

Emergency Department Crowding in California: A Silent Killer?

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In this issue of *Annals*, Sun et al¹ report on the association between emergency department (ED) crowding and 3 important outcomes—mortality, hospital length of stay, and costs—in a broad cohort of admissions in 187 California hospitals in 2007.¹ Patients admitted on days with high crowding, measured as the top quartile of ambulance diversion, had a 5% higher chance of death, an almost 1% longer hospital stay, and 1% higher costs per admission, after adjusting for other factors. The estimate of the human and financial costs attributable to ED crowding was 300 additional inpatient deaths, 6,200 excess hospital days, and \$17 million extra.

Circa 2013, walk into the average large, inner-city, US hospital ED on a Monday afternoon, California or not, and the typical scene is a packed waiting room with hallways lined with sick and injured patients. Admitted patients are boarding for hours, many left untended or certainly not carefully watched, while harried staff scurry furiously to treat new, potentially ill patients.

To the average emergency care provider, the harmful effect of this daily dysfunction found in the authors' article probably comes as no big surprise.

But the first reports of crowding in US EDs emerged in the late 1980s and early 1990s.² Now, more than 20 years later, the first published claims-based, US-based, health services research report links what may seem to an everyday person to be an obviously unsafe environment to negative patient outcomes. It is also notable that in the last 2 decades, the term "ED crowding" has become somewhat outdated with the realization that one of the main causes of ED crowding is "hospital crowding" and its result: prolonged boarding of admitted patients in the ED.

This raises the question, why has it taken so long to link ED and hospital crowding with poor outcomes in the United States and put stark evidence-based estimates on its human and economic tolls? Well, there are several reasons.

First, in any health service research study, one of the goals is to link an "X," an exposure, to a "Y," the outcome. The relationship between ED crowding and outcomes has been elusive because there are both X problems and Y problems.

THE X PROBLEM: CROWDING EXPOSURE

Despite years of research, there still is no criterion standard for measuring crowding in the ED. Early reports relied on subjective assessments, whereas more recent studies have used objective measures of ED census, such as the occupancy rate.³ However, all crowding measures suffer from the fact that patients spend long periods in the ED: they may arrive at a crowded ED at 5 PM but ultimately depart the ED at 5 AM the next day, when crowding has mostly dissipated, or the opposite may happen. Is their patient-level exposure to crowding the state of the ED when they arrived or left, or perhaps an average?

The study by Sun et al¹ uses an even less perfect crowding exposure, a high level of daily diversion for an individual hospital. This was done by linking reports of diversion with claims data, no small feat, which may further explain why this relationship has not been reported on previously. However, although this clever technique does allow the comparison of hospitals on more crowded days to less crowded days, as measured by the number of diversion hours, it assigns the same crowding exposure to the patient who arrives at 3 AM as the patient who arrives at 3 PM.

Indeed, nighttime ED crowding is very different from daytime crowding because daily crowding tends to follow a sinusoidal pattern.⁴ Another recent study found that the intraday variation in ED crowding was nearly 10 times the between-day variation, so any day-level crowding exposure is limited.⁵

THE Y PROBLEM: OUTCOMES

Presumably, outcomes from ED and hospital crowding would be easy to observe. But in reality, finding objective outcomes plausibly linked to crowding has been difficult. Several studies have linked crowding to delays in care; specifically, for pain medications, antibiotics, and other treatments in various patient populations.⁶ The fact that crowding itself would contribute to or exacerbate the next person's wait is intuitive. Imagine showing up at a crowded business, ED or not, and having to wait at the back of a long line. If you are not explicitly prioritized (ie, you aren't obviously sick or jump the line), it makes sense that longer lines will translate to delays.

But the conceptual relationship between long lines and measurable patient safety outcomes is not so proximate. On the front end, some EDs have had unfortunate waiting room deaths

clearly attributable to crowding but so rare that they would not show up in any large number crunch.

Complications, by comparison, which are more common, are also plausibly associated with crowding. For example, a patient may experience a cognitive error from crowding because of overworked, overwhelmed staff, such as a medication error or a missed diagnosis. Or a complication may occur on the back end during a prolonged episode of hallway boarding, such as a pressure ulcer or a fall in an older adult. Or perhaps crowding will cause a critically ill patient not to receive needed 1:1 physician intensive care services such as insufficient resuscitation or suboptimal ventilator management because most EDs are not staffed to care for ICU patients for long periods.

Some studies have linked ED crowding to higher short-term complication rates and medical errors in single-center studies or databases designed explicitly to study errors.^{7,8} But studying these links in large claims-based data sets is less feasible because complication timing is not specifically reported, making it difficult to differentiate whether a complication was present on admission or not.

Sun et al¹ used 3 outcomes available in many claims data sets: mortality, hospital length of stay, and cost per admission. Important outcomes, no doubt, but they are somewhat distal to the crowding exposure. Mortality, for example, during a hospitalization may occur in the first few hours because of a crowding-related misadventure or maybe on day 28 of a prolonged ICU stay. There are similar problems with attributing prolonged lengths of stay and higher costs to high rates of diversion.

SOME SYSTEMS ADAPTED TO DYSFUNCTION

Another unspoken issue in the relationship between ED and hospital crowding and quality outcomes is that some EDs may have actually adapted to the inhospitable crowded environment and have created safer mechanisms to deal with the dysfunction. These may include adding nurses or techs to the triage area, using point-of-care testing to identify high-risk patients (ie, troponin or lactate), or creating hospital policies that ensure that patients who are likely to be harmed by crowding (such as boarders) are rapidly evaluated and cared for by inpatient teams in the ED.

The lack of reporting of relationships between crowding and mortality in single-center studies, especially in centers that have robust ways of measuring crowding and outcomes, may be perhaps because some have found no relationship between crowding and mortality. These studies might not appear in the literature because of either publication bias by journals that may view negative studies as less interesting or researchers not wanting to publicize these findings. If this publication bias does exist, then one side effect might be that certain adaptive mechanisms that are effective in modifying the relationship between crowding and outcomes do not receive adequate attention in the peer-reviewed literature.

REFLECTING ON ED AND HOSPITAL CROWDING AS A “SILENT KILLER”

So what are we to make from the finding by Sun et al¹ that a strong crowding-outcome link exists even with an imperfect ED and hospital crowding measure and outcome? Well, possible alternative explanations could be residual confounding, or maybe this is just a spurious finding. Perhaps it could be selection bias in that sicker patients decide to stay during episodes of crowding or that diversion itself modifies admission decisions. But given that the authors conducted a robust statistical analysis and controlled for pretty much every other possible factor, these explanations are not likely.

This should leave the reader with an uneasy feeling that perhaps even though some of the hospitals in California may have adapted to crowding, the chronically unsafe environment perpetuated by our nation's hospitals is a silent killer that has taken more than 2 decades to uncover. Notably, “silent” does not suggest that the ED community has been quiet on this topic, but it has not received the same attention as other public health problems that cause preventable deaths, such as smoking, firearms, or obesity.

Another consideration that was not directly studied in the article is the effect that ED and hospital crowding has on disaster preparedness. Superimposing the surges of patients who would need care during a natural or manmade disaster on an already overwhelmed ED and hospital system could prove catastrophic.

A PATH TO FINDING A CURE FOR ED AND HOSPITAL CROWDING

The final questions are what should we as emergency care providers and those outside the ED do with the findings? We first need to further study what factors allow certain hospitals to adapt to crowding, whereas others can't. Specifically, what interventions might lead to safer care during episodes of crowding and diversion, which, like other public health problems listed above, are unlikely to disappear tomorrow? We also need to be more transparent about systems that have adapted so others might learn. In addition, how can we be best “prepared” for a major disaster in a system that tolerates being over capacity most of the time?

For those outside the ED, such as hospital administrators or state or federal policymakers, measuring and fixing crowding and holding hospitals accountable should be a top priority. Especially for hospitals' financial officers, the relationship between crowding and higher costs should be carefully examined in this study and others.⁹

Stakeholders outside the ED should also realize that the causes and solutions for crowding lie as much in the ED as they do in the hospital. Fixing ED and hospital crowding will ultimately require a multidisciplinary approach to reduce the morbidity and mortality associated with this silent killer that threatens not only our nation's health but also our ability to respond to a major disaster. In the new area of public

accountability for both ED and hospital-level crowding, and perhaps even regional crowding, finding and implementing local and cross-hospital solutions will become increasingly important to hospitals, communities, and the patients we serve.

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