

Boarding is a prevalent issue in many Emergency Departments across the country and throughout the world. It's an issue that crowds the ED and waiting room and frustrates providers. The Institute of Medicine has called boarding the leading safety concern for First World EDs***. Boarding has increasingly become a problem in recent years, leading many EDs and hospitals to try to formulate solutions to address the issue.

The Issue

While the issue certainly affects ED providers and staff, and is often referred to as "ED boarding," it is important to realize that boarding is not an ED issue; it is a hospital and medical system issue. The root cause is a lack of access to appropriate level of care. This is not a facilities or infrastructure issue, but a flow issue.

PCPs are overwhelmed with mandates to see increasing number of patients, pushing their schedules beyond the ability to see acute care issues in the office. These patients are then presenting to the ED with non-emergent pathology, increasing ED volume and crowding, limiting access to ED beds for those with emergent pathology.

The paucity of outpatient mental health care also leads to ED crowding in multiple ways. Patients are often unable to access outpatient treatment and enter crisis due to this lack of stable management. While it is certainly appropriate for patients in crisis to be in the ED, appropriate outpatient psychiatric care could reduce the number of patients entering a crisis state. Additionally, this lack of outpatient psychiatric care impacts patients being discharged from inpatient psychiatric care. Patients cannot be discharged without a safe discharge plan, including follow up with outpatient services. If these services are scarce, it takes patients longer to be discharged from inpatient care, creating a block of access to these inpatient beds for those patients in crisis, keeping these crisis patients in the ED

Long-term care facilities and rehabilitation facilities also contribute to this access block. These facilities are often unable or unwilling to accept patients being discharged from the hospital on evenings and weekends. This block keeps patients who are ready for discharge and no longer need acute medical care in an inpatient bed, keeping other patients who need acute medical care stuck in ED beds.

Because the emergency department is open 24/7 and is often the initial point of access for medical care, the ED is the area that feels the most effect from these block of access issues. Because of the issues within the hospital and within the medical system as a whole, the ED becomes crowded and admitted patients end up boarding in ED beds, as there are no inpatient beds available.

The Effects

Hip Fractures¹

- Retrospective Study assessing the effect of ED crowding on assessment and treatment of pain in patients admitted with hip fractures
- Measure of crowding: ED Census, Mean LOS of admitted patients
- Outcomes: documentation of pain and time to treatment of pain
- Results

- Mean time to first documented assessment of pain: 40 minutes
- Mean time to first documented pain treatment: 141 minutes
- Mean time between first documented pain assessment and treatment: 121 minutes
- ED Census >120% of bed capacity associated with significantly lower probability of documented pain assessment than ED Census ≤120% of bed capacity. OR 0.47 (95% CI 0.22-0.97)
- ED Census >120% of bed capacity also associated with lower likelihood of pain documentation of first assessment (OR 0.46, 95% CI 0.21-0.98), and longer time to pain assessment (parameter estimate 0.79, log transformation - 6.13 minutes)
- Bottom Line: Older patients with hip fractures are at increased risk for underassessment and undertreatment of pain as ED census and ED LOS increase

Asthma²

- Retrospective study assessing the effect of ED crowding on LOS of asthmatic patients ultimately discharged from ED
- Measure of crowding: ED census, WR population, number of admitted patients in ED, total ED patient hours (all assessed across quartiles)
- Outcomes: overall ED length of stay, time to order of first nebulizer treatment, time to order of steroid treatment
- Results
 - All four measures of crowding had a direct correlation with longer LOS for asthmatic patients
 - All four measures had a direct correlation with longer time to treatment
 - From lowest to highest quartile of admitted patients in ED, LOS increased by 72 minutes
- Bottom Line: Crowding slows initiation of treatment and time to discharge for asthmatic patients presenting to the ED, and further exacerbates the crowding issue

Sepsis³

- Retrospective study of patients with severe sepsis admitted to the hospital from the ED
- Measures of crowding: ED occupancy, WR population, admitted patients in the ED, and total ED patient hours
- Outcomes: Time to IV fluids, Time to antibiotics, implementation of protocolized care, in-hospital mortality
- Results
 - As occupancy and patient-hours increased, patients were less likely to receive IV fluids within 1 hour of arrival (OR 0.73 [95% CI 0.59-0.92]; 0.64 [0.51-0.81], respectively)
 - Increased ED occupancy, patient hours, and boarding inpatients all negatively impacted administration of antibiotics within 3 hours of arrival (OR 0.77 [95% CI 0.61–0.96]; 0.77 [0.61–0.96]; 0.75 [0.59–0.96], respectively)
 - Between the lowest and highest quartiles of inpatient boarders, the percent implementation of protocolized care dropped from 71.3% to 50.2% (p ≤0.0001)
 - None of the ED crowding measures had a statistically significant impact on in-hospital mortality
- Bottom Line: ED crowding negatively impacts timely administration of IV fluids and antibiotics and the following of protocol-based care in the treatment of sepsis.

Delirium⁴

- Retrospective study of all adult patients in the ED who were subsequently admitted to the hospital, looking at the association of delirium and time in hallway and total ED time

- Results
 - Patients identified with delirium were more likely to spend a higher percentage of time in the ED hallway (49.9% vs 30.0%, $p < 0.001$) compared patients not identified with delirium
 - Patients identified with delirium were more likely to have a longer ED length of stay (15.8 hr vs 12.8 hr, $p < 0.001$)
 - Patients identified with delirium had more ED room transfers (4.9 vs 4.0, $p < 0.001$)
- Bottom Line: Prolonged time in the ED and care in hallway beds while in the ED had a direct correlation with the development of delirium while admitted to the hospital

Abdominal Pain

Pain Management⁵

- Secondary analysis of a previously enrolled cohort presenting to the ED with acute abdominal pain
- Measures of crowding: ED occupancy, total ED patient hours, WR population, and admitted patients in the ED
- Outcomes: Administration of analgesia, delay of analgesia (>1h between triage time and analgesia administration and >1h between room placement and analgesia)
- Results
 - No association between crowding measures and failure to treat with analgesia
 - Delay in time to analgesia from triage were independently associated with all four crowding measures
 - Total ED patient hours, lowest quartile to highest: RR 1.54, 95% CI 1.32-1.80
 - ED occupancy, lowest quartile to highest: RR 1.64, 95% CI 1.42-1.91
 - Boarding inpatients, lowest quartile to highest: RR 1.58, 95% CI 1.36-1.81
 - WR Population, lowest quartile to highest: RR 1.53, 95% CI 1.31-1.77
- Bottom Line: Crowding delays administration of pain medications if you present to the ED with abdominal pain.

CT Interpretation⁶

- Prospective cohort study of adult patients presenting to the ED who received an abdominal CT for the evaluation of acute abdominal pain
- Measures of Crowding: ED Census, WR population, boarding inpatients in ED
- Outcome: Time from triage to preliminary CT interpretation
- Results
 - Median time from triage to CT interpretation for all patients was 375 minutes
 - Median time from CT order to CT interpretation for all patients was 203 minutes
 - All crowding measures were independently associated with increased triage to CT read time.
 - ED Census, lowest quartile to highest: 310min vs 433min, $p < 0.001$
 - WR population, lowest quartile to highest: 318min vs 445min, $p < 0.001$
 - Boarding patients, lowest quartile to highest: 339min vs. 419min $p < 0.001$
 - Secondly, all crowding measures were independently associated with increased triage to room time
 - ED Census, lowest quartile to highest: 19min vs 84min, $p < 0.001$
 - WR population, lowest quartile to highest: 22min vs 92min, $p < 0.001$
 - Boarding patients, lowest quartile to highest: 22min vs. 79min $p < 0.001$
- Bottom Line: Crowding can lead to an almost two hour delay to CT interpretation, potentially delaying surgical management.

Chest Pain⁷

- Retrospective study of patients ≥ 30 yo admitted to the hospital following presenting to the ED with chest pain (STEMI patients excluded)
- Measures of crowding: WR population, total ED patient hours, ED occupancy, admitted patients in ED, and average LOS for patients moved to inpatient beds in the 6 hours prior to ED triage of chest pain patient (trailing ED LOS)
- Outcomes: Adverse cardiac event (death, cardiac arrest, MI, CHF, ventricular tachycardia or ventricular fibrillation, supraventricular dysrhythmias, symptomatic bradycardia, or hypotension) during hospitalization that was not present on ED arrival
- Results
 - In patients with and without documented ACS, increased waiting room population was associated with a higher risk of adverse cardiac event
 - ACS cohort: OR 3.7 (95% CI 1.3-11.0) between highest and lowest quartile
 - Non-ACS cohort: OR 3.5 (95% CI 1.4-8.4) between highest and lowest quartile
 - In patients with and without documented ACS, increased total ED patient hours was associated with a higher risk of adverse cardiac event
 - ACS cohort: OR 5.2 (95% CI 2.0-13.6) between highest and lowest quartile
 - Non-ACS cohort: OR 4.3 (95% CI 2.6-7.3) between highest and lowest quartile
 - ED occupancy, Inpatients in ED, and trailing ED LOS were not found to be associated with increasing risk of adverse cardiac event in either the ACS or non-ACS cohort
- Bottom Line: There is an association between worse outcomes of ACS and non-ACS based chest pain as crowding increases.

Pneumonia and PCI⁸

- Cross-sectional study looking at the University Health Consortium (UHC) 2004 survey of 24 hospitals' ED cycle time, and data on mandatory reported performance measures in 2004
- Measures of crowding: Survey of 24 ED administrative directors assessing for ED volume, staffing levels, average LOS, ICU admission rates, bed turnover rates, diversion hours, and turnaround times for lab studies and CXRs
- Outcomes: percentage of patients admitted for pneumonia who received antibiotics within 4 hours of hospital arrival and percentage of patients with STEMI or new left bundle branch block AMI who received PCI within 2 hours of hospital arrival
- Results
 - There were no ED crowding measures significantly associated with the percentage of AMI patients receiving PCI within 2 hours
 - Multiple crowding measures were associated with lower percentage of pneumonia patients receiving antibiotics within 4 hours (presented using spearman correlation coefficients below)
 - ED length of stay (overall) -0.44 (p 0.04)
 - ED length of stay (admitted) -0.47 (p 0.08)
 - ED visits -0.58 (p 0.004)
 - Left-without-being-seen % -0.51 (p 0.01)
 - Turnaround time for CXR -0.83 (p 0.001)
- Bottom Line: There is no correlation between crowding and delay to PCI. As crowding increases, turnaround time of CXR increases, and thus the time to diagnosis of pneumonia. This delay delays time to antibiotic treatment.

Patient Satisfaction

Admitted Patients⁹

- Retrospective cohort study of patients admitted through the ED who completed Press-Ganey patient satisfaction surveys
- Measures of Crowding: Patient specific (WR time, ED boarding time, ED treatment time, initial placement in hallway treatment space), ED specific (WR population, ED occupancy, total ED patient hours, inpatients boarding in ED, and average LOS for admitted patients transferred to inpatient beds within the 6 hours prior to the current patient's triage time)
- Outcome: Press-Ganey satisfaction scores
- Results
 - Each of the measures of crowding were significantly associated with a lower likelihood of recommending the ED to others and the Composite ED Press-Ganey score when comparing the highest to lowest quartile of each measure
 - Boarding time, hallway placement, total ED patient hours, and LOS for recently admitted patients were significantly associated with a lower likelihood of recommending the hospital to others
 - Boarding time, hallway placement, and total ED patient hours were significantly associated with a lower overall rating of hospital care
 - ED treatment time and hallway placement were significantly associated with lower scores for the question "how well did the staff work together for you?"
- Bottom Line: Inpatients were not satisfied with the ED or aspects of their hospital care when the ED was crowded

Discharged Patients¹⁰

- Retrospective cohort study of patients discharged from the ED who completed Press-Ganey patient satisfaction surveys
- Measures of crowding: ED occupancy rate, modified EDWIN Score (determined based on patient number and acuity, number of attending physicians, and total bed availability. Higher scores are indicative of a more crowded ED), hospital diversion status
- Outcome: Press-Ganey satisfaction scores
- Results
 - Statistically significant decrease in the likelihood of meeting patient satisfaction goal (mean satisfaction score ≥ 85) with increase in average ED occupancy rate and increased modified EDWIN score
 - ED occupancy rate OR 0.32, 95% CI 0.17-0.58
 - Modified EDWIN score OR 0.05, 95% CI 0.004-0.55
 - There was no statistically significant association between diversion status and likelihood of meeting patient satisfaction goal
- Bottom Line: Discharged ED patients are less satisfied when the ED is crowded

Violence Towards Staff¹¹

- Retrospective record review of ED Incident reports, Orders of Emergency Detainment, and Physical/Chemical Restraint Logs for documentation of violent incidents
- Measure of Crowding: ED Occupancy rate, patient-to-physician ration, patient-to-nurse ratio, number of patients who left without being seen (LWBS), and average LOS
- Outcome: days during which a violent incident (or multiple incidents) occurred
- Results
 - Based on a multivariable logistic regression model, occupancy rate, patient-to-physician ratio, and average LOS were all significantly associated with the presence of violent incidents
 - Occupancy Rate OR 4.290, 95% CI 2.137-8.612

- Patient-to-physician ratio OR 1.372, 95% CI 1.242-1.515
- Average LOS OR 1.883, 95% CI 1.410-2.514
- Bottom Line: Crowding places staff at increased risk of violent events

Medication Errors¹²

- Prospective observational study at a large tertiary care hospital with an emergency medicine residency and dedicated ED pharmacists
- Measure of crowding: average daily modified EDWIN score
- Outcome: Medication errors detected by ED pharmacists
- Results
 - There was a positive correlation between average daily modified EDWIN score and error detection frequency, spearman correlation coefficient 0.33, p 0.001
- Bottom Line: As the ED gets more crowded, providers are more likely to make medication errors

Mortality

10 Day Mortality¹³

- Retrospective stratified cohort analysis of patients admitted from the ED
- Measure of Crowding: Mean ED occupancy for 8 hour shifts over 3 12-week periods. Shifts in the highest quartile were classified as overcrowded
- Outcome: In-hospital mortality within 10 days of ED presentation
- Results
 - Relative risk of 10 day mortality in patients who presented to the ED during an overcrowded shift was 1.34, 95% CI 1.04-1.72
 - Deaths within 10 days in Overcrowded cohort 144 (0.42%)
 - Deaths within 10 days in matched non-overcrowded cohort 101 (0.31%)
- Bottom Line: Patients who present during overcrowded periods have higher 10 day inpatient mortality than those presenting during non-crowded shifts

2, 7, and 30 Day Mortality¹⁴

- Retrospective analysis of patients admitted through the ED
- Measures of Crowding: Hospital Occupancy, percentage of ED patients waiting for ≥8hr for an inpatient bed (access block occupancy), Overcrowding Hazard Scale (calculated from hospital occupancy and access block occupancy, range 1-9)
- Outcomes: 2, 7, and 30 day mortality
- Results
 - Positive Relationship between 7 day mortality and hospital occupancy
 - Relative increase in mortality of 18% (95% CI, 0.5%-38%) when hospital occupancy is 90-99% compared to occupancy <90%
 - Hazard Ratio 1.2 (95% CI, 1.1-1.3)
 - Relative increase in mortality of 46% (95% CI, 14%-85%) when hospital occupancy is ≥100% compared to occupancy <90%
 - Hazard Ratio 1.3 (95% CI 1.1-1.6)
 - Linear relationship between Overcrowding Hazard Scale and 7 day mortality
 - r=0.98 (95% CI, 0.79-1.00)
 - When Overcrowding Hazard Ratio >2 on patient arrival, mortality is increased on days 2, 7, and 30
 - Day 2 hazard ratio 1.3 (95% CI, 1.1-1.6)
 - Day 7 hazard ratio 1.3 (95% CI, 1.2-1.5)
 - Day 30 hazard ratio 1.2 (95% CI, 1.1-1.3)

- Patients who died and experienced overcrowded conditions had longer total duration of stay in the ED and had longer physician waiting times compared to those who died and did not experience overcrowded conditions
 - Risk ratio per hour of ED stay 1.1 (95% CI, 1.1-1.1)
 - Risk ratio per hour of ED wait for physician 1.2 (95% CI, 1.1-1.3)
- Bottom Line: Patients who present during times of ED crowding have higher 2, 7, and 30 day mortality than those presenting during less crowded periods

Length of ED Boarding and Mortality¹⁵

- Retrospective cohort study of patients admitted to the hospital from the ED
- Measure of Crowding: Length of Boarding in the ED
- Outcomes: In-hospital mortality
- Results:
 - Mortality increased with increased boarding time from 2.5% in those boarding <2hours to 4.5% in those boarding ≥12hours
 - After multivariate analysis, the Odds Ratio for mortality was 1.43 (95% CI, 1.13-1.82) for patients boarding in the ED for 12-24 hours compared to those boarding <2hr
 - Subsequent ICU transfers and hospital LOS also increased with increased boarding times
- Bottom Line: As patients board for longer periods in the ED, their in-hospital mortality, need for transfer to ICU, and hospital LOS increase

Inpatient Mortality¹⁶

- Retrospective cohort analysis of 995,375 patients admitted through the ED in 187 hospitals
- Measure of Crowding: EMS diversion hours, periods of high ED crowding were defined as days within the top quartile of daily ambulance diversion hours for the specific facility
- Outcome: Inpatient mortality
- Results
 - Inpatient mortality was increased when patients presented during periods of high ED crowding
 - OR 1.05 (95% CI, 1.02-1.08)
 - Additionally, Length of stay and hospital costs were increased when patients presented during periods of high ED crowding
 - LOS OR 1.008 (95% CI, 1.005-1.012)
 - Cost OR 1.011 (95% CI, 1.007-1.015)
- Bottom Line: Patients presenting during crowded periods have higher mortality, total hospital LOS, and hospital cost than those presenting during non-crowded periods

Solutions

Again, this is not a facilities or infrastructure issue, but a flow issue. Expansions don't fix the issue. Solutions need to focus on improving systems in the hospital and improving flow through all areas of medical care. It's also important to consider the silo effect when looking for solutions. If people don't feel the negative repercussions of their actions, they are unlikely to make changes. For example, if staff on the inpatient floor are slow in discharging a patient and cleaning the room, they don't feel the effects that their actions are having on the ED which is being crowded by admitted patients who don't have floor beds to move to. Some solutions can work on implementing systems in which people feel the impact of their actions.

Seven Day Per Week Hospital

As more patients are admitted to the hospital through the ED as opposed to through PCPs or elective admissions from home, the hospital must change with the changing patient population. If staffing and elective admissions are different on weekdays vs. weekend days there are self-imposed ebbs and flows of patient volume. In order to smooth out the volume fluctuations, hospital staffing, elective surgical cases, and elective admissions need to be consistent across all days of the week.

Cincinnati Children's Hospital was suffering from boarding issues and had planned a \$130 million, 100 bed expansion. Instead of this expansion, the hospital smoothed its surgical schedule across all seven days and was able to drastically reduce boarding and forgo the expensive expansion.***

Boston Medical Center suffered from such a severe boarding crisis that the hospital was on ambulance diversion 30% of the time. The hospital noted that most elective admissions happened towards the beginning of the week and this was correlated with time on diversion. After smoothing the elective admission schedule to be similar across all seven days of the week, ambulance diversion time was drastically decreased as flow was improved.***

Hallway Patients

Emergency department staff and patients are all too familiar with the issues with caring for patients in the hallway due to the boarding issue. But what if the emergency department wasn't the only place in the hospital where care took place in the hallway? Mount Sinai Hospital in New York City published a paper in ***, showing that if inpatient floors took limited numbers of hallway patients, flow in the emergency department was improved.*** One possible way to implement this change is to send admitted patients to the floor when their bed is assigned, whether the bed is clean or not. Now the floor staff feels the pressure to get that bed cleaned and get the patient out of the hallway. The Mount Sinai study found that 90% of the time when a patient was sent to the floor when the bed was assigned, the bed became ready within 1 hour.*** This is an example of the silo effect in action.

Improving Ancillary Staff

In Dr. Sanders' example, the ED was overwhelmed on a Thursday night with 108 patients, 25 admitted patients, and more than 30 patients waiting to be seen and needed to go on ambulance diversion. This all stemmed from the fact that there was only one environmental services provider who was cleaning inpatient beds in the entire hospital. When more providers were brought in to clean beds, the ED was able to be decompressed. This exemplifies boarding being a flow issue as opposed to a facilities issue. Increasing the number of beds in a hospital will make no difference if there are not enough staff to ready those rooms for patient use. Ancillary staffing needs to reflect the needs of the hospital, whether that requires hiring more staff, optimizing schedules, or using surge staffing policies.

Morning and Weekend Discharges

Patients admitted to the inpatient floor at Maine Medical Center have ½ day shorter LOS on average than patients who are admitted to the floor in the afternoon. Because of this, MMC has made a push for increased morning discharges, allowing for inpatient beds to be ready for patients from the ED when the ED census usually increases later in the day. MMC has used social workers and care coordinators to

work on the logistics of discharge prior to the actual day of discharge in order to improve the efficiency of the discharge process.

Multiple studies *** have shown that the discharge rate on weekend days is often half of the discharge rate on weekdays. Often this is due to the inability to discharge patients to long term care or rehab facilities on the weekend. MPH Montefiore in New York City *** made efforts to make discharges and transfers to long-term care facilities even across all seven days. By increasing weekend discharges, the hospital was able to eliminate ED boarding, close a 30 bed unit, and save \$70 million in the first year following this change.

We know that long-term care and rehabilitation facilities do not have the same staffing on weekends and during the evening/overnight that they do during weekdays, which often limits these facilities from accepting transfers at these times. We need to work with these facilities to find a system by which patients in the hospital who no longer need acute medical care can be transferred to these facilities at any time of the day or any day of the week.

Proactivity

There are some days that the ED will be overwhelmed just by native ED patients, and not by boarders. This is the nature of emergency medicine. On these days, the hospital and ED providers must be proactive to improve flow to help limit the impacts of boarding later in the day as access block develops. This requires Emergency Physicians and ED administration to represent the emergency department on hospital committees and with hospital decision makers. While boarding is an issue that ED providers primarily feel the impacts of, it is not our issue to face alone. We¹⁷ must communicate effectively with our colleagues throughout the hospital and the medical community to improve our systems to best serve our patients.

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