Emergency Department Crowding Is Associated With Poor Care for Patients With Severe Pain

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Study objective: We study the impact of emergency department (ED) crowding on delays in treatment and nontreatment for patients with severe pain.

Methods: We performed a retrospective cohort study of all patients presenting with severe pain to an inner-city, teaching ED during 17 months. Poor care was defined by 3 outcomes: not receiving treatment with pain medication while in the ED, a delay (>1 hour) from triage to first pain medication, and a delay (>1 hour) from room placement to first pain medication. Three validated crowding measures were assigned to each patient at triage. Logistic regression was used to test the association between crowding and outcomes.

Results: In 13,758 patients with severe pain, the mean age was 39 years (SD 16 years), 73% were black, and 64% were female patients. Half (49%) of the patients received pain medication. Of those treated, 3,965 (59%) experienced delays in treatment from triage and 1,319 (20%) experienced delays from time of room placement. After controlling for factors associated with the ED treatment of pain (race, sex, severity, and older age), nontreatment was independently associated with waiting room number (odds ratio [OR] 1.03 for each additional waiting patient; 95% confidence interval [CI] 1.02 to 1.03) and occupancy rate (OR 1.01 for each 10% increase in occupancy; 95% CI 0.99 to 1.04). Increasing waiting room number and occupancy rate also independently predicted delays in pain medication from triage (OR 1.05 for each waiting patient, 95% CI 1.04 to 1.06; OR 1.18 for each 10% increase in occupancy; 95% CI 1.15 to 1.21) and delay in pain medication from room placement (OR 1.02 for each waiting patient, 95% CI 1.01 to 1.03; OR 1.06 for each 10% increase in occupancy, 95% CI 1.04 to 1.08).

Conclusion: ED crowding is associated with poor quality of care in patients with severe pain, with respect to total lack of treatment and delay until treatment. [Ann Emerg Med. 2007;xx:xxx.]

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INTRODUCTION

Acute pain is one of the most common reasons for seeking emergency care. According to the 2004 National Hospital Ambulatory Medical Care Survey data, approximately 32% of emergency department (ED) patients presented with either moderate or severe pain.[1] However, oligoanalgesia, which is defined as the undertreatment of pain, is common in EDs.[2-6] Factors associated with oligoanalgesia include older age, ethnicity, provider perceptions of a patient's pain, concern about drug-seeking behavior, and reluctance to mask symptoms to ensure an accurate diagnosis.[7-16] In the era of ED crowding,[17-19] another potential reason for oligoanalgesia may be that providers are too busy to appropriately assess and treat ED patients with painful conditions. A recent study demonstrated that older adults with hip fracture are less likely to receive analgesia and more likely to experience delays in analgesia at high levels of ED census.[20] However, to our knowledge, there have been no studies reporting the impact of ED crowding on a general sample of ED patients with severe pain.

We sought to study the impact of ED crowding on both treatment and delays in treatment in a broad cohort of ED patients who presented at triage with a complaint of severe pain. We hypothesized that when the ED is crowded, patients will experience both failure to receive treatment and delays in treatment for pain.

MATERIALS AND METHODS

Study Design and Setting

We performed a retrospective study of all ED patients 18 years of age and older who presented at triage with a complaint

Editor's Capsule Summary

What is already known on this topic:

Emergency department (ED) crowding may result in delays in the administration of medication such as antibiotics for pneumonia.

What question this study addressed:

Does crowding cause delays in treatment for pain?

What this study adds to our knowledge:

In this retrospective analysis of 13,578 patients treated at a single inner-city ED, patients with severe pain were slightly less likely to receive pain medications quickly when the ED volume increased.

How this might change clinical practice:

Crowding may delay the administration of pain medication in some patients. Standing orders for the administration of pain medication might mitigate such delays.

of severe pain from April 1, 2005, to September 30, 2006. The study was performed in a large, adult, urban, tertiary care ED with 55,000 annual ED visits. The ED has 25 treatment rooms, 15 hallway treatment spaces, a separate 8-bed fast track, and an attached 3-bed trauma bay.

Data Collection and Processing

We identified all ED patients who reported severe pain (defined as 9 or 10 of 10 on the pain scale) at their triage evaluation by using a computerized medical record search. We excluded patients who left without being seen. In the ED, providers use a computerized charting and order entry system called EMTRAC (University of Pennsylvania, Philadelphia, PA). For each triage note, it is required that nurses enter a categorical pain scale from 0 (no pain) to 10 (most severe pain), determined by face-to-face interview of patients in the triage area, where patients with any complaint of pain are asked to rate their level of pain from 1 of 10 to 10 of 10.

Triage nurses can choose to administer some analgesics (such as acetaminophen) without specific physician orders; however, this is typically only performed for patients with fevers. Occasionally, for patients with severe pain, nurses will seek out an attending physician for analgesia administration. In most cases, however, triage patients are either asked to wait in the waiting room until a treatment area is available or are transported directly to the treatment area. Once patients are in the treatment area, they are evaluated by nurses and physicians, and analgesia, if ordered, is administered.

We defined a pain medication broadly as any medication that is indicated for analgesia, which included oral medications such as ibuprofen, acetaminophen, and combination medications (oxycodone/acetaminophen); intravenous medications such as morphine, ketorolac, and hydromorphone; and other medications such as antacids (Maalox Novartis, Basel, Switzerland; viscous lidocaine, or ranitidine) that are specifically used for certain painful conditions. In EMTRAC, triage time, room time, and medication order times are automatically stamped. Medication administration times are entered directly by nurses after they administer medications.

There were 3 prespecified primary outcomes in this study. The first was whether patients received any pain medication during their ED visit. For patients who received any pain medication, there were 2 outcomes related to delays in administration of pain medication. The first was a delay of greater than 1 hour from triage time (the first reporting of severe pain) until receipt of analgesia. The second was a time greater than 1 hour from arrival in a treatment room until receipt of analgesia. We used a 1-hour delay in receipt of pain medication because this outcome was used previously and because we thought that it was a reasonable standard to be used in a general population of ED patients.[13] There are no standardized reassessments for pain in our electronic medical record, and we did not consider reassessments in this analysis.

We used EMTRAC to retrospectively assign the following overall ED crowding indicators at triage: occupancy (the percentage of overall beds filled), total patient-care hours (the arithmetic sum of the hours of all patients in the ED, excluding trauma and fast-track patients), and the number of patients in the waiting room. These were chosen from a recently published list of potential crowding indicators and were included because they were significant variables in previous studies on the impact of ED crowding on quality of care.[21,22] We used EMTRAC to obtain the following variables to test as potential confounders: patient age, race, sex, triage level (a 4-level system is used, in which triage level 1 is the most severe and triage level 4 is the least severe). These were chosen because they are known risk factors for oligoanalgesia.[7-15] Database searches in EMTRAC were performed with Microsoft Access (Microsoft Corporation, Redmond, WA). Data were then transferred to Stata, version 9.0 (StataCorp, College Station, TX) for analysis. Our institutional review board found this study exempt from human subjects review.

Primary Data Analysis

Data are reported with 95% confidence intervals, SDs, and interquartile ranges (IQRs). We used multivariable logistic regression to determine combined effects of ED crowding measures on the primary outcomes, adjusting for patient-level confounding. For our modeling strategy, we included known patient-level factors affecting the ED treatment of pain and added crowding factors to the model that were independent, added predictive value to the model (C-statistic), and minimized multicollinearity. Potential nonlinearity in the relationship between ED crowding variables and the outcomes was determined by testing the adjusted and unadjusted association at quartiles of ED crowding measures. Because some patients were repeat visitors, 95% CIs represent clustered

Table 1. Patient demographics and ED crowding measures (n=13,758).

Patient demographics	Crowding measures
Age, y, mean (SD)	39 (16)
Female sex	64%
Race, %	
Black	73
White	18
Asian	1
Other	8
Triage level, %	
1 (Most severe)	4
2	40
3	38
4	17
ED crowding measures	
Median total patient-care hours	120 (IQR 82–164)
Median occupancy rate, %	65 (IQR 50–78)
Waiting room patients, No.	8 (IQR 4–13)

estimates to account for between- and within-patient variability, using the Stata cluster command. Hosmer-Lemeshow goodness of fit was used to test whether the models estimates fit the data at acceptable levels.

RESULTS

Throughout the study period, 13,758 patients reported severe pain at ED triage. The median waiting room time was 28 minutes (IQR 8 to 72 minutes). A total of 6,746 (49%) patients received pain medication while in the ED. Of those, 4,052 (60%) were treated with narcotic analgesia. Of the patients who were treated, the median time from triage to administration of first pain medication was 74 minutes (IQR 34 to 142 minutes) and median time from room placement until first pain medication was 23 minutes (IRQ 8 to 49 minutes). A total of 3,965 (59%) treated patients had to wait for at least an hour from triage for medications, and 1,319 (20%) patients had to wait for more than 1 hour from room placement until administration of their first dose of pain medication. Table 1 provides demographic characteristics, ED crowding levels, and characteristics of pain medication.

In multivariable analysis, increasing levels of ED crowding measures were significantly associated with failure to treat or delayed treatment, after adjustment for patient-level confounding. Table 2 reports the results of multivariable analysis by the 3 primary outcomes.

LIMITATIONS

There are a number of limitations in this study. The largest limitation is that it is a retrospective study, and like other studies on the treatment of pain in the ED, although pain score was measured, patient desire for pain medication and reasons for nontreatment or delays in treatment were not directly measured. We did not include any reassessment of pain and measured patients' subjective pain at only 1 point (triage). Because pain can change over time without any intervention,

Table 2. Adjusted models using ED crowding measures, adjusting for patient-level factors to predict primary outcomes (n=13,758).

Adjusted models	Adjusted OR (95% CI)
No analgesia in the ED	
Waiting room number*	1.03 (1.02–1.03)
Occupancy rate†	1.01 (0.99–1.04)
Age ≥65 y	1.61 (1.40–1.86)
Female sex	1.30 (1.20–1.41)
White race	0.89 (0.80–0.98)
More severe triage level (1 or 2)	1.10 (1.02–1.18)
Delay >1 h in analgesia from triage	
Waiting room number*	1.05 (1.04–1.06)
Occupancy rate†	1.18 (1.15–1.21)
Age ≥65 y	1.47 (1.22–1.77)
Female sex	1.37 (1.25–1.50)
White race	0.84 (0.75–0.94)
More severe triage level (1 or 2)	0.57 (0.52–0.62)
Delay >1 h in analgesia placement in room	
Waiting room number*	1.02 (1.01–1.03)
Occupancy rate†	1.06 (1.04–1.08)
Age ≥65 y	1.61 (1.39–1.87)
Female sex	1.26 (1.16–1.36)
White race	0.90 (0.81–0.99)
More severe triage level (1 or 2)	0.89 (0.83–0.95)

*For an increase in waiting room number of 1 patient.
†For an increase in occupancy rate of 10%.

this may have biased results by excluding patients who reported a low pain score at triage but may have had severe pain at room arrival. In addition, this may have biased results for patients whose pain improved spontaneously. Because nurses manually enter time of administration after administering medications, there may have been discrepancies between the recorded time and the actual time of medication administration. This study was performed at only 1 hospital, which limits the generalizability of these results to other settings. It has been shown in previous studies that a significant predictor of oligoanalgesia is the effect of specific providers' practice patterns.[8] We were unable to cluster on the provider and thus could not control for provider effects.

DISCUSSION

We detected a significant association between measures of ED crowding and oligoanalgesia as defined by delays in treatment and nontreatment with pain medications in a general population of ED patients reporting severe pain at triage. These findings were robust in multivariable analysis after adjusting for other known risk factors for oligoanalgesia. The assessment and treatment of pain is an important outcome in emergency care and a significant quality issue. Many studies have reported that pain is often undertreated in the ED.[2-6] We found similar relationships between age, race, and sex that have been reported in the literature on ED oligoanalgesia.[9-14,16] In addition, we report that severity is associated with a higher odds of nonreceipt of any pain medication, possibly because providers focus more on diagnosis than symptom control. However, when

patients with more severe conditions were actually treated, they were less likely to experience delays in treatment.

The Joint Commission for Accreditation of Healthcare Organizations has made assessment and management of pain a quality standard on which hospitals are judged.[23] Recent guidelines by the American Pain Society recommend that efforts be made to improve the quality and specifically the timeliness of pain management.[24] Previous studies have reported associations between ED crowding and poorer quality of patient care.[25,26] The associations reported in this study provide more evidence that when the ED is crowded, patients do not receive optimal care. The relationship between ED crowding and oligoanalgesia is not unexpected. When the ED gets busier, staff may be less responsive to the needs of individual patients, and as a result, patients have a higher likelihood of nontreatment and also delays in treatment.

These findings indicate that ED crowding is not only associated with oligoanalgesia in older adults with hip fracture[19] but also with oligoanalgesia in the broad ED patient population. Although Hwang et al[20] reported a specific threshold effect (>120% occupancy) for ED census on oligoanalgesia, we did not find a specific threshold effect of crowding measures and oligoanalgesia in the unadjusted and adjusted models. A potential reason for this is that care of patients with hip fracture, because they have a definite injury, may not be affected only at relatively high levels of crowding. In a broad ED patient population with less clear-cut diagnoses, care may be affected at lower levels of ED crowding. These data challenge the concept of a specific threshold level to define a crowded ED, in which high-quality care is delivered up to a specific crowding threshold, above which care quality declines.

In the multivariable models, we found independent effects of waiting room number and ED occupancy delays in treatment. When the variable total patient-care hours was added to the regression model that already contained occupancy and waiting room number, it did not add predictive value to the model and was not an independent predictor of delays and nontreatment, because of the collinearity with occupancy and waiting room number. That is, the more parsimonious model (fewer crowding variables) was actually better, which indicates that because of collinearity between the myriad ways to measure crowding, using only a few of the simplest measures (waiting room number and occupancy) is highly predictive of poorer quality care. In addition to waiting room number, occupancy rate was predictive of delays in administration but was not a significant predictor of nontreatment. A potential reason for this is that when there are many undifferentiated patients waiting, ED staff may feel rushed to move existing patients and may be less responsive to the needs of individual patients such as pain control. Waiting room number seemed to be highly predictive of failure to treat, as well as treatment delays, and independent of occupancy, indicating that waiting room number may serve as one reasonable criterion standard for ED crowding. It is easily measured, has good face validity, and is generalizable. Walking in the front door of any ED and counting waiting room patients may represent a good barometer for how crowded it is. Future studies should consider using waiting room number and other simple measures of crowding as components in an index for ED crowding. As certification and quality organizations propose and implement process measures for emergency care and pay-for-performance, they may consider using ED crowding measures themselves as quality measures and defining crowding by an individual patient's exposure to elements such as waiting room number when the patient is triaged. Because ED crowding has now been shown to be associated with poorer quality of care for pneumonia, acute myocardial infarction, and now pain, it may make more sense to consider broad fixes to health care quality than to only focus on specific conditions.

We demonstrate a significant association between ED crowding and oligoanalgesia (both delays and nontreatment) in a large academic ED. These results were independent after adjusting for other known risk factors for oligoanalgesia. Efforts to improve health care system functioning and reduce ED crowding may improve the quality of ED pain management.

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