

Emergency department shifts and decision to admit: is there a lever to pull to address crowding?

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Emergency department (ED) crowding has long been recognised as posing significant patient safety threats. Research has demonstrated ties between ED crowding and delays in time-sensitive, disease-specific interventions such as thrombolysis in patients with acute myocardial infarction¹ and stroke,² resuscitation in trauma patients,³ antibiotics for patients with community-acquired pneumonia,⁴ and more recently the timely treatment of patients with sepsis.⁵ Elderly patients in particular may be vulnerable to crowding.⁶ More broadly, it has become clear that periods of high ED crowding are associated with increased inpatient mortality, length of stay and costs,⁷ as well as decreased patient experience.^{8,9}

Through health systems engineering, lean, and Six Sigma, ED leaders have sought to increase the efficiency of EDs, decrease crowding and improve the quality of care. Understanding the factors that contribute to ED crowding, including queuing theory, several solutions have been implemented to try to decompress crowded EDs.^{10,11} These ED solutions include matching the number of clinical shifts to expected patient arrival curves, positioning clinicians in triage,¹² creating observation units,¹³ and streaming patients (split flow).¹² Hospital system solutions have also been explored, including alternative pathways such as home hospital programmes,¹⁴ transferring lower acuity patients to partner community hospitals,¹⁵ smoothing the elective surgery schedule¹⁶ and boarding limited numbers of admitted ED patients in hospital hallways until a hospital bed becomes available.¹⁷ Over the years, groups like the Institute for Healthcare Improvement, American College of Emergency Physicians, and the American Academy of Emergency Medicine have disseminated,

taught and coached ED leaders on these operational improvement initiatives.

An important factor contributing to ED crowding involves patient disposition and the frequently cited bottlenecks arising from the inability to move patients from the ED to the inpatient floors due to hospital capacity constraints.^{18,19} In the current issue, Tyler *et al*²⁰ advance the science in this field by evaluating an additional lever that could potentially be pulled to effect inpatient capacity: ED clinician factors that may contribute to variable admitting practice patterns. Tyler and colleagues²⁰ reviewed data from 2010 to 2016 at a large academic medical centre in Boston. Of patients seen in the last shift hour, 43% were admitted vs 39% seen at any other time during the shift. Consistent with this observation, there was a general increased likelihood of admission for later hours in shifts, not just the last hour. For instance, the relative risk of admission was 1.03 in hour 7 (1.01–1.05), 1.04 in hour 8 (1.01–1.06) and 1.06 in hour 9 (1.013–1.101).

The authors conclude that the decision to admit is not purely related to medical indications or patient factors, but that the fatigue and cognitive overload that clinicians experience may play a small but statistically significant role as the shift progresses. Even granting this inference that the observed increase in admissions reflects end-of-shift fatigue, the small increase seems unlikely to have direct clinical impact, as the authors acknowledge in their discussion. Of the almost 300 000 ED visits in the study period, only 2% occurred in the last hour of physicians' shifts and the absolute difference in risk was only 4%. This certainly limits the potential impact of an intervention targeted at their specific findings. Additionally, it is possible that their



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findings are an inherent consequence of shift work and that adjustments in shift length may have little effect in changing this relationship.²¹ Whatever the shift length, there will always be a ‘last hour’.

It is also important to consider the effect that staffing and incentive systems may play on practice patterns and the findings presented in this study. Although some EDs incentivise providers based on their productivity during a given shift, others are agnostic of the volume of patients seen. This, as well as the general institutional culture around handing off patients who are still relatively undifferentiated, may drive differences in admitting patterns. As is so often the case, practice patterns in emergency medicine are likely highly dictated by the local culture, and thus these findings may be difficult to generalise. However, it still may be of interest to ED leaders to think about appropriate shift lengths, optimal overlap of clinical shifts, expectations of ED clinicians to continue to see or not see new patients for the last hour of their shift, and the incentives that may drive certain behaviours.

As we think about this study in the context of ED crowding, although hospital capacity constraints constitute well-documented contributing factors, we must also acknowledge the myriad other factors that play a role in creating crowded EDs and their different effects on quality.²² The conceptual model proposed by Asplin *et al*²³ reinforces the important roles that *input* (demand for emergency care, access to unscheduled, urgent and safety net care), *throughput* (timely triage, diagnostic evaluation and disposition decision), and *output* (availability of inpatient beds which is related to staffing, precautions, room turnover and discharges of inpatients) all play.²² To that end, while understanding the association between patients being evaluated later in an emergency physician shift and their likelihood of being admitted is important, any association found would be only one small piece of a complex puzzle. This is a puzzle which is only made more complex by the ageing population and resultant increase in patient acuity. As such, to ensure that solutions match the contributing factors, they must address the whole system: from outpatient primary care, through hospitalisation, to the postacute environment.¹¹

Although the small increase in admissions observed in Tyler *et al*'s²⁰ study seems unlikely to have clinically important effects on ED crowding, the observation nonetheless has value for other reasons. First, the observation provides another example of the footprint of fatigue in healthcare. As noted by the authors, their findings may be attributable to the cumulative effects of fatigue and decreased cognitive reserve experienced at the end of an ED shift. There are other articles on shift length, such as those showing that hand hygiene compliance for nurses progressively decreases each hour as shifts progress.²⁴ Second, from a practical perspective, the results of Tyler and colleagues highlight the potential value in being attentive to these effects

and perhaps tailoring work environments to acknowledge them. Variation in decision making towards the end of a shift raises the question: could we design a better model of shift coverage? For example, in some settings nurses and pharmacists do not perform high-stakes tasks towards the end of their shifts. One could imagine doing the same for emergency physicians. Instead of seeing new patients or engaging in complex medical decision making, they could instead focus on wrapping up other cases where the decisions have already been made.

Research spurred from this hypothesis, that there is a cumulative effect of fatigue and decreased cognitive reserve at the end of an ED shift, should be investigated more directly in the context of shift hour and in relation to other important tasks in emergency medicine. Ultimately, any investigations that advance this agenda should include all the health professionals at the bedside. Mental fatigue and cognitive overload can decrease performance for all caregivers—physicians, nurses, advanced practice providers and pharmacists—who provide critical care to patients in ED settings.

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REFERENCES

- Schull MJ, Vermeulen M, Slaughter G, *et al*. Emergency department crowding and thrombolysis delays in acute myocardial infarction. *Ann Emerg Med* 2004;44:577–85.
- Tsai M-T, Yen Y-L, Su C-M, *et al*. The influence of emergency department crowding on the efficiency of care for acute stroke patients. *Int J Qual Health Care* 2016;28:774–8.
- Wu D, Zhou X, Ye L, *et al*. Emergency department crowding and the performance of damage control resuscitation in major trauma patients with hemorrhagic shock. *Acad Emerg Med* 2015;22:915–21.
- Pines JM, Localio AR, Hollander JE, *et al*. The impact of emergency department crowding measures on time to antibiotics for patients with community-acquired pneumonia. *Ann Emerg Med* 2007;50:510–6.
- Peltan ID, Bledsoe JR, Oniki TA, *et al*. Emergency department crowding is associated with delayed antibiotics for sepsis. *Ann Emerg Med* 2019;73:345–55.
- Ackroyd-Stolarz S, Read Guernsey J, MacKinnon NJ, *et al*. The association between a prolonged stay in the emergency department and adverse events in older patients admitted to hospital: a retrospective cohort study. *BMJ Qual Saf* 2011;20:564–9.
- Sun BC, Hsia RY, Weiss RE, *et al*. Effect of emergency department crowding on outcomes of admitted patients. *Ann Emerg Med* 2013;61:605–11.

- 8 Chang AM, Lin A, Fu R, *et al.* Associations of emergency department length of stay with publicly reported quality-of-care measures. *Acad Emerg Med* 2017;24:246–50.
- 9 Rasouli HR, Esfahani AA, Nobakht M, *et al.* Outcomes of crowding in emergency departments; a systematic review. *Arch Acad Emerg Med* 2019;7:e52.
- 10 O'Neill SM, Miake-Lye I, Childers CP, *et al.* Effectiveness of interventions to improve the efficiency of emergency department operations: an evidence MAP. *Am J Emerg Med* 2018;36:2314–7.
- 11 Morley C, Unwin M, Peterson GM, *et al.* Emergency department crowding: a systematic review of causes, consequences and solutions. *PLoS One* 2018;13:e0203316.
- 12 Broida RI, Desai SA, Easter BD, *et al.* *Emergency department crowding: high impact solutions.* American College of Emergency Physicians: Emergency Medicine Practice Committee, 2016.
- 13 Ross MA, Hockenberry JM, Mutter R, *et al.* Protocol-Driven emergency department observation units offer savings, shorter stays, and reduced admissions. *Health Aff* 2013;32:2149–56.
- 14 Levine DM, Ouchi K, Blanchfield B, *et al.* Hospital-Level care at home for acutely ill adults: a pilot randomized controlled trial. *J Gen Intern Med* 2018;33:729–36.
- 15 Cha WC, Shin SD, Song KJ, *et al.* Effect of an independent-capacity protocol on overcrowding in an urban emergency department. *Acad Emerg Med* 2009;16:1277–83.
- 16 Litvak E, Fineberg HV. Smoothing the way to high quality, safety, and economy. *N Engl J Med* 2013;369:1581–3.
- 17 Viccellio A, Santora C, Singer AJ, *et al.* The association between transfer of emergency department boarders to inpatient hallways and mortality: a 4-year experience. *Ann Emerg Med* 2009;54:487–91.
- 18 Derlet RW, Richards JR. Overcrowding in the nation's emergency departments: Complex causes and disturbing effects. *Ann Emerg Med* 2000;35:63–8.
- 19 Forster AJ, Stiell I, Wells G. The effect of hospital occupancy on emergency department length of stay and patient disposition. *Acad Emerg Med* 2003;10:127–33.
- 20 Tyler PD, Fossa A, Joseph JW, *et al.* Later emergency provider shift hour is associated with increased risk of admission: a retrospective cohort study. *BMJ Qual Saf* 2019. doi:10.1136/bmjqs-2019-009546. [Epub ahead of print: 13 Nov 2019].
- 21 Chan DC. The efficiency of Slacking off: evidence from the emergency department. *Econometrica* 2018;86:997–1030.
- 22 Vermeulen MJ, Guttman A, Stukel TA, *et al.* Are reductions in emergency department length of stay associated with improvements in quality of care? A difference-in-differences analysis. *BMJ Qual Saf* 2016;25:489–98.
- 23 Asplin BR, Magid DJ, Rhodes KV, *et al.* A conceptual model of emergency department crowding. *Ann Emerg Med* 2003;42:173–80.
- 24 Dai H, Milkman KL, Hofmann DA, *et al.* The impact of time at work and time off from work on rule compliance: the case of hand hygiene in health care. *J Appl Psychol* 2015;100:846–62.