Study on Patient Flow in Queensland's public hospitals

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Association between delays to patient admission from the emergency department and all-cause 30-day mortality

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ABSTRACT

Background Delays to timely admission from emergency departments (EDs) are known to harm patients.

Objective To assess and quantify the increased risk of death resulting from delays to inpatient admission from EDs, using Hospital Episode Statistics and Office of National Statistics data in England.

Methods A cross-sectional, retrospective observational study was carried out of patients admitted from every type 1 (major) ED in England between April 2016 and March 2018. The primary outcome was death from all causes within 30 days of admission. Observed mortality was compared with expected mortality, as calculated using a logistic regression model to adjust for sex, age, deprivation, comorbidities, hour of day, month, previous ED attendances/emergency admissions and crowding in the department at the time of the attendance.

Results Between April 2016 and March 2018, 26 738 514 people attended an ED, with 7 472 480 patients admitted relating to 5 249 891 individual patients, who constituted the study's dataset. A total of 433 962 deaths occurred within 30 days. The overall crude 30-day mortality rate was 8.71% (95% CI 8.69% to 8.74%). A statistically significant linear increase in mortality was found from 5 hours after time of arrival at the ED up to 12 hours (when accurate data collection ceased) ($p<0.001$). The greatest change in the 30-day standardised mortality ratio was an 8% increase, occurring in the patient cohort that waited in the ED for more than 6 to 8 hours from the time of arrival.

Conclusions Delays to hospital inpatient admission for patients in excess of 5 hours from time of arrival at the ED are associated with an increase in all-cause 30-day mortality. Between 5 and 12 hours, delays cause a predictable dose–response effect. For every 82 admitted patients whose time to inpatient bed transfer is delayed beyond 6 to 8 hours from time of arrival at the ED, there is one extra death.

Key messages

What is already known on this subject

- Small studies from Canada and Australia have indicated that there is an increased mortality rate among patients who experience delays in admission to an inpatient bed from the emergency department (ED).
- Counterfactual modelling has shown reduced patient mortality as a result of the NHS 4-hour operational standard. The NHS Benchmarking Network found a coefficient of determination (R^2 value) of 0.07 between time greater than 4 hours in the ED and a hospital's Summary Hospital-level Mortality Indicator.

What this study adds

- This study of over five million NHS patients shows an increase in all-cause 30-day mortality that is independently associated with delays to hospital admission from the ED rather than with crowding alone.
- The standardised mortality rate starts to rise from 5 hours after the patient's time of arrival at the ED.
- The increasing effect of long stays in the ED before inpatient admission can be measured and represented as a number needed to harm metric: after 6–8 hours, there is one extra death for every 82 patients delayed.

standard is a binary time threshold for discharge, admission or transfer; it starts when the patient arrives at the ED, and time in the ED beyond 4 hours is a 'breach' of the 'target'.)

For more than a decade, the 4-hour standard served both patients and the NHS well but, during

Background

- QH commissioned EMF to coordinate an academically robust piece looking at causes and solutions to improve patient flow across Queensland's public hospitals
- EOI process
- We formed a team
  - QH
  - QAS
  - UQ
  - CSIRO
- Commissioned to do this work

Emergency Medicine Foundation Queensland

Request for Submissions – Study on Patient Flow in Queensland's public hospitals

Last updated: May 2022

The Emergency Medicine Foundation (EMF) is a non-profit organisation dedicated to enhancing patient emergency healthcare experience and outcomes, saving lives and promoting system sustainability in Queensland. EMF's remit is the promotion and delivery of a research, education and grant program in the field of emergency healthcare.

EMF supports high quality research directed at improving the healthcare of patients in emergencies within the pre-hospital and emergency department settings. EMF has several research initiatives including its flagship Queensland Research Program which is fully funded by the Queensland Government through Queensland Health.

EMF is collaborating with Queensland Health on a large research program to find effective, evidence-based solutions to improve patient flow in Queensland's public hospitals. The first component of this program is a study to analyse patient flow in Queensland Hospitals, including consideration of Queensland Ambulance Service. This Request for Submissions invites researchers and research teams to submit proposals to conduct this study.

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Why is this work needed?

- This is a hard problem with proven mortality consequences
- This is a very complex adaptive system
- Lots written but much is hard to find or interpret
- Many patient flow interventions undertaken are not ever evaluated against the problem they were intended to solve and then perpetuated even if they are unsuccessful (QAO finding)
  - Duplication of effort
  - Implementation of disproven interventions
  - Unrealistic expectations of proven interventions if applied to a different problem or setting

Measuring emergency department patient wait time (Report 2: 2021–22)

Initiatives are not always evaluated

While Case study 1 (Figure 2G) provides some examples where the HHSs and the department have evaluated improvement initiatives to assess their effectiveness, they have not always done so. For example, hospitals we visited were not always able to provide evidence that they evaluated their initiatives, for example the use of short-term treatment areas within EDs. In other cases, the evaluations of strategies trialled have not always been able to identify the key learnings that would lead to improvement in the overall performance of the system as a whole.

Why is this work needed (cont)?

- Lots of focus on ED patient flow or inpatient patient flow but little whole of system research
- The context in which this complex adaptive system operates is rapidly changing
- Detailed patient flow analyses tend to be single site or local, making scaling and dissemination difficult
- Where studies do identify patient flow bottlenecks, little is understood from the front line about the reasons or impediments to implementation or novel solutions (especially beyond the ED)
  - The rubber hits the road with frontline

Why is this work needed (cont)?

- This makes it almost impossible for policy makers and healthcare managers to know what to do

Scope and objectives of program works

1. Literature Review
   - To inform subsequent phases
   - To provide an evidence repository accessible to those who need to use the information
2. Quantitative Pieces
   - Identify and quantify the context in which this complex adaptive system evolving
   - To undertake detailed multi-site system analysis to better be able to identify, predict, and evaluate the impact of interventions
3. Qualitative Study
   - To better understand the “why” across the system
   - Better inform solution design and identify implementation barriers before they occur

Systematic Review
&
Qualitative Study

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Primary objective

To inform strategies

to improve emergency access performance

across Queensland.

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Study design

- **Literature review**
- **Qualitative Study**

Literature review

Provide a comprehensive and up-to-date summary of:

a. the challenges impeding patient flow in the Emergency Department(ED),

b. the evidence regarding proven, disproven, and unproven patient flow interventions

Synthesize the current state-of-the-art evidence and information

(Hybrid methodology: traditional scientific AND targeted search)

The results of the literature review

inform the design of the qualitative component and quantitative activities of the project

a useful repository of information for system manages and policy makers

Qualitative Study

- **Understanding of challenges and barrier:**

  to achieving good patient flow in Queensland public hospitals from the experiences of service providers and consumers.

- **Participants:** hospital staff, Queensland Ambulance Service (QAS), primary care and Residential Aged Care Facilities (RACF) and consumers
  - 5 participants in each stakeholder group / 4 per care setting

- **Information gathering method**: Surveys and semi structured focus groups (online or in person)

- **Methods for collecting sound data:** Mobile app – 'Voice Recordings')

- **Data analysis:** Focus groups: Leximancer / Thematic analysis

  Survey: SPSS / Leximancer

Participant recruitment and consent

- **Participant recruitment:** via email secondary to partnership links with Queensland Health
- **Sampling:** purposive sampling
- **Information about Project:** A short presentation (10 minutes) explaining the aims, design, benefits and risks of the research to the governance teams and focus group participants.
- **Consent:** free, prior and informed
- **Documentation:** information sheet and consent form

Ethical considerations

- **Participant risks:** Low direct risk to participants
- All participant data and information de-identified and anonymised

- **Participant benefits:** Improve emergency access performance across Queensland

Study outcomes

- Inform strategies to improve emergency access performance across Queensland.
- Identifying bottlenecks and barriers to achieving good patient flow system wide.

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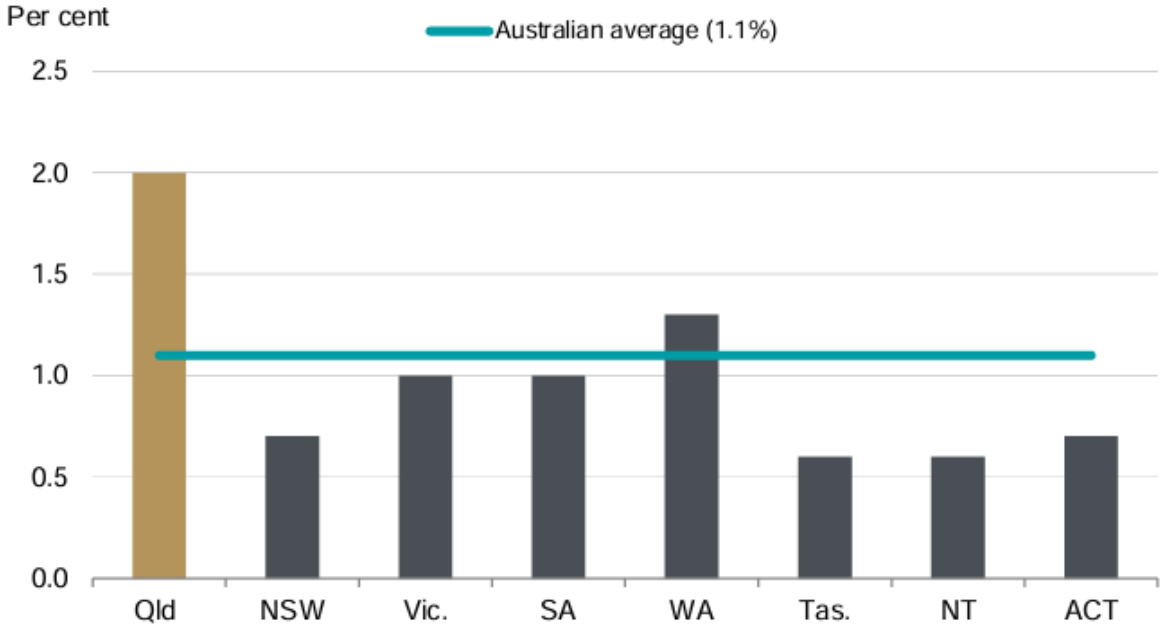
Contextual Insights

Contextual insights into causes of access block

- Population
- Socio-economic characteristics
- Health behaviours
- Health status
- Health workforce
- Primary health care services
- Potentially Preventable Hospitalisations
- Aged Care
- National Disability Insurance Scheme (NDIS)

Population growth rate, Australia and states and territories, year ending 30 June 2022



Source: Queensland Government Statistician's Office

Queensland population growth rate = 2% (to June 2022), above national average (1.1%) and highest of all state and territories.

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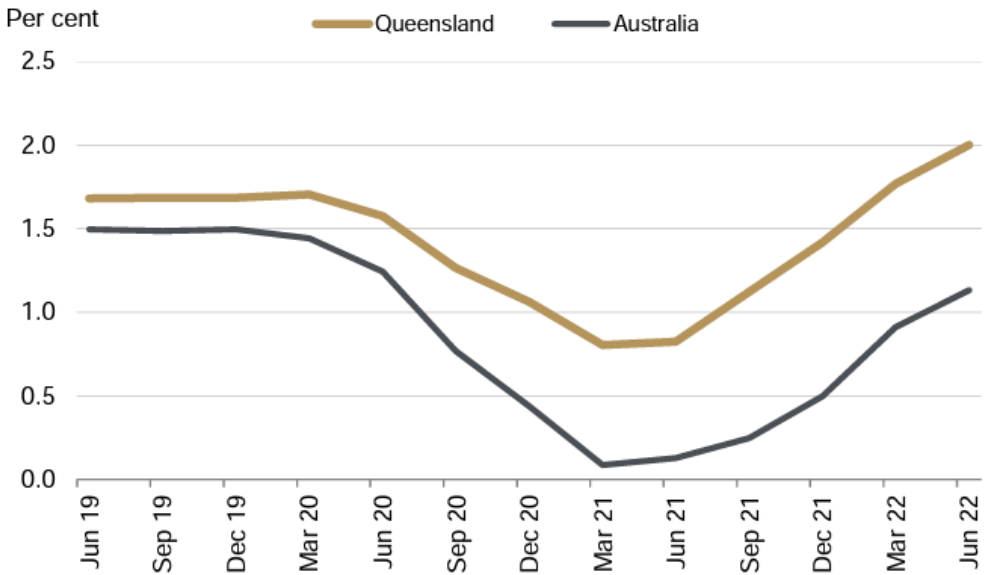
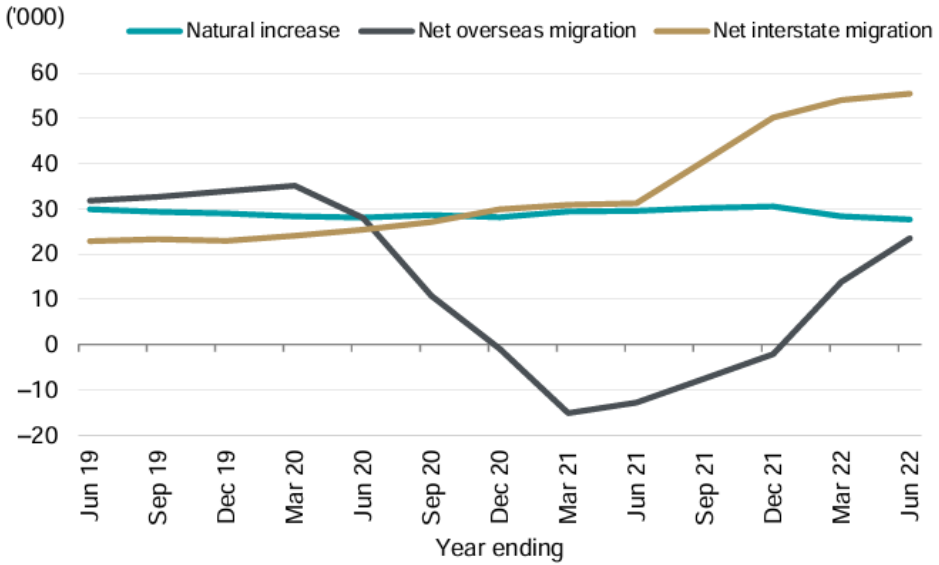
Annual population growth rate, Queensland and Australia



Source: Queensland Government Statistician's Office

Annual population increase by components of population change, QLD



Source: Queensland Government Statistician's Office

Qld Population at 30/6/22 = 5,322,058 (20.5% of the Australian population). Increase = 104,405 persons over the previous 12 months.

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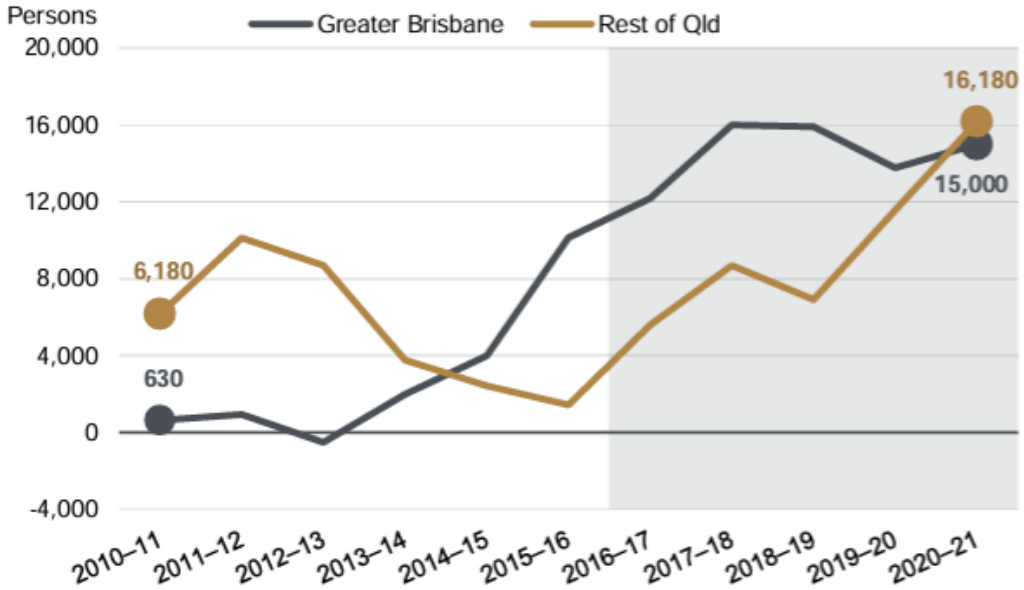
Net internal migration over time, Greater Brisbane and Rest of QLD



Source: Queensland Government Statistician's Office

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Components of population change - QLD

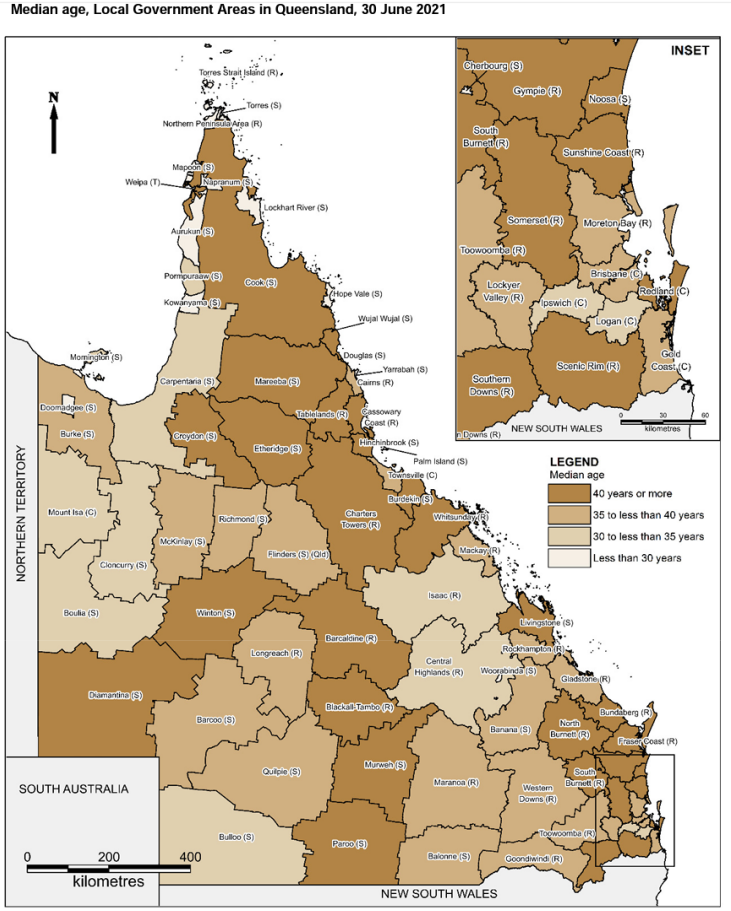
Components of population change (persons), Queensland							
Quarter	Natural increase	Net overseas migration	Interstate arrivals	Interstate departures	Net interstate migration	Population change	Estimated resident population
	— persons —						
Dec-16	7,296	5,943	27,785	22,857	4,928	18,359	4,884,196
Mar-17	7,949	11,370	24,564	20,356	4,208	23,703	4,907,899
Jun-17	7,705	7,409	25,295	20,128	5,167	20,475	4,928,374
Sep-17	6,696	7,040	23,049	17,647	5,402	19,221	4,947,595
Dec-17	6,754	1,818	30,687	22,954	7,733	16,394	4,963,989
Mar-18	8,262	11,337	26,155	20,453	5,702	25,376	4,989,365
Jun-18	7,644	7,546	26,047	20,186	5,861	21,137	5,010,502
Sep-18	6,959	9,596	23,063	18,043	5,020	21,519	5,032,021
Dec-18	7,181	5,258	31,623	24,410	7,213	19,589	5,051,610
Mar-19	7,908	11,294	26,737	21,562	5,175	24,309	5,075,919
Jun-19	7,832	5,601	26,596	21,173	5,423	18,799	5,094,718
Sep-19	6,416	10,440	23,465	17,995	5,470	22,068	5,116,786
Dec-19	6,808	6,580	29,830	22,970	6,860	19,974	5,136,760
Mar-20	7,273	12,468	24,353	18,085	6,268	25,738	5,162,498
Jun-20	7,542	-1,514	24,141	17,391	6,750	12,505	5,175,003
Sep-20	6,978	-6,781	21,547	14,375	7,172	6,569	5,181,572
Dec-20	6,303	-5,172	28,667	18,963	9,704	9,782	5,191,354
Mar-21	8,517	-1,701	26,914	19,665	7,249	12,669	5,204,023
Jun-21	7,736	808	32,695	25,641	7,054	13,630	5,217,653
Sep-21	7,576	-1,469	45,511	28,899	16,612	22,134	5,239,787
Dec-21	6,649	208	40,861	21,614	19,247	25,256	5,265,043
Mar-22	6,372	14,269	29,305	18,234	11,071	31,055	5,296,098
Jun-22	7,050	10,422	26,712	18,224	8,488	25,960	5,322,058

Source: Queensland Government Statistician's Office

Age distribution

From ABS regarding 2021 population distribution:

- Greater Brisbane had a higher proportion of its population aged 20-44 years (36%) than the rest of Queensland (31%), reflecting the pattern of young adults moving to capital cities for work and education purposes.
- Brisbane had a lower proportion aged 55 years and over (25%) than the rest of the state (32%).
- Patients aged ≤ 4 years (6% of Qld population) accounted for 10% of ED presentations.
- Patients aged ≥ 65years (16% of Qld population) accounted for 19% of ED presentations.



Sources: ABS; Queensland Government Statistician's Office; AIHW - Emergency department care, 2021–22: Australian hospital statistics

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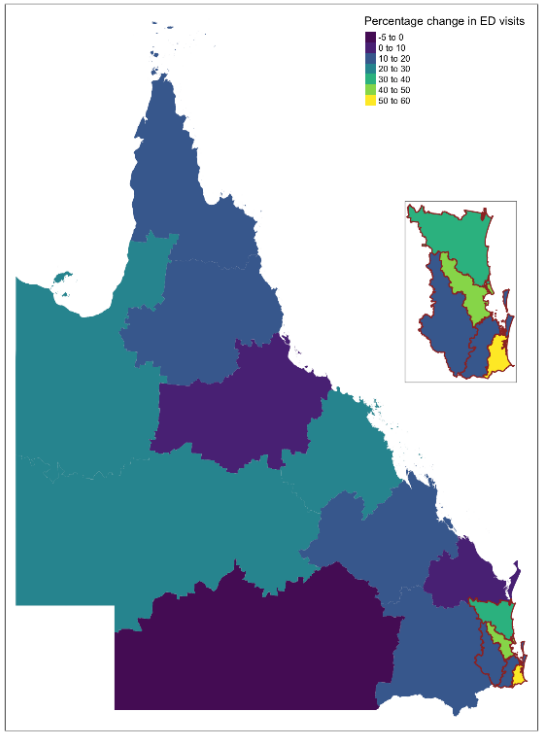
Changes in ED presentations: 2017 to 2022

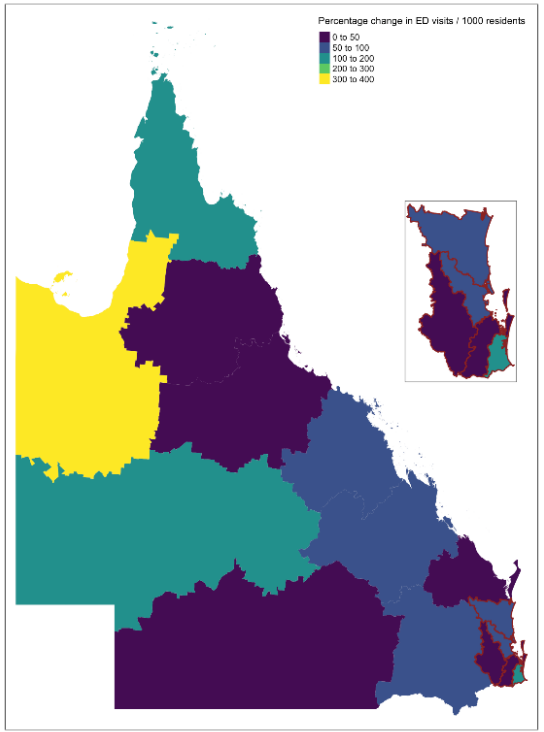
RAW COUNTS



Data Sources:

- Queensland Government Open Data Portal - Emergency departments - quarterly data;
- HHS boundaries from Queensland Spatial Catalogue, State of Queensland (Department of Resources);
- Population ABS and Qld Health mapping of SA2 to HHS

PER 1000 POPULATION



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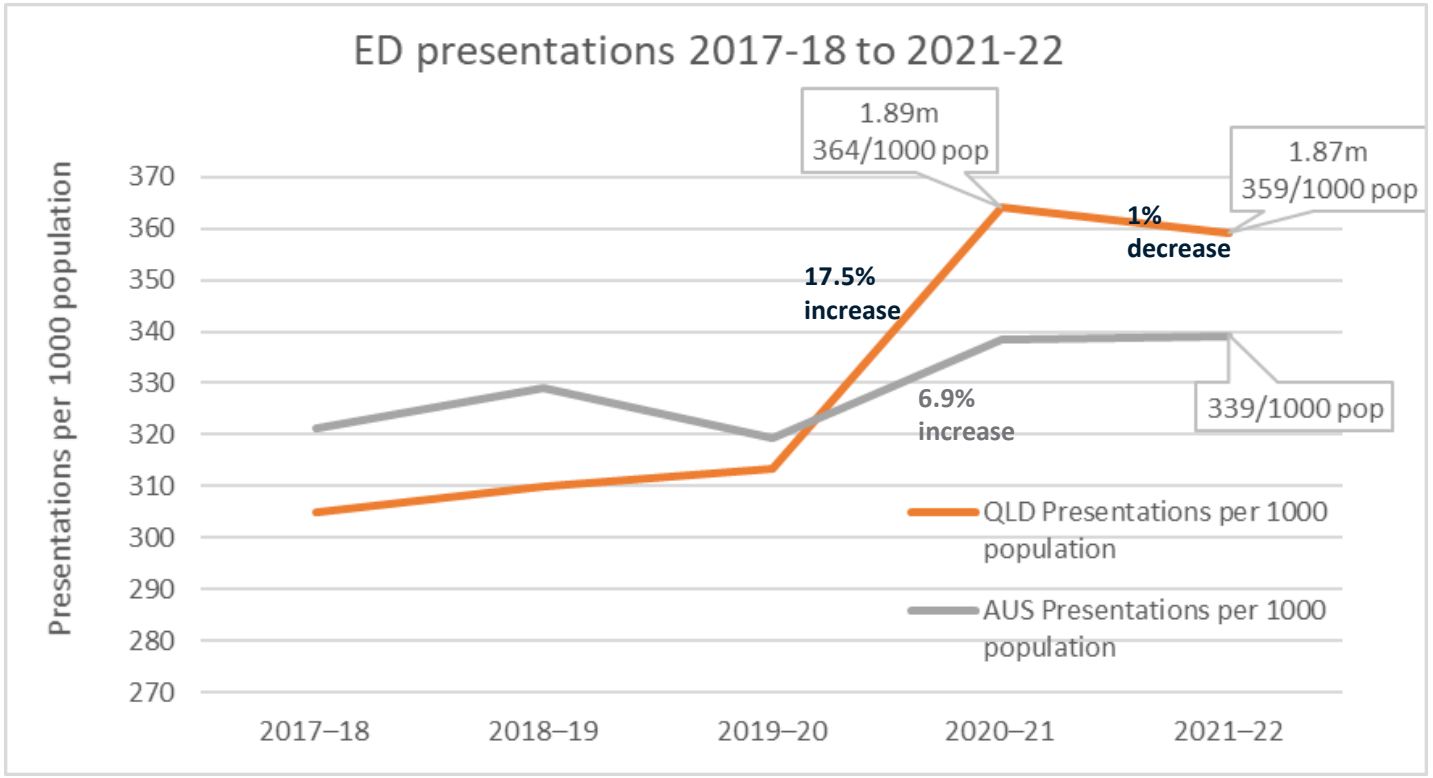
% Change in ED presentations

ED Presentations	% Change (Average since 2017–18)
New South Wales	1.1
Victoria	0.9
Queensland	5.4
Western Australia	3.7
South Australia	3.1
Tasmania	1.6
Australian Capital Territory	-0.7
Northern Territory	1.9
Total	**2.3**
Presentations per 1,000 population	
New South Wales	0.5
Victoria	0.1
Queensland	4.2
Western Australia	2.2
South Australia	2.1
Tasmania	-0.6
Australian Capital Territory	-3.1
Northern Territory	1.5
Total	**1.4**

Of all states and territories, Qld has had the highest % change in average growth rates since 2017-18

Data Source: AIHW - Emergency department care, 2021–22: Australian hospital statistics

Emergency department activity



Data Source: AIHW - Emergency department care, 2021–22: Australian hospital statistics

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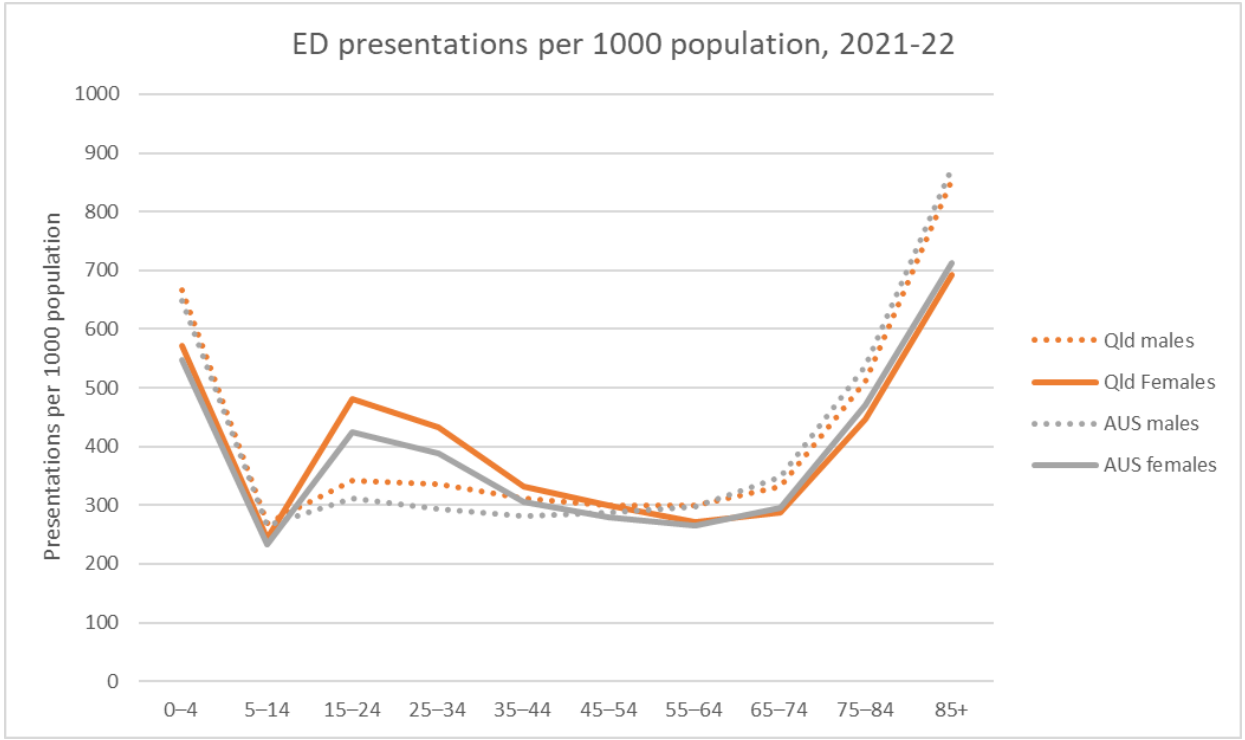
Per capita attendance



Data Source: AIHW - Emergency department care, 2021–22: Australian hospital statistics

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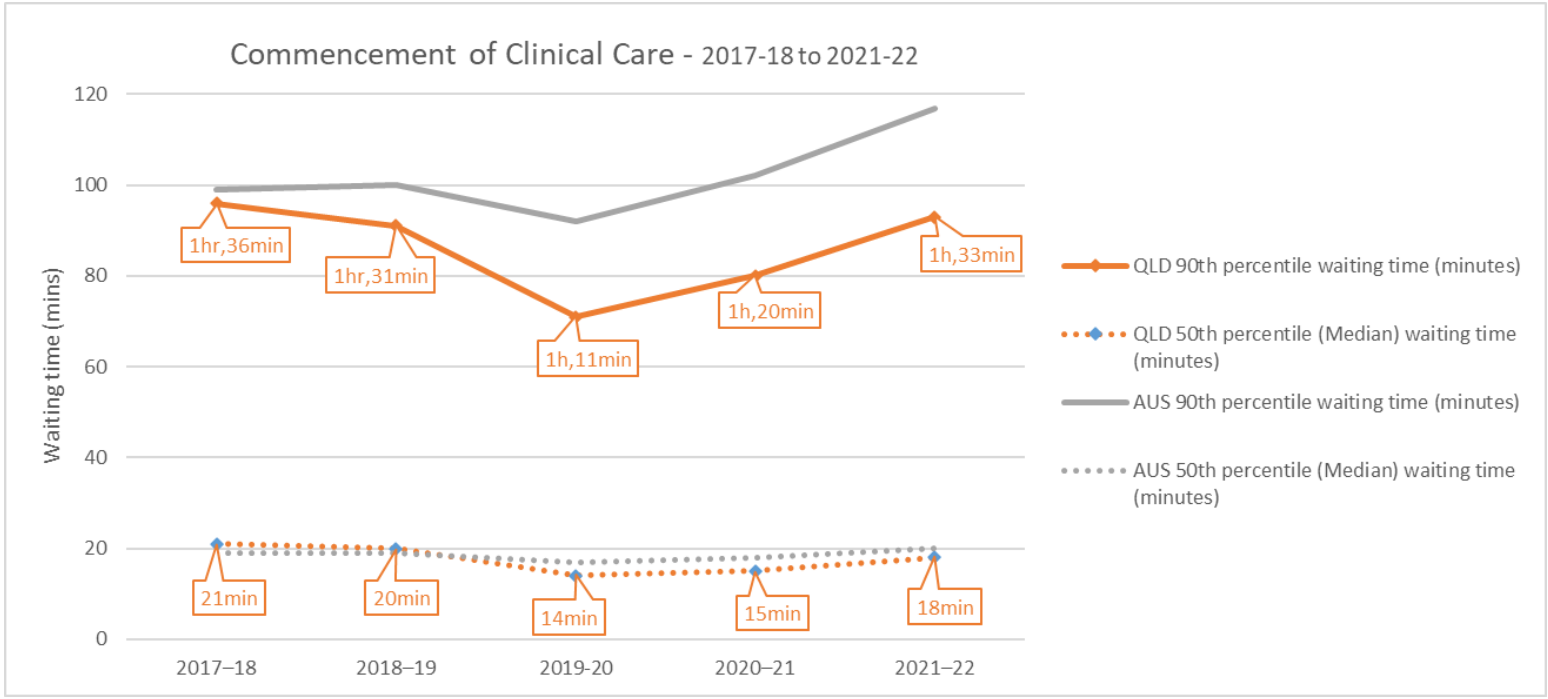
Waiting Time Statistics



Data Source: AIHW - Emergency department care, 2021–22: Australian hospital statistics

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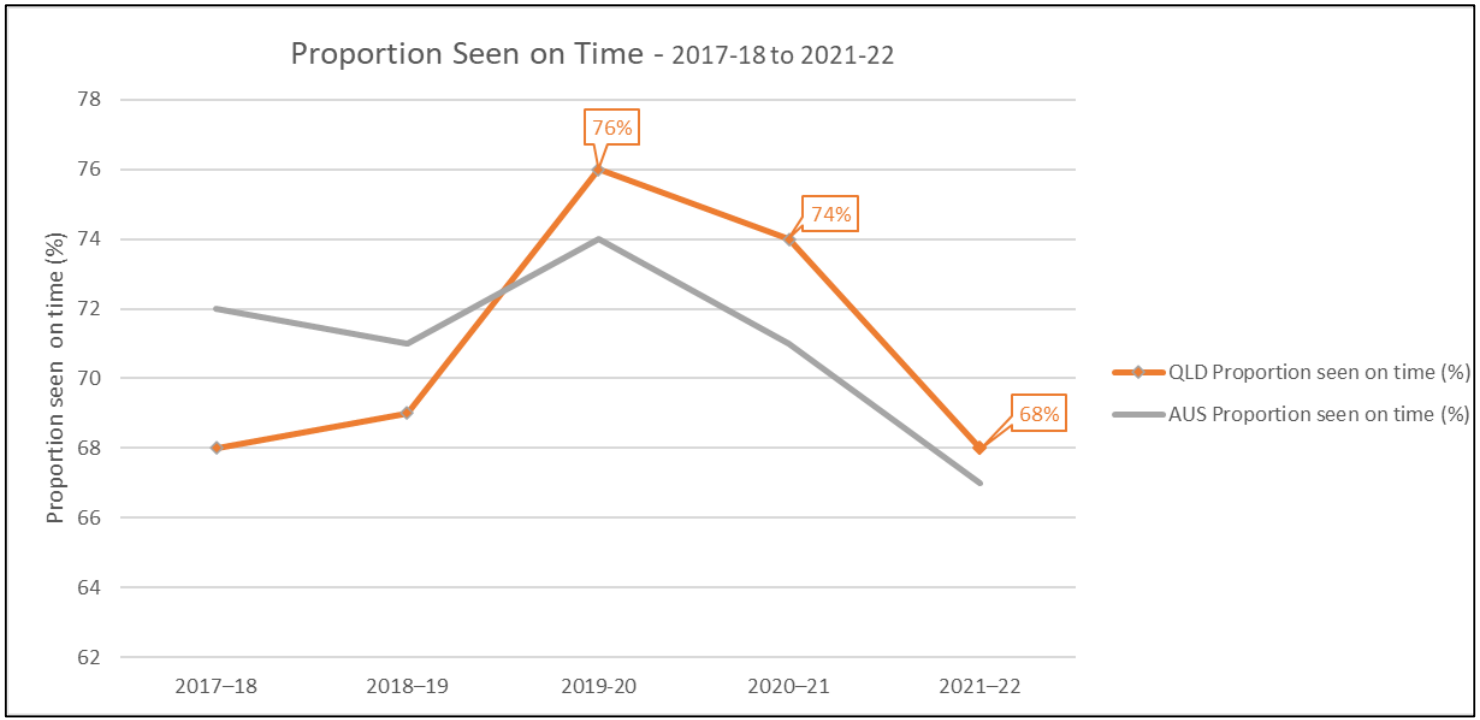
Waiting Time Statistics



Data Source: AIHW - Emergency department care, 2021–22: Australian hospital statistics

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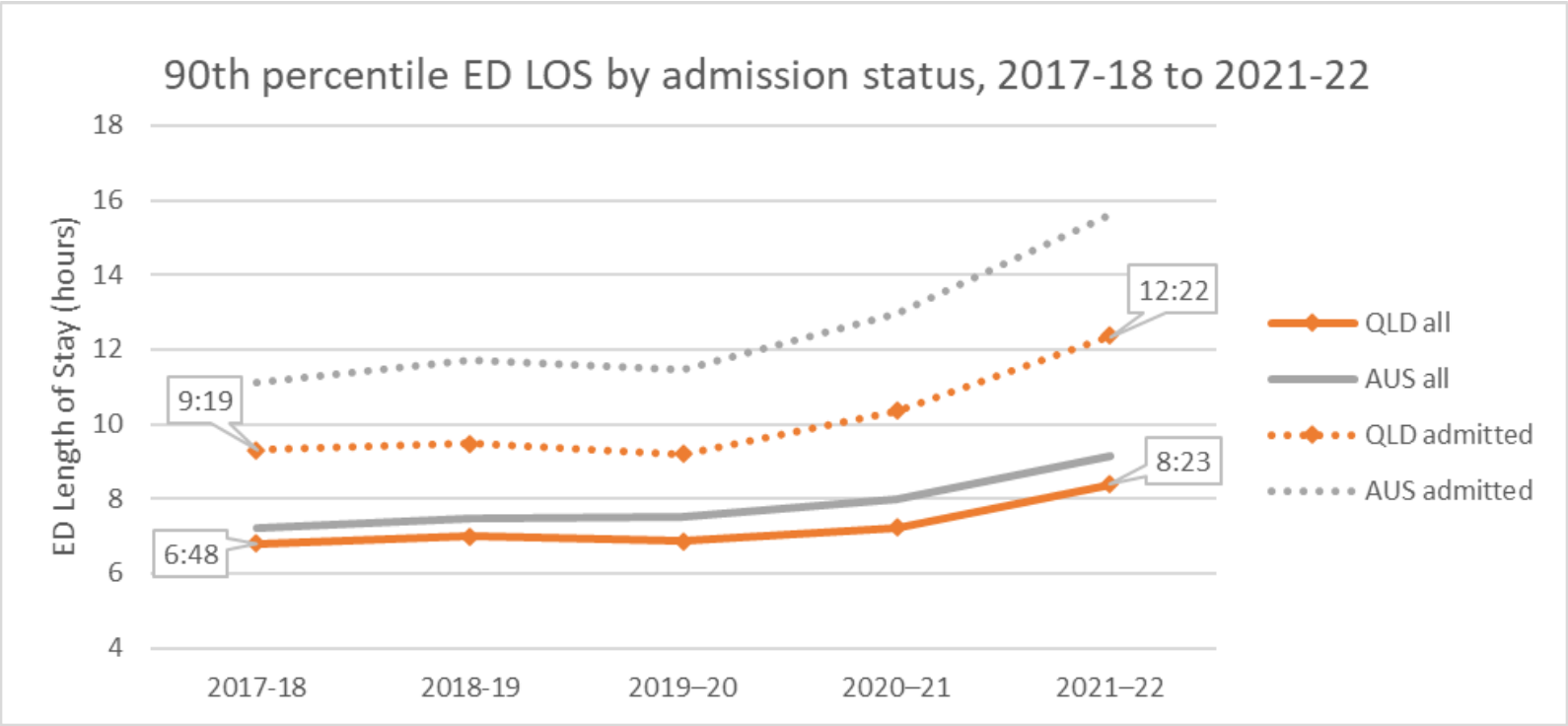
Patient ED LOS



Data Source: AIHW - Emergency department care, 2021–22: Australian hospital statistics

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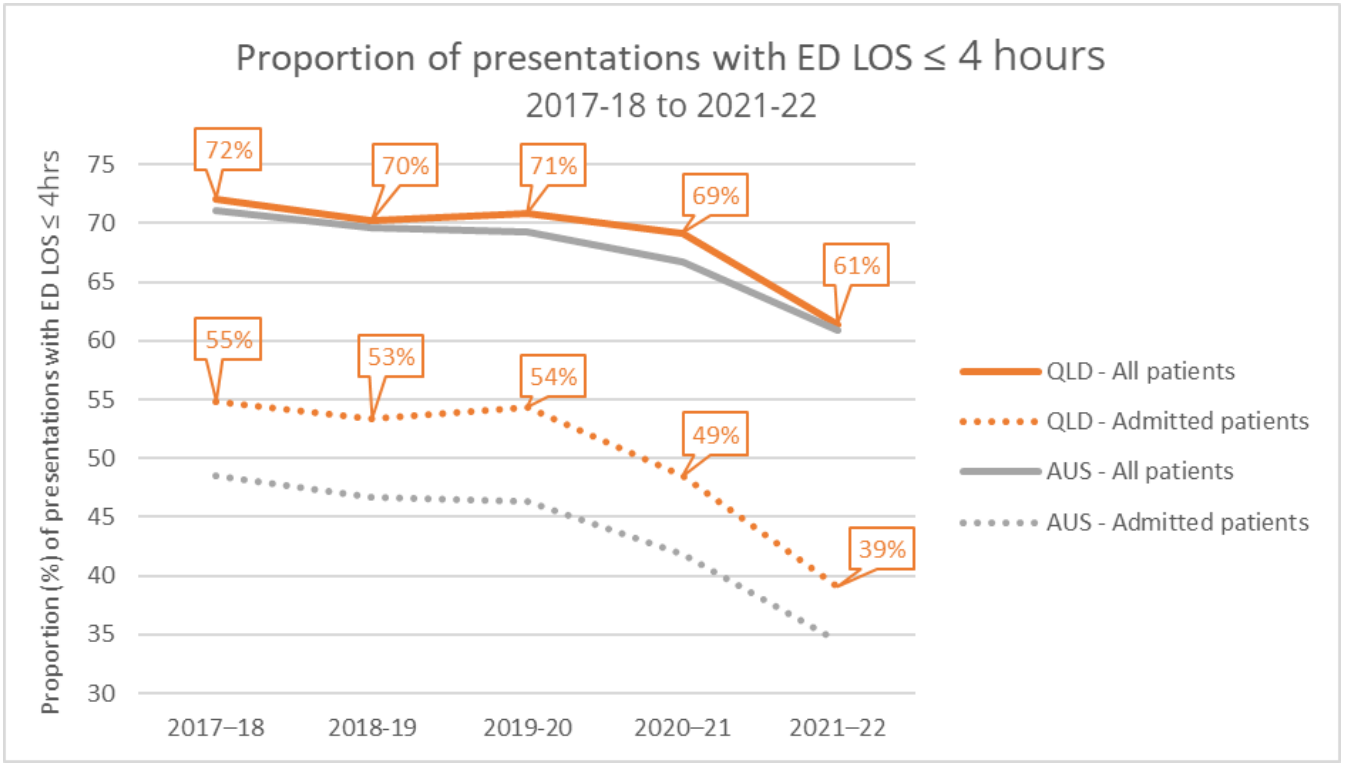
ED visits completed in 4 hours



Data Source: AIHW - Emergency department care, 2021–22: Australian hospital statistics

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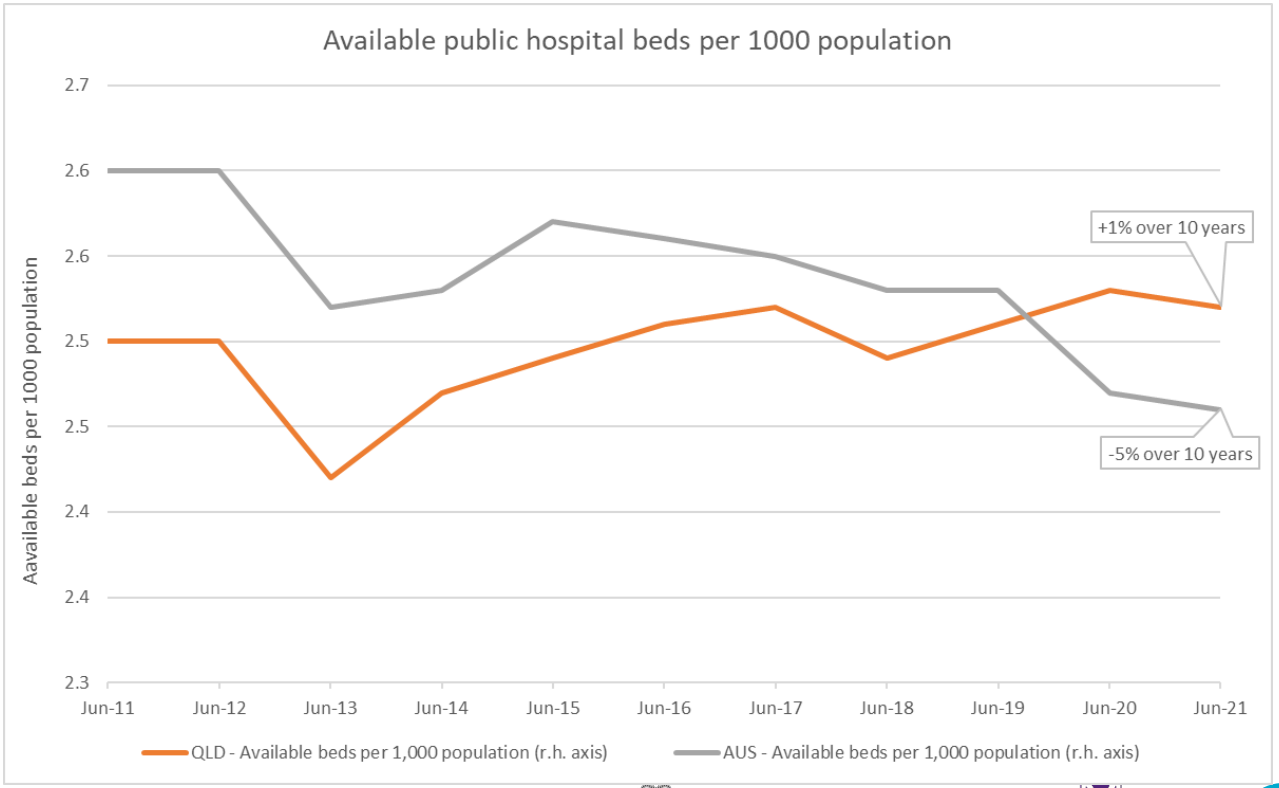
Available hospital beds



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Data Source: AIHW - Hospital resources

Analytical Study

Proposed ED, Ambulance, Inpatient modelling

- Ambulance-ED interface: relationships between the number of ambulances at the door, the number of patients in ED, Patient Off Stretcher Time, and ED length of stay.

- ED flow: patient journey through the ED, and quantifying the impact of reducing treatment and departure delays on flow performance.

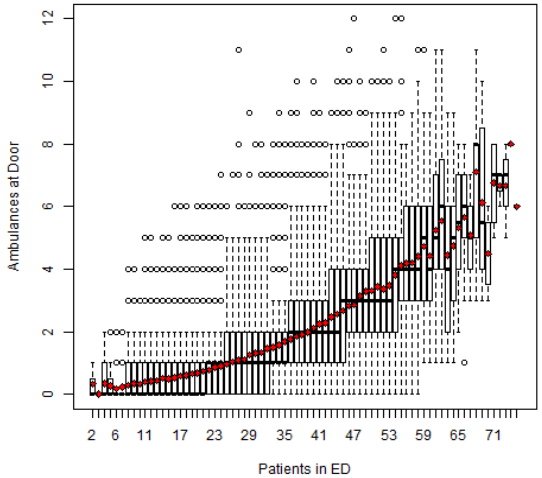
- Inpatient flow, to determine optimal bed occupancy targets to avoid flow bottlenecks, plausible discharge timing targets, and recommended bed stocks by specialty to achieve a given flow performance.

- Analysis Period: Jan 2017 – June 2022

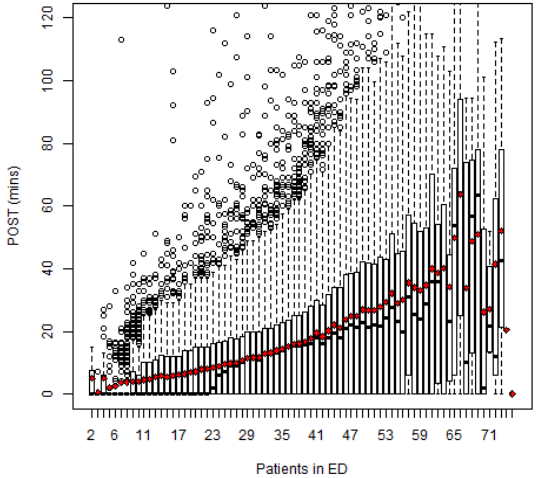
Hospital sites for detailed patient flow analysis

- - 00004 THE PRINCE CHARLES HOSPITAL
- - 00011 PRINCESS ALEXANDRA HOSPITAL
- - 00015 IPSWICH HOSPITAL
- - 00016 REDCLIFFE HOSPITAL
- - 00022 QUEEN ELIZABETH II JUBILEE HOSPITAL
- - 00028 REDLAND HOSPITAL
- - 00029 LOGAN HOSPITAL
- - 00030 CABOOLTURE HOSPITAL
- - 00032 SUNSHINE COAST UNIVERSITY HOSPITAL
- - 00049 NAMBOUR GENERAL HOSPITAL
- - 00062 BUNDABERG BASE HOSPITAL
- - 00068 GYMPIE HOSPITAL
- - 00069 HERVEY BAY HOSPITAL
- - 00071 MARYBOROUGH HOSPITAL
- - 00104 TOOWOOMBA HOSPITAL
- - 00136 GLADSTONE HOSPITAL
- - 00141 ROCKHAMPTON HOSPITAL
- - 00172 MACKAY BASE HOSPITAL
- - 00200 TOWNSVILLE UNIVERSITY HOSPITAL
- - 00201 ROYAL BRISBANE & WOMEN'S HOSPITAL
- - 00202 QUEENSLAND CHILDREN'S HOSPITAL
- - 00214 CAIRNS HOSPITAL
- - 00246 MOUNT ISA HOSPITAL
- - 00934 ROBINA HOSPITAL
- - 00936 GOLD COAST UNIVERSITY HOSPITAL

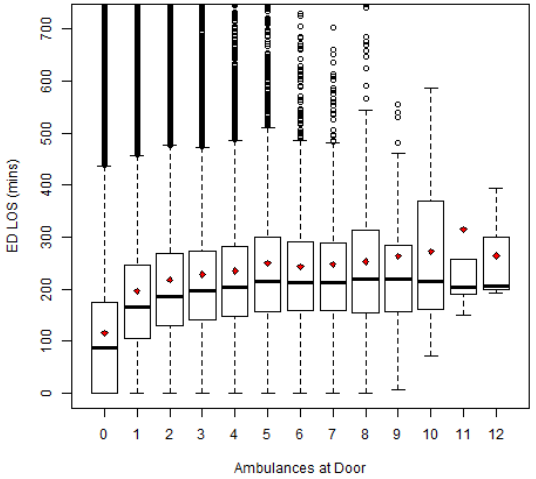
Activity 1: Ambulance-ED interface



(a) Ambulances at Door Vs Patients in ED



(b) Average POST vs Patients in ED



(c) Average ED LOS vs Ambulances at Door

Khanna S, Boyle J, Bosley E, Lind J. Ambulance Arrivals and ED Flow - A Queensland Perspective. Stud Health Technol Inform. 2018;252:80-85

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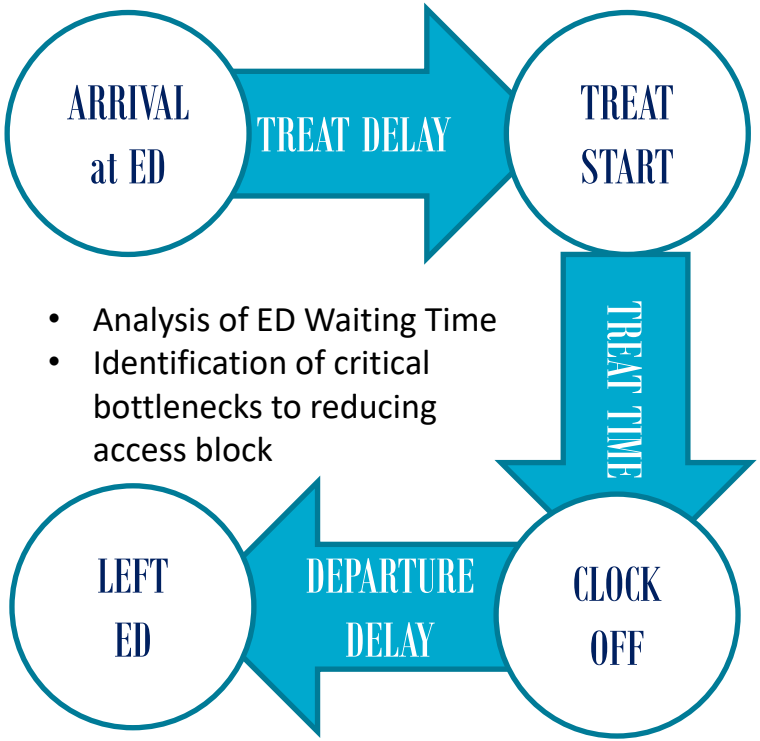
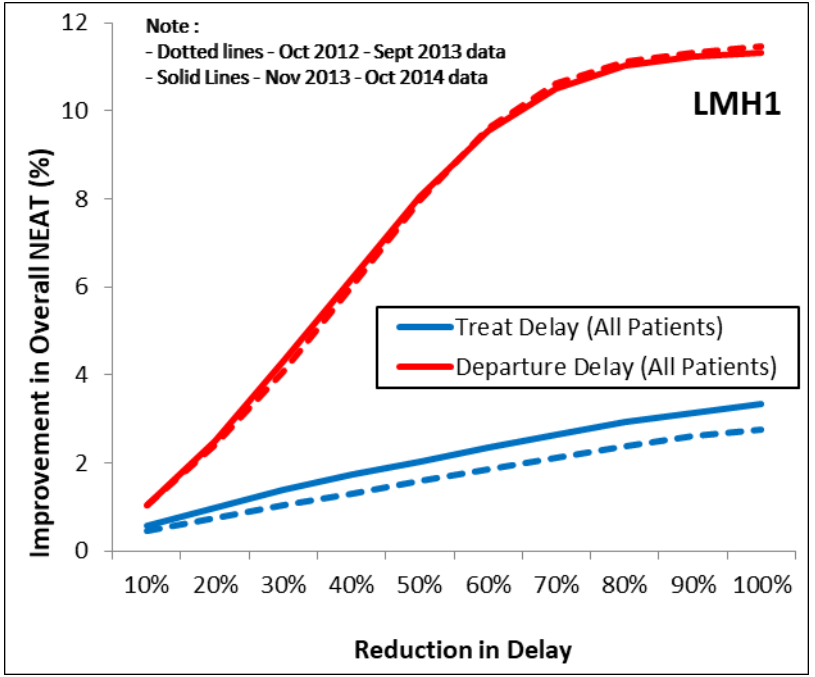
Activity 2: ED flow



- Analysis of ED Waiting Time
- Identification of critical bottlenecks to reducing access block



S Khanna, J Boyle, N Good, A Bell, J. Lind. Analysing the emergency department patient journey: Discovery of bottlenecks to emergency department patient flow, Emerg Med Aust. Nov 2016

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Activity 3: Understanding effects of hospital occupancy

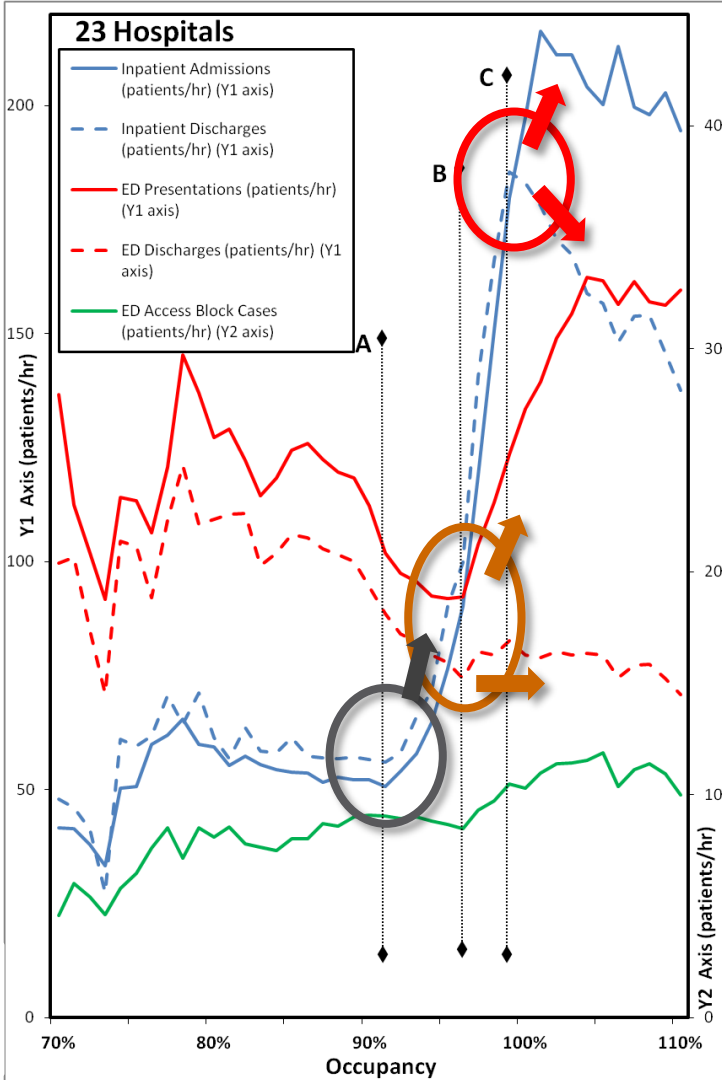
ED, Admission & Discharge vs occupancy

3 key choke points - performance declines:

- A - Admission/discharge surge
- B - ED overwhelmed
- C - Admissions overwhelmed

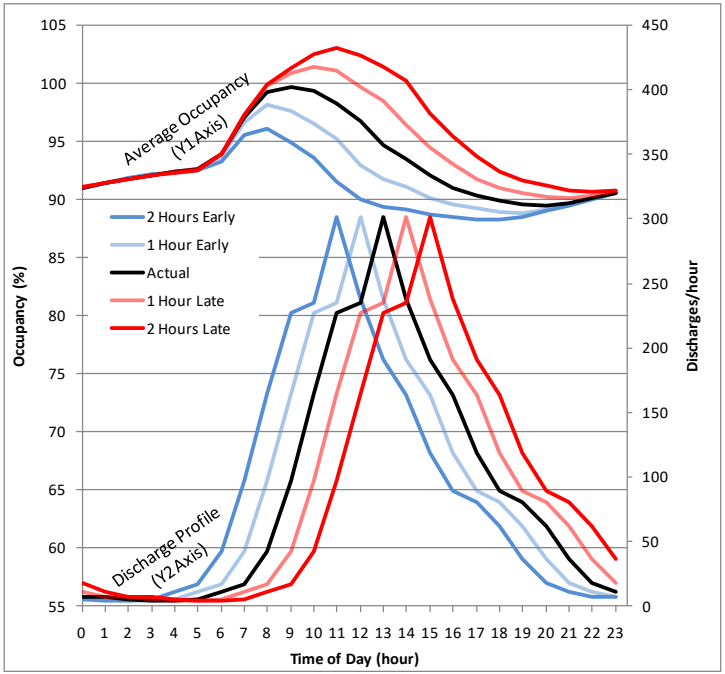
Overcrowding affects :

- ✓ Access Block
- ✓ ED Length of Stay (Inpatients)
- ✓ Inpatient Length of Stay
- ✓ Inpatient Admissions from ED
- ☒ ED Length of Stay (not admitted)



Khanna et al. Unravelling relationships: Hospital occupancy levels, discharge timing and emergency department access block. Emerg Med Australas. 2012 Oct;24(5):510-7

Activity 4: Quantifying the effects of earlier patient discharge



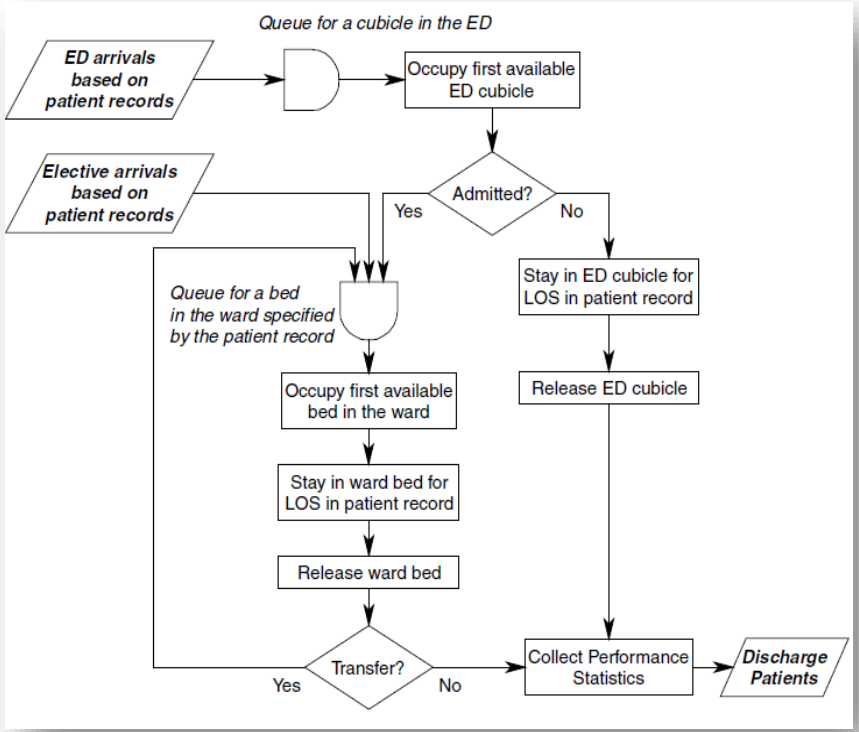
2 Hour Early Discharge (23 Hospitals) :

- Average Occupancy reduced from 94% to 92%.
- Maximum Occupancy reduced from 111% to 106%.
- Time spent above 95% occupancy reduced from 35% to 22%.

Khanna et al. Unravelling relationships: Hospital occupancy levels, discharge timing and emergency department access block. Emerg Med Australas. 2012 Oct;24(5):510-7

Comparing early discharge strategies

Scenario	Description
1	50% of patients to be discharged by 10am, 80% by 12pm and 100% by 2pm.
2	35% of patients to be discharged by 11am, 70% by 2pm and 100% by 5pm.
3	50% of patients to be discharged by 11am, 70% by 2pm and 100% by 5pm.
4	80% of patients to be discharged by 11am.
5	40% of patients to be discharged by 10am, 70% by 2pm, 90% by 5pm and 100% by 10pm.
6	Select the same patients as for Scenario 7 but change only the emergency discharge times, leaving elective patient discharge times unchanged.
7	Select the same patients as for Scenario 3 but change only the emergency discharge times, leaving elective patient discharge times unchanged.



Khanna S, Sier D, Boyle J, Zeitz K. Discharge timeliness and its impact on hospital crowding and emergency department flow performance. Emerg Med Australas. 2016 Feb 4.

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Discharge strategy outcomes

Improvements in Patient Flow performance

% change as compared to baseline						
Scenario	Scenario Description	NEAT Performance	Ave Bed Occupancy	Ave Inpatient LOS	Ave wait for Inpatient Bed - from ED	Ave wait for Inpatient Bed - All
1	**50% by 10am, 80% by 12pm, 100% by 2pm.**	+16.1%	-1.5%	-1.7%	-25.5%	-24.2%
2	35% by 11am, 70% by 2pm, 100% by 5pm.	+5.7%	-0.2%	-0.3%	-6%	-5.7%
3	50% by 11am, 70% by 2pm , 100% by 5pm.	+9.4%	-0.5%	-0.5%	-11.8%	-10.5%
4	**80% by 11am.**	+16.2%	-1.5%	-1.6%	-24.9%	-23.5%
5	40% by 10am, 70% by 2pm, 90% by 5pm, 100% by 10pm.	+7.3%	-0.3%	-0.4%	-8.6%	-7.7%
6	Same as Scenario 5 but ED only	+6.9%	-0.2%	-0.3%	-7.3%	-6.4%
7	Same as Scenario 1 but ED only	+15.7%	-1.2%	-1.3%	-22.7%	-20.5%

- LOS reduced by up to 1.7%
- Average Occupancy reduced by up to 1.5%
- NEAT compliance improved by up to 16%
- Average wait time for an inpatient bed reduced by up to 25%

Khanna S, Sier D, Boyle J, Zeitz K. Discharge timeliness and its impact on hospital crowding and emergency department flow performance. Emerg Med Australas. 2016 Feb 4.

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Activity 5: Inpatient bed configurations

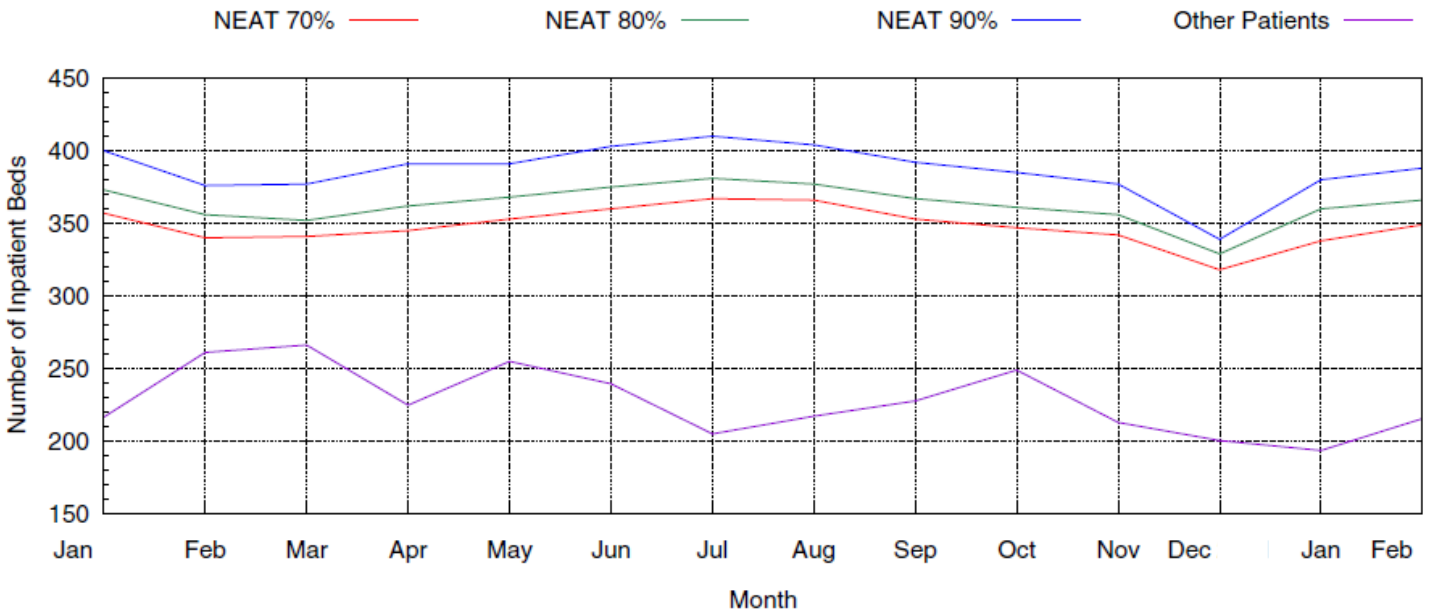
How Many of What Beds?

NEAT Target:
ED LOS<4hrs

Specialities	Cluster	70%	80%	90%
Cardiology, Cardiac Surgery, Resp & Sleep Med, Thoracic Surgery.	1	33	34	36
Paediatric Medicine, Paediatric Surgery.	2	7	7	8
Spinal.	3	9	10	10
ENT/H&N, Ophthalmology, Neurology, Neurosurgery, Stroke, Vascular.	4	35	36	38
Haematology, Oncology, Palliative Care, Radiation Onc.	5	23	24	25
Gynaecology, Orthopaedics, Plastic Surgery, Urology, Breast Surgery.	6	30	31	33
Colorectal, Gastroenterology, Liver Transplant Unit, Hepato Biliary and Transplant, Upper GI-Endo.	7	52	54	58
Psychiatry.	8	9	9	11
Emergency Medicine, Short Stay Obs.	9	19	21	22
Dermatology, Endocrinology, General Medicine, Geriatric Medicine, Clinical Pharmacology, Renal, Rheumatology, Infectious Diseases, Renal Dialysis.	10	87	89	92
Anaesthetics, General Surgery, Nuclear Medicine, Radiology, Rehabilitation	11			
Intensive Care.	ICU	6	6	7
	Total	310	321	340

Activity 5: Inpatient bed configurations

Beds required per month by performance level



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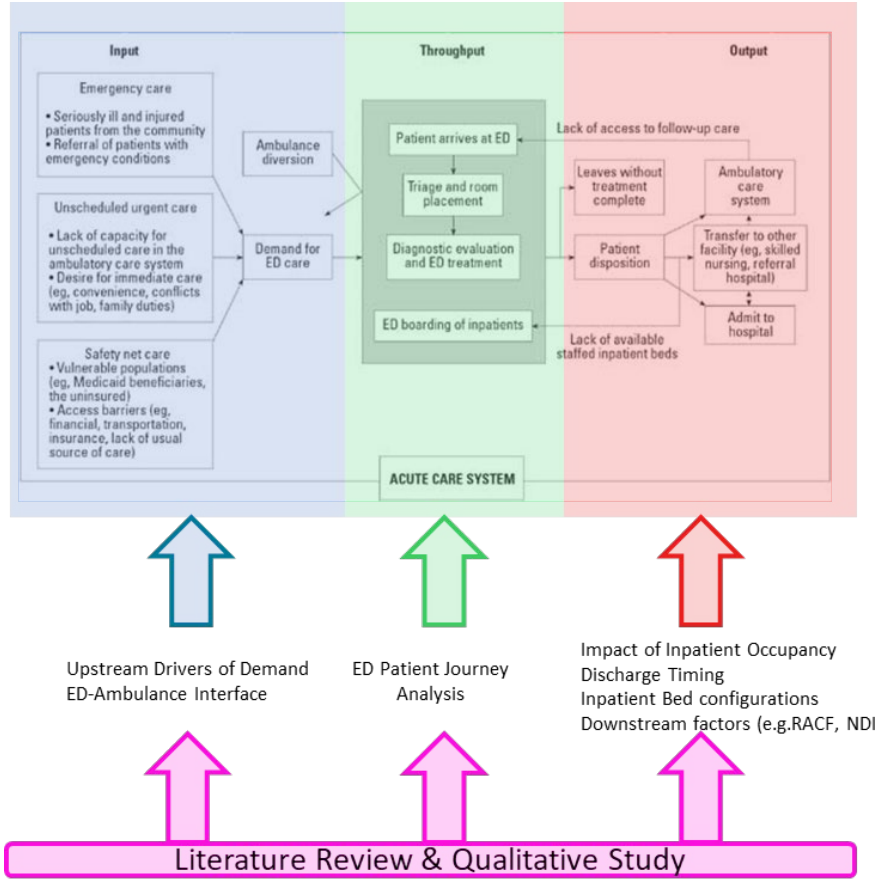
Project timeframe

- Ethics and Regulatory Approvals: Sep – Mar 2023
- Literature Review: Feb 23 – June 2023
- Data Quality Review & Preliminary Exploratory Analysis: Jan - Apr 2023
- Data aggregation, formatting and preparation: May 2023
- Model development and validation: Jun 2023 – Nov 2023
- Contextual insights: Jan 2023 – Nov 2023
- Qualitative Study: Mar 2023 – Nov 2023
- DELIVERABLES
  - INTERIM PROGRESS REPORT – 30 June 2023
  - FINAL REPORT – 15 Dec 2023

Source: Asplin et al. A conceptual model of emergency department crowding. Ann Emerg Med. 2003 Aug;42(2):173-80



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Questions ?
Suggestions ?

Thank you

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