

## Emergency Department Crowding and Patient Boarding Lead to Delays in Care

McCarthy ML, Zeger SL, Ding R, et al. Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. *Ann Emerg Med* 2009;54:492–503.

### Study Overview

**Objective.** To determine the association between emergency department (ED) and hospital crowding with ED waiting room, treatment, and boarding times.

**Design.** Multicenter, retrospective observational cohort study.

**Setting and participants.** The study was conducted at 4 geographically dispersed tertiary-care, academic level 1 trauma centers. Data were collected on all ED visits seen in the non-pediatric portion of the EDs over a 1-year period. Crowding was measured at regular intervals throughout each patient's ED stay. Variables used to determine ED crowding were number of patients in the waiting room, number of patients being treated, and number of patients boarding. Hospital crowding predictors were inpatient medicine bed occupancy rates. Covariates included patient demographics (age, sex, insurance status) and clinical characteristics (standardized chief complaints, mode of arrival, and acuity level as measured by the Emergency Severity Index [a 1–5 scale whereby high-acuity patients are levels 1–2 and less urgent patients are levels 3–5]).

**Main outcome measures.** Waiting room time (time from registration to room placement), treatment time (time from room placement to disposition decision [hospital admission or ED discharge]), and boarding time (time from disposition decision to ED–hospital transfer for admitted patients). Discrete-time survival analysis was employed to evaluate the effect of crowding on the probability of completing each of the ED care periods.

**Results.** Adjusting for differences in demographic and clinical characteristics, ED crowding predictors (the number of patients in the waiting room, number being treated in the ED, and number of boarders each with independent effects) at each site were associated with increased waiting room time (up to 158% increase). With boarding time models, the number of boarders and inpatient medicine occupancy rate both had independent effects by increasing boarding times (up to 179% increase). Crowding factors also had a negative

effect on ED treatment times; however, these effects were relatively small (up to 8% increase).

**Conclusion.** A dynamic evaluation of ED crowding as measured by numbers of patients in the waiting room, receiving treatment, or boarding in the ED was associated with longer waiting room and boarding times for ED patients.

### Commentary

ED crowding has been described as being “emblematic of the systematic problems in the delivery of efficient, high-quality medical care where demand for services frequently exceeds supply [1].” Evaluation of times to care may be used as an index for the quality of care for patients seen in the ED. Prior studies have demonstrated that crowding factors are associated with the negative consequences of delays in care for time-sensitive conditions including thrombolytics for acute myocardial infarction, antibiotics for pneumonia, analgesics for pain [2–4], and overall poorer clinical outcomes [5].

This study by McCarthy et al demonstrates an increase in waiting room and boarding times for patients seen in the ED when there is an increase in number of patients either in the waiting room, being treated, or waiting for hospital beds if they are admitted (boarders). A conceptual model of ED crowding can be broken into the components of input, throughput, and output. “Input” is any condition or event that demands ED services. “Throughput” is patient care flow or length of stay in the ED; throughput has 2 phases: (1) triage, room placement, and clinician evaluation, and (2) diagnostic testing and treatment. “Output” is the discharging of patients from the ED—whether out of the ED to the community or as a hospital admission [6]. The results of this study indicate that increases of patient volume to both the throughput and output components of ED care and crowding result in longer times to care. While the findings in this study appear obvious and follow the premise of queuing theory (mathematical modeling of waiting lines), the results directly demonstrate that increases in patient volume, especially those in the waiting room and boarders, result in longer times in the ED “waiting line” to get into the ED (waiting room) and into the hospital

(admitted patients waiting for available hospital beds). This presents 2 areas that may be targeted for the improvement of ED patient throughput by decreasing the number of patients in the waiting room or the number of boarders waiting for inpatient hospital beds. The importance of improving patient throughput is significant not only because studies have demonstrated that delays in ED care are associated with poorer clinical outcomes, but also potentially for a hospital's bottom line with regard to patient satisfaction and their impression of how well the ED and the hospital is run and their willingness to return to the facility [7,8].

It is significant to note that the number of boarding patients in the ED was associated with the greatest patient care delays (increasing times up to 179%), whether time spent in the waiting room or time boarding in the ED. Admitted ED patients waiting for hospital beds is a capacity issue that primarily represents inadequate access to inpatient beds secondary to resource or policy limitations of a hospital. Targeting the reduction of boarders in the ED will require administrative solutions and systemwide changes to facilitate increased inpatient bed capacity and the transfer of boarders beyond and out of the ED. Conversely, if access to inpatient beds is limited for patients admitted from the ED, there will not only be increased delays in timely ED patient care but also the risk of decreased patient satisfaction.

Limitations of the study include the inability to study how the different periods of ED care (waiting room, treatment, and boarding periods) may have impacted the completion of care in the other phases. The investigators did not study the impact of covariates such as diagnostic testing, specialty consultation, or treatments and how these may have affected ED care time periods. Finally, although this was a multicenter study, findings may not generalize to settings that do not include tertiary care, academic level 1 trauma centers.

### Applications for Clinical Practice

Hospital and ED administrators should be aware of the negative consequences of increased patient volume on times to care and throughput times in the ED. Attempts should be made by administrators not only to reduce the number of patients in the ED waiting room but more importantly to reduce the number of admitted patients waiting for hospital beds in the ED.

—Review by Ula Hwang, MD, MPH

### References

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