Ambulance Diversion

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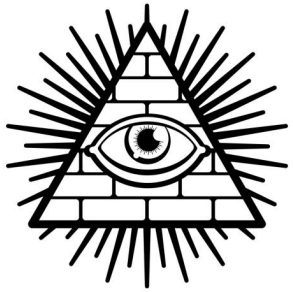
Disclaimer

- No conflicts of interest
- Speaking only on my own behalf

UC San Diego
Health Sciences

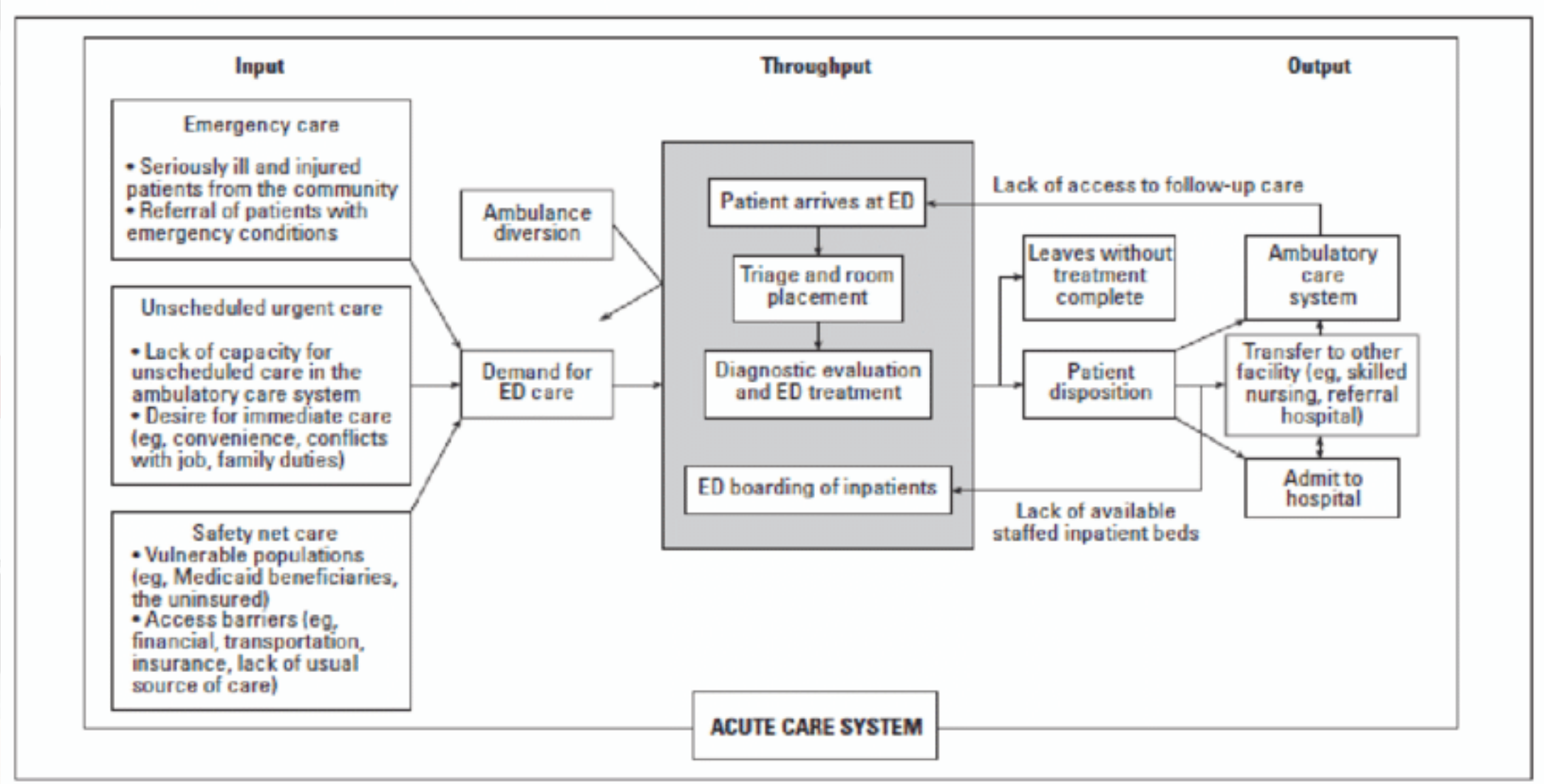


Today's plan

- Give a brief overview of ambulance diversion
- Discuss some of the literature addressing specific questions relating to ambulance diversion
- Leave plenty of time for questions and discussion

What is ambulance diversion?

- Ambulance diversion: what a hospital requests when they don't want ambulances to come to them
- Ambulance bypass: what an ambulance does when it goes past the nearest facility
- Access block: when patients in the ED are admitted but unable to move to their inpatient areas
- Crowding: when the demand for patient care in the ED exceeds the capacity of the facility to provide that quality care in a reasonable time frame



Asplin, B. R., et al. (2003). "A conceptual model of emergency department crowding." Ann Emerg Med **42**(2): 173-180.

Why do we care?

- As initially envisioned, diversion makes good sense: move ambulances away from a critically overburdened ED to make sure that everybody has prompt access to care
- This was meant to be a rarely-used tool
- Today, diversion is standard operating procedure in many places

- This was true 20 years ago, and it's no less true today

Asplin, B. R. (2003). "Does ambulance diversion matter?" Ann Emerg Med **41**(4): 477-480.

Who goes on diversion

- 2000-2008 study period in Orange County (California)
- Hospitals that provided specialty services (e.g., trauma, burn, cardiovascular surgery, renal transplant, and cardiac catheterization) were on diversion 4.1% (95% CI 1.6-6.7%) more often than non-specialty hospitals
  - Study looked at ED diversion only, not specialty-specific diversion
- Presence of specialty services and inpatient occupancy rate accounted for 31% of variance in each hospital's time on diversion

Kahn, C. A., et al. (2014). "Characteristics of hospitals diverting ambulances in a California EMS system." Prehosp Disaster Med **29**(1): 27-31.

Who goes on diversion

- Los Angeles County, 1998-2004
- 80 hospitals, of which 9 closed during the study period
- Diversion hours monthly increased from 57 hours (95% CI 51-63) to 190 hours (95% CI 180-200)
- Hospital closures increased monthly diversion by 56 hours (95% CI 28-84) for 4 months at the nearest ED
- County-operated hospitals had 150 more hours (95% CI 90-200) and trauma centers had 48 more hours (95% CI 9-87) each month than other hospitals
- Diversion hours at any facility were positively correlated to diversion hours at the next-closest ED

Sun, B. C., et al. (2006). "Effects of hospital closures and hospital characteristics on emergency department ambulance diversion, Los Angeles County, 1998 to 2004." Ann Emerg Med **47**(4): 309-316.

Contributors to ambulance diversion

- 2005-2012 study period
- 10% increase in inpatient volume led to a 5.0% (95% CI 3.8-6.3) increase in diversion hours, while a 10% increase in ED volume led to a 0.7% (95% CI 0.2-1.2) increase in diversion hours
  - That's a 7-fold higher impact of inpatient volume compared to ED volume
- When the next-closest ED went on diversion, EDs went on diversion for 8% (mild) (95% CI 5-11), 23% (moderate) (95% CI 18-27), and 44% (severe) (95% CI 37-51) more hours; total chance of going on diversion was increased by 10% (95% CI 8-12), 19% (95% CI 15-22), and 21% (95% CI 17-25)

Hsia, R. Y., et al. (2018). "Is Inpatient Volume Or Emergency Department Crowding A Greater Driver Of Ambulance Diversion?" Health Aff (Millwood) **37**(7): 1115-1122.

Diversion is a symptom of a larger problem

- This is ultimately an issue of overall health system capacity
- Ambulance diversion is one of the only tools an EMS system has to manage ED crowding in times of patient surge
  - When every time is a time of patient surge, the tool is much less useful
- Several studies have demonstrated worse outcomes for patients in times of high ambulance diversion and high ED crowding

Inpatient outcomes

- Study of California acute-care, non-federal hospitals in 2007
- 995,379 ED visits resulting in admission to 187 hospitals
- Patients admitted on days with high ED crowding experienced:
  - 5% greater chance of inpatient death (95% CI 2-8)
  - 0.8% longer stay (95% CI 0.5-1)
  - 1% increased costs per admission (95% CI 0.7-2)
- Excess outcomes included:
  - 300 inpatient deaths (95% CI 200-500)
  - 6,200 hospital days (95% CI 2,800-8,900)
  - $17 million in costs (95% CI 11-23 million)

Sun, B. C., et al. (2013). "Effect of emergency department crowding on outcomes of admitted patients." Ann Emerg Med **61**(6): 605-611 e606.

Cardiac outcomes

- Study of diversion and acute myocardial infarction related deaths in New York City
- Significant association between increasing diversion and increasing AMI-related deaths
  - Annually, represented about 84 excess deaths

Li, M., et al. (2019). "A review on ambulance offload delay literature." Health Care Manag Sci **22**(4): 658-675.

Hospital-level financial outcomes

- One-year review of 62,588 patient visits at a 450-bed central Pennsylvania hospital (non-profit, community, teaching) in 2004-2005
- 1,334 registered patients eloped from the ED after triage but before treatment
- Ambulances normally arrived at about 1.84 patients/hour; there were 354 hours of diversion in the study period
- Loss of revenue from ambulance diversions and patient elopements was estimated at $3,881,506 (not including critical care and procedural billing)
  - $3,150,079 from diversion
  - $731,427 from elopement

Falvo, T., et al. (2007). "The financial impact of ambulance diversions and patient elopements." Acad Emerg Med **14**(1): 58-62.

Hospital-level financial outcomes

- 40,000 annual visit urban academic nonprofit teaching hospital and level 1 trauma center, 444 beds
- July 2003-December 2006
- Profitability actually increased during periods of diversion
  - Higher by $91k/week and $119k/week for moderate and severe diversion respectively compared to no diversion
  - Higher by $93k/week and $65k/week for high and moderate diversion respectively compared to mild diversion
- Authors concluded that hospitals do well when they're full, regardless of where the patients are coming from

Handel, D. A. and K. John McConnell (2009). "The financial impact of ambulance diversion on inpatient hospital revenues and profits." Acad Emerg Med **16**(1): 29-33.

Equity in diversion-related outcomes

- Looked at 202 acute-care, non-federal hospitals in California in 2007
- Hospitals serving a much higher proportion of minority patients had 4.1 (95% CI 1.26-13.3) times as much ambulance diversion in their areas compared to those hospitals with low proportions of minority patients
- Noted that almost all of the hospitals were on diversion at some point: 92% (188 out of the 202 hospitals)

Hsia, R. Y., et al. (2012). "California hospitals serving large minority populations were more likely than others to employ ambulance diversion." Health Aff (Millwood) **31**(8): 1767-1776.

Equity in diversion-related outcomes

- Used a non-public AMI database from 2001-2011
- Hospitals treating a high share of Black patients were more likely to experience ambulance diversion
- Black patients had higher mortality than White patients when exposed to higher levels of ambulance diversion
  - 90-day mortality 2.88% higher (95% CI 0.64-5.12) (RR 19%)
  - 1-year mortality 3.09% higher (95% CI 0.31-5.88) (RR 14%)
  - More difference when looking only at hospitals with high numbers of Black patients
- Mortality rates were similar at low levels of diversion, but diverged with increasing levels of diversion
- Results held when controlled for individual communities

Hsia, R. Y., et al. (2017). "Impact Of Ambulance Diversion: Black Patients With Acute Myocardial Infarction Had Higher Mortality Than Whites." Health Aff (Millwood) **36**(6): 1070-1077.

Are there alternatives?

- Is keeping our current system tenable in light of the above information?
- If we maintain diversion, should we consider:
  - Centrally-initiated diversion
  - Centrally-monitored diversion
  - Standards regarding when a facility may consider diversion
- Should we simply get rid of ambulance diversion?

Centrally initiated diversion

- Study of three Canadian EDs in one city
- ED capacity monitored at central dispatch using a favorable/not favorable capacity code
- Ambulances were advised to avoid the most crowded ED; bypass did remain an option with pre-defined criteria
- Overall ambulance volume and total ED volume increased, as did proportion of people >65 years of age, but proportion of time that EDs had a favorable capacity code went up from 58% to 79%, and total diversion hours dropped from 198 to 27

McLeod, B., et al. (2010). "Matching capacity to demand: a regional dashboard reduces ambulance avoidance and improves accessibility of receiving hospitals." Acad Emerg Med **17**(12): 1383-1389.

Centrally monitored diversion

- March 2020 trial in San Francisco (11 EDs, 46 square miles, 850,000 people)
- Paramedic supervisor and base hospital physician determined destination for non-critical patients
  - Hospitals could still put themselves on diversion
- Load-leveling improved, but diversion hours overall actually increased
- Unclear if prehospital patient volume actually affected hospital decisions to go on diversion

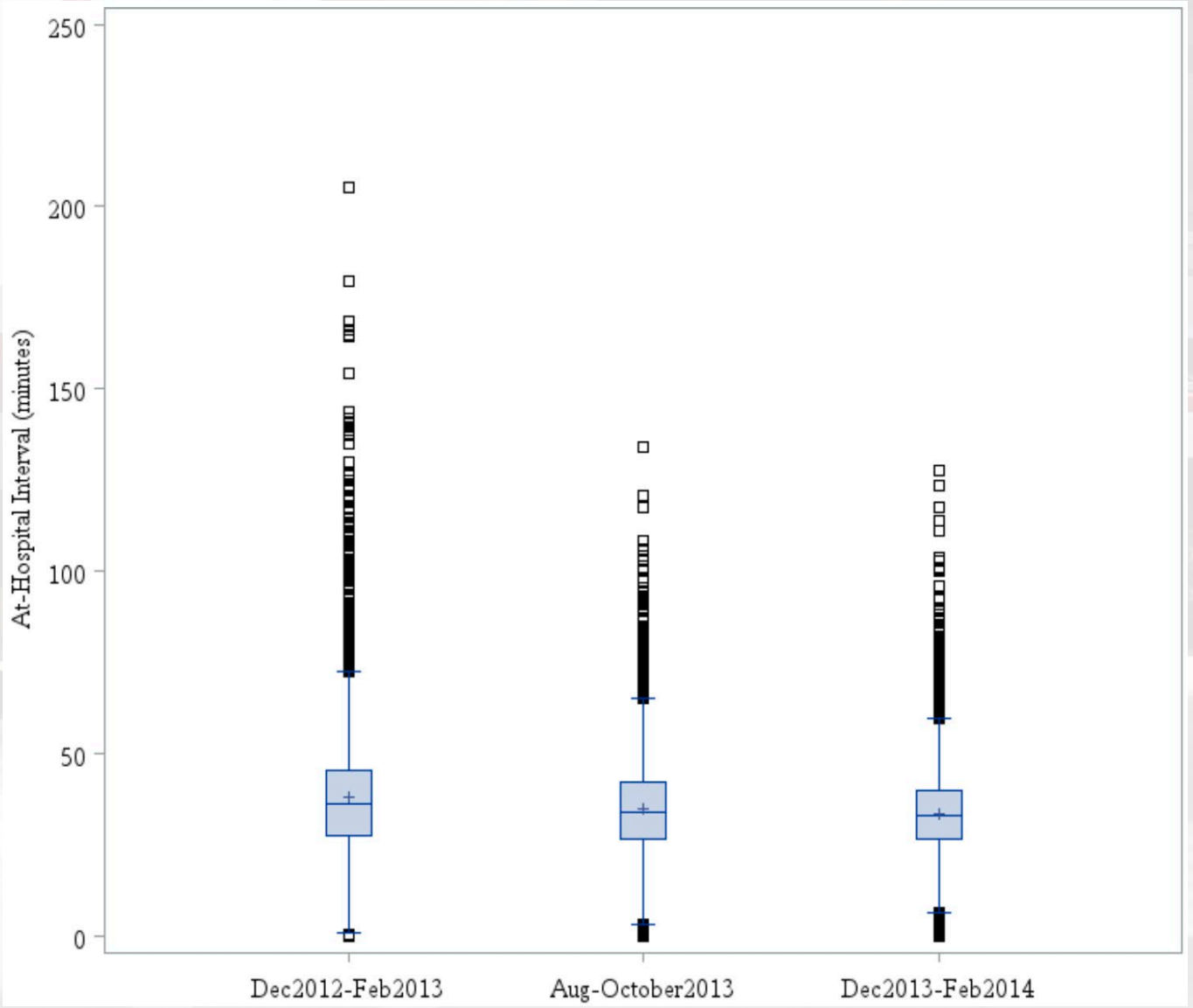
Bains, G., et al. (2021). "Centralized Ambulance Destination Determination: A Retrospective Data Analysis to Determine Impact on EMS System Distribution, Surge Events, and Diversion Status." West J Emerg Med **22**(6): 1311-1316.

Centrally monitored diversion

- Trial in Baltimore in 2013-2014
- Senior EMS paramedic placed in the fire communications bureau from 0900-2100 daily
  - Empowered to suggest alternative hospital destinations based on monitoring of delays at receiving facilities
  - Hospital EDs could request temporary diversion as well
- Most time intervals improved slightly
  - At-hospital time decreased by 4.53 minutes (95% CI 4.14-4.92) (compared to seasonally-matched pre-intervention controls); also a drop in outlier times
  - Hospital alert time dropped by 1,723 hours in a 3-month period
  - Fire suppression unit on-scene time decreased by 0.30 minutes

Halliday, M. H., et al. (2016). "The Medical Duty Officer: An Attempt to Mitigate the Ambulance At-Hospital Interval." West J Emerg Med **17**(5): 662-668.

Outlier times



Centrally monitored diversion

- 2017 ”nurse navigator” program for a single health system with two EDs close to each other in New Haven
- Non-binding recommendations on destination based on age, sex, and chief complaint
- Used a dashboard with real-time metrics on staffing, capacity, anticipated discharges, specific service availability, etc. (M-F 0900-1700)
- Turnaround time and interfacility transports between the two facilities decreased

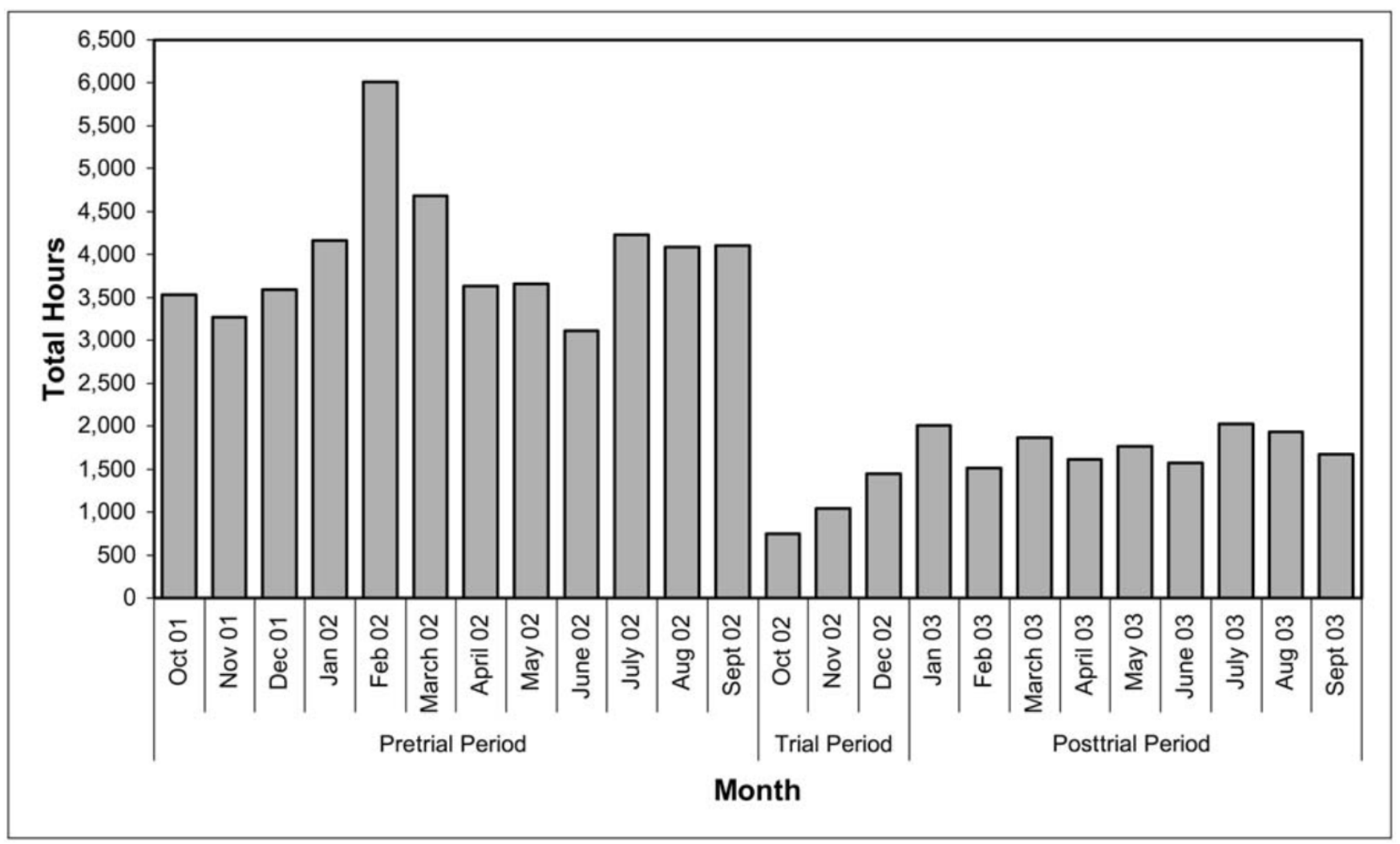
Felice, J., et al. (2019). "Effects of Real-time EMS Direction on Optimizing EMS Turnaround and Load-balancing Between Neighboring Hospital Campuses." Prehosp Emerg Care **23**(6): 788-794.

Less-diversion trial

- County-wide committee recommended guidelines for when to go on diversion
- Oct 2001-Sept 2003 was evaluated (second year was the intervention year; 3 months intervention, 9 months observation)
- Overall, ambulance runs increased
- Patients being diverted from their preferred hospital decreased by about 1,000 patients/month
- Diversion hours decreased by about 3,000 hours/month

Vilke, G. M., et al. (2004). "Community trial to decrease ambulance diversion hours: the San Diego county patient destination trial." Ann Emerg Med **44**(4): 295-303.

Less-diversion trial



Limiting diversion trial

- Sacramento-based trial from 2006-2009
- “Tight diversion criteria”
- EDs limited to 3h of diversion at a time, then must stay open for at least 1h
- After 6 months, went to 2h; 6 months later, to 1h
- Diversion hours went down
  - 2006 (pre-implementation): 8,469
  - 2007 (during implementation): 4,592
  - 2008: 2,439
  - 2009: 2,306
  - This represents an 87.4% (95% CI 64.6-95.5) decrease in diversion hours across the region
- Context
  - From 2006 to 2009, overall increases were noted in EMS arrivals (7.8%), ED census (13.0%), hospital admissions (6.6%), Intensive Care Unit admissions (17.1%), and overall Sacramento population (1.9%).

Patel, P. B. and D. R. Vinson (2012). "Ambulance diversion reduction and elimination: the 3-2-1 plan." J Emerg Med **43**(5): e363-371.

No-diversion trial

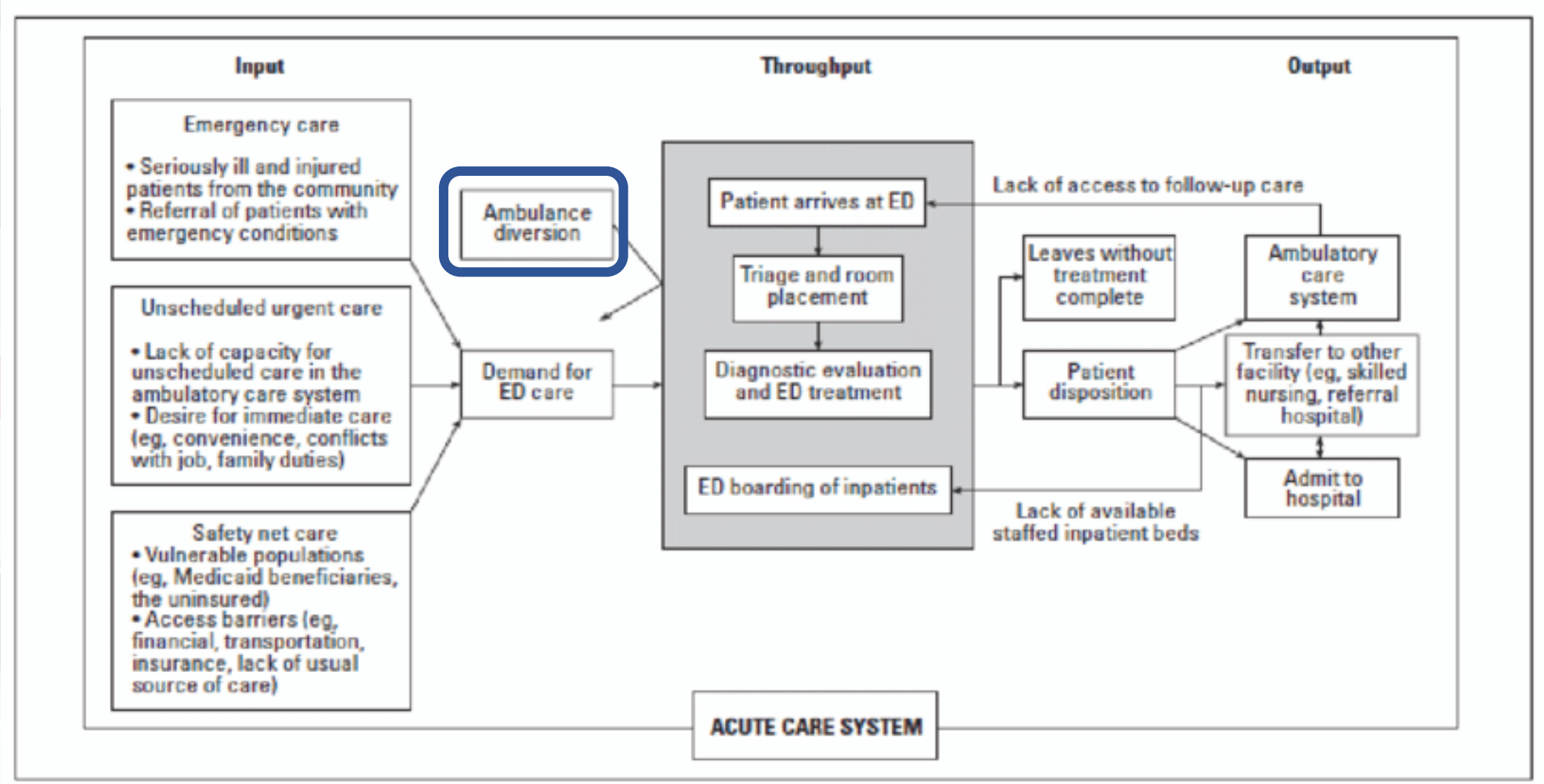
- One hospital temporarily augmented staff so they could avoid diversion; no changes at a nearby hospital (blocks away)
- During the 1-week trial, total diversion hours for both hospitals were 1.5 hours (47 the week before, 56 the week after)
- Number of patients diverted that week was 2 (usually 40)
- Authors noted an “oscillatory phenomenon”, which disappeared during that week

Vilke, G. M., et al. (2004). "Approach to decreasing emergency department ambulance diversion hours." J Emerg Med **26**(2): 189-192.

No-diversion policy statewide

- Massachusetts eliminated ambulance diversion statewide in 2009
- Studying the first year after the implementation of the ban, there was no increase in ED crowding or ambulance turnaround time in the 9 Boston EDs evaluated; TAT decreased slightly (2-3 minutes)
- Hospitals that had been high diverters actually decreased their lengths of stay by about 10 minutes
- No changes in admissions, elopements, or volume
- Qualitative measures also improved

Burke, L. G., et al. (2013). "The effect of an ambulance diversion ban on emergency department length of stay and ambulance turnaround time." Ann Emerg Med **61**(3): 303-311.e301.
Rathlev, N. K., et al. (2013). "No diversion in Western Massachusetts." J Emerg Med **44**(2): 313-320.
O'Keefe, S. D., et al. (2014). ""No diversion": a qualitative study of emergency medicine leaders in Boston, MA, and the effects of a statewide diversion ban policy." Ann Emerg Med **63**(5): 589-597.e587.



Asplin, B. R., et al. (2003). "A conceptual model of emergency department crowding." Ann Emerg Med **42**(2): 173-180.

Ambulance offload delay and ED crowding review

- Li, M., et al. (2019). "A review on ambulance offload delay literature." Health Care Manag Sci **22**(4): 658-675.
- Morley, C., et al. (2018). "Emergency department crowding: A systematic review of causes, consequences and solutions." PLoS One **13**(8): e0203316.

Contributors to ambulance offload delay

- Main determinants of crowding and access block during the pandemic were:
  - Reductions in hospital occupancy
  - Reduction in elective surgery levels
- They did not include:
  - ED volume
  - Ambulance run volume

Bein, K. J., et al. (2021). "Does volume or occupancy influence emergency access block? A multivariate time series analysis from a single emergency department in Sydney, Australia during the COVID-19 pandemic." Emerg Med Australas **33**(2): 343-348.

ED crowding causes

Table 5. Studies identifying causes of ED crowding.

Input
Presentations with more urgent and complex care needs [20, 29–31, 108]
Increase in presentations by the elderly [20, 31, 114, 115]
High volume of low-acuity presentations [29, 117]
Access to primary care [29, 109, 117]
Limited access to diagnostic services in community [31]
Throughput
ED nursing staff shortages [30, 31]
Presence of junior medical staff in ED [113]
Delays in receiving test results and delayed disposition decisions [20]
Output
Access block [20, 29–31, 110–112]
ICU and cardiac telemetry census [116]

ICU = Intensive Care Unit

https://doi.org/10.1371/journal.pone.0203316.t005

Morley, C., et al. (2018). "Emergency department crowding: A systematic review of causes, consequences and solutions." PLoS One **13**(8): e0203316.

ED crowding consequences

Table 4. Studies reporting consequences of ED crowding.

Patient Effects
Poor patient outcomes e.g. for patients with chest pain [29, 30, 75, 92, 107]
Increased mortality [3, 80, 85, 96, 99–101]
Delayed assessment and care [29, 30, 76–79, 81, 83, 84, 87, 89–91, 93, 94, 98, 103, 104], including surgery [97]
Increased IPLOS [82, 88, 95, 99, 101]
Risk of readmission [3, 74]
Reduced patient satisfaction [102]
Exposure to error [17, 18]
Staff Effects
Non-adherence to best practice guidelines [18, 75–79, 90, 91, 93, 94, 98, 103, 104]
Increased staff stress [29]
Increased violence towards staff [29, 86]
System Effects
Increased IPLOS [82, 88, 95, 99, 101]
Increased EDLOS [29, 84, 105, 106]

IPLOS = inpatient length of stay EDLOS = emergency department length of stay

https://doi.org/10.1371/journal.pone.0203316.t004

Morley, C., et al. (2018). "Emergency department crowding: A systematic review of causes, consequences and solutions." PLoS One **13**(8): e0203316.

Potential solutions to ED crowding

Table 6. Studied and suggested solutions to ED crowding.

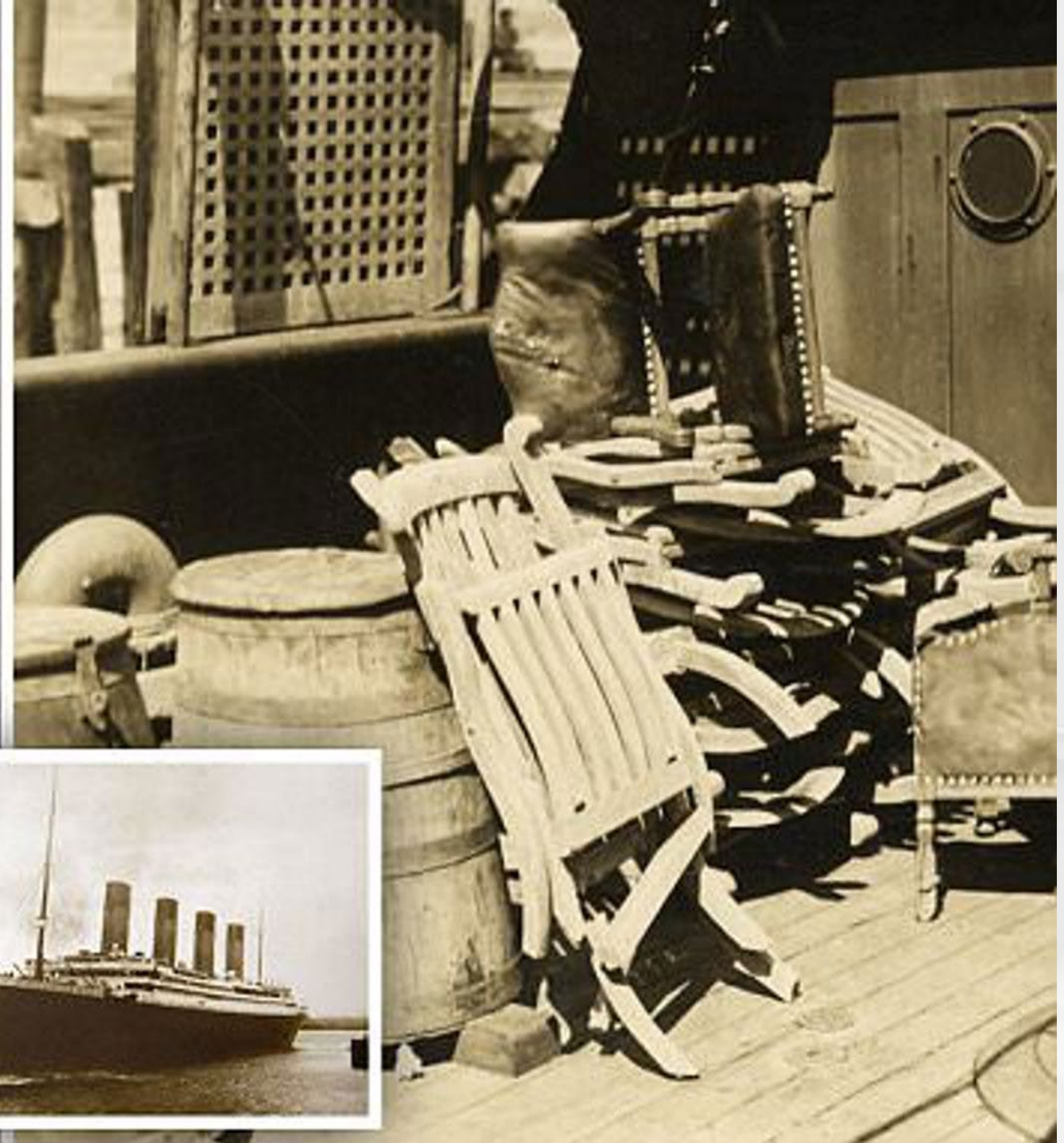
Input
GP-led walk-in centres / Co-located GP [32, 33, 64]
Extended GP opening hours [37, 43, 58, 72]
Choice of ED [64]
Social interventions including; education campaigns, financial disincentives, redirection [32]
Throughput
Split ESI 3 on presentation [34]
Earlier physician assessment [21, 23, 38, 50, 63, 65, 67, 71], including physician-led/supported triage [25, 40, 45, 47, 56, 60]
Fast-track / flexible care area [42, 55, 56]
Shorter turnaround-times for laboratory tests [26, 27, 52, 53, 66]
ED nurse flow coordinator [35, 44, 69]
Bedside registration [56, 68]
Nurse initiated protocols [28]
Earlier inpatient consultation [49]
Increased ED bed numbers [57, 69]
Increased ED staff [69]
Output
Active bed management [20, 36, 39, 46]
Leadership program/Support [39, 61, 67]
Implementation of nationally mandated, timed patient disposition targets [48, 54, 59, 62, 67, 69]
ED staff direct admit rights [63, 67]
Admitting team prioritise ED admissions [67]
Alternative admission policies [22, 41, 69, 70, 73]
Increased inpatient beds and staff [69]

GP = general practitioner ESI = Emergency Severity Index

https://doi.org/10.1371/journal.pone.0203316.t006

Conclusions

- ED crowding is a very real problem with significant consequences, most importantly for our patients
- The best available evidence suggests that ambulance traffic, while symptomatic of ED crowding issues, is not a significant contributor to ED crowding
  - Specifically, diversion can be reduced or eliminated without significantly affecting ED crowding
- Successfully addressing ED crowding requires a systems-based approach that addresses the entirety of the patient care episode



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Questions