t-tests. Multivariate regression utilized to identify independent effects of the co-variants on median daily DCLOS.

Results: We analyzed 24,127 patient visits. ED patient DCLOS was longer for patients seen on days with prolonged EDLOS (193.7 minutes, 95%CI 186.7–200.7 vs. 152.8, 144.9–160.5, $P < .0001$). Variables that were associated with increased daily median EDLOS for admits included: daily admits ($P = 0.01$), room to doctor time ($P < .01$), number of patients that left without being seen ($P < .01$). When controlling for the covariate daily census, differences in DCLOS remained significant for the ≥6 hours group (189.4 minutes, 95%CI 184.1–194.7 vs. 164.8, 155.7–173.9 ($P < .0001$)).

Conclusion: Prolonged ED stays for admitted patients were associated with prolonged throughput times for patients discharged home from the ED.

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1. Introduction

The emergency department has become the entry portal for the hospital as well as the final safety net for all patients in the United States healthcare system. As a consequence of these roles, EDs are becoming increasingly crowded (or overcrowded) with adverse consequences. McCusker linked administrative databases of over 670,000 patients and found that a 10% increase in emergency bed relative occupancy ratio was associated with a 3% increase of the following 30-day outcomes: deaths (for admitted and discharged patients), one or more return ED visits (among discharged patients), and hospital admission at first return visit with a “strong correlation between bed crowding and mortality among large emergency departments” [1]. Numerous other studies have shown similar negative effects on patient outcomes [2–10].

In response to these concerns, the Institute of Medicine has recommended that hospitals reduce ED overcrowding and utilize tools such as queuing theory on admission process and 23 hour ED observation units for improving hospital efficiency [11]. The Centers for Medicare and Medicaid Services (CMS) and The Joint Commission (TJC) have begun to regulate the process with the following performance measure—TJC element LD.04.03.11 that states “the hospital measures and sets goals for mitigating and managing the boarding (the practice of holding patients in the ED or a temporary location for four or more hours after the decision to admit or transfer has been made) of patients who come through the emergency department” [12].

Researchers studying the area of ED patient flow have demonstrated that a variety of internal processes, external factors and the ED department size can impact the ED throughput [13–45]. Such studies of internal inputs have addressed department process changes, including the use of “fast track” areas and redesigning the location of nursing staff and physicians throughout the ED [21–28]. Investigators have also evaluated the effect of optimizing laboratory efficiencies including point of care testing as a means to reduce emergency department length of stay [29–34]. The other major factors in ED flow are hospital occupancy

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* Corresponding author at: Department of Emergency Medicine, Texas A&M Health Science Center/Christus Spohn, Corpus Christi, TX 78405. Tel.: +1 361 902 6762.

E-mail address: PRichmanMDMBA@gmail.com (P.B. Richman).

and boarding of in-patients in the ED, and, as previously noted, these have been shown to have an adverse impact on emergency department length of stay and outcomes for patients who are ultimately admitted to the hospital [16,17,20,35–39].

The ED is a complex system due to the uncontrolled nature of inputs. Patient factors that influence ED flow include variation in acuity, types of chief complaints and unpredictable surges in patient volume throughout a given day. Flow is also significantly influenced by hospital-based factors outside the direct domain of ED control. As customer service surveys for ED patients focus on patients who are discharged home, it is also important to understand the impact of patient boarding on flow for this large segment of the ED census. We conducted a prospective, observational study to test the hypothesis that extended EDLOS for admitted patients (boarding) would be associated with increased length of stay for those patients ultimately discharged from the ED (DCLOS), and quantify that effect in our institution.

2. Methods

2.1. Study design

We performed a prospective, observational study to assess the relationship between throughput of patients discharged from the ED and boarding times for patients admitted to the hospital through the ED.

2.2. Study setting

We conducted this study at an urban county hospital facility. The hospital is a designated level-2 trauma center by the American College of Surgeons covering a 12-county region. Physicians at our facility see 48,000 ED patients annually, with an admission rate of 17.5%. Twenty-five percent of those admissions are admitted to the intensive care units. Physician staffing in the main part of the ED consists of an attending physician and two emergency medicine residents (of variable levels of training) for a 24-hour period, an additional fast track area staffed 20 hours by an advanced practice practitioner. The radiology department is located directly behind the ED and is equipped with CT, ultrasound, as well as MRI capabilities. The Christus Spohn Institutional Review Board designated our study as exempt status prior to the initiation of data collection.

2.3. Population

Consecutive patient encounters during the period from March 2013 to November 2013 were identified through query of our electronic medical record (Meditech Information Technologies, Inc, Westwood, MA).

2.4. Study process

The ED had an evaluation process during the study period that is typical of most EDs. All walk-in patients checked in at the triage window, which was staffed by an ED technician. The patient signed in on a triage complaint form with their name, time of arrival, and chief complaint (time of arrival started the ED intervals). Then, a registered nurse evaluated the patient. A vast majority of the patients received an evaluation using the Emergency Severity Index (ESI) index based on the stability of the patient as well as need for evaluation [40]. If their complaint had potential severity, and/or if a room were available, the patient would be immediately assigned to an ED room. If no rooms were available, the triage nurse asked the patient to wait in the lobby until a room was available for further evaluation. Most patients that arrived by ambulance were immediately taken to a room for evaluation (in that situation, time of nurses initial triage started the ED intervals). The emergency physician, or advanced practice practitioner then assessed the patient to determine if further evaluation or consultation was necessary. The emergency physician determined if the patient needed to be admitted

to the hospital for further treatment (EDLOS for admits), or discharged home with discharge instructions for care at home (DCLOS).

2.5. Method of measurement

Median daily time interval data was collected from the ED tracking system, Meditech©. This is a dynamic tracking system that requires the staff to time mark the following events: when the patient received a room (room), when the physician assessed the patient (doctor), and when the patient was discharged from the ED (dismiss). The variables collected included classic ED measures as defined by Welch et al [41] (Table 1). We chose those variables as they represented the ED measures with separate event points entered for every visit, and represented distinct ED measures in the flow of a patient through the ED.

2.6. Primary data analysis

The data analysis includes summary statistics for the intervals analyzed. The interval data was divided into 2 groups based on the median daily EDLOS for admits. 6 hours was chosen as the dividing point to reflect 2 hours for the physician to make a decision to admit the patient and the additional 4 hours from the TJC element LD.04.03.11 for maximum acceptable hold interval in the emergency department. Mean intervals of the 2 groups, divided based on the daily median interval EDLOS for admits, were compared by t-tests. Subsequently, we utilized regression analysis to control for confounding variables. Our multiple regression model contained the following variables: DCLOS (dependent), EDLOS for admit group (<6 hours, >= 6 hours), daily census, LWBS (count), median daily room to doctor, median daily door to MD, and number of admissions. The number of admissions and median door to MD variables that were highly correlated were excluded to avoid multicollinearity.

3. Results

Data were collated from 24,127 patient visits. There was an admission rate of 17.3% during the study period. Patient characteristics are presented in Table 2. Our emergency department has visits primarily by adults with only 2.66% of the census comprised of pediatric patients. The emergency severity index (ESI) level 3 and 4 categorization of patients was similar, but 21.36% of the visits did not receive the ESI designation in the electronic medical record. The department has a high

Table 1
Emergency department (ED) metrics and definitions [36].

ED Interval	Meditech Interval	Definitions
Room to doctor (doctor includes physician, resident or allied health professional)	Room to provider	Time it takes for a physician to see the patient in the room after the patient is placed in the room
ED LOS for discharged patients (DCLOS)	Received to dismiss	The time interval in minutes between arrival time to physical discharge time
ED LOS for admitted patients (EDLOS for admits)	Received to dismiss (Admitted patients)	The time interval in minutes between arrival time and physical departure of the patient from the ED treatment area
Total patients per day (Daily Census)	New arrivals	Total number of patients that signed up for triage that day.
Admit	ADMIT	All patients that are given a bed in the hospital (includes admissions and observation status)
Left without being seen (LWBS)		Any patient who leaves the ED before initiation of the MSE.

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