**Impact of National Emergency Access Target policy on
emergency departments' performance: a time-trend
analysis for New South Wales, Australian Capital Territory
and Queensland**

Journal:	<i>Emergency Medicine Australasia</i>
Manuscript ID	EMA-2018-136
Manuscript Type:	Original Research
Date Submitted by the Author:	12-Apr-2018
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Keywords:	National Emergency Access Target, trend analysis, NSW, ACT, QLD
Abstract:	<p>Objectives: To evaluate the impact of the Australian National Emergency Access Target (NEAT) policy introduced in 2012 on ED performance. Design and setting: A longitudinal cohort study of NEAT implementation</p>

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	<p>using linked data, for 12 EDs across NSW, ACT and QLD between 2008 and 2013. Segmented regression in a multi-level model was used to analyse ED performance over time before and after NEAT introduction.</p> <p>Main outcome measures: ED length of stay ≤ 4 hours, access block, number of ED presentations, short-stay admission (≤ 24 hours), >24 hour admissions, unplanned ED re-attendances within 7 days and "left at own risk" (including "did not wait for assessment").</p> <p>Results: Two years after NEAT introduction, ED length of stay ≤ 4 hours increased in NSW and QLD (OR=2.48 and 3.24; $p<0.001$), and access block decreased (OR=0.41 and 0.22; $p<0.001$). ED presentations increased over time before and after NEAT introduction with a significant increase above the projected trend in NSW after NEAT (mean ratio=1.07). Short-stay admissions increased in QLD (OR=2.60), ACT (OR=1.68) and NSW (OR=1.35). Unplanned ED re-attendances did not change significantly. Those who left at their own risk decreased significantly in NSW and QLD (OR=0.38 and 0.67).</p> <p>Conclusion: ED presentations continued to increase over time in all jurisdictions. NSW and QLD, but not in ACT, showed significant improvement in time-based measures. Significant increases in short-stay admissions suggest a strategic change in ED process associated with NEAT implementation. Rates of unplanned ED re-attendances and those leaving at their own risk showed no evidence for adverse effects from NEAT.</p>

Key Findings:

- NEAT was a fundamental policy change to Australia's emergency healthcare system, but the impact of this policy required study.
- This is the largest longitudinal cohort study in eastern Australian jurisdictions involving 12 hospitals over 6 years. NSW and QLD, but not ACT, showed significant reductions in ED length of stay and access block. Rates of unplanned ED re-attendances and patients who left at own risk suggest the policy has not adversely affected on patient outcomes.
- Time-based ED targets appear to improve ED function. Patient flow outcomes improved with NEAT without adversely affecting care quality and access.

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New South Wales, Australian Capital Territory and Queensland**

Abstract

Objective: To evaluate the impact of the Australian National Emergency Access Target (NEAT) policy introduced in 2012 on ED performance.

Methods: A longitudinal cohort study of NEAT implementation using linked data, for 12 EDs across NSW, ACT and QLD between 2008 and 2013. Segmented regression in a multi-level model was used to analyse ED performance over time before and after NEAT introduction. The main outcomes measures were ED length of stay ≤ 4 hours, access block, number of ED presentations, short-stay admission (≤ 24 hours), >24 hour admissions, unplanned ED re-attendances within 7 days and “left at own risk” (including “did not wait for assessment”).

Results: Two years after NEAT introduction, ED length of stay ≤ 4 hours increased in NSW and QLD (OR=2.48 and 3.24; $p<0.001$), and access block decreased (OR=0.41 and 0.22; $p<0.001$). ED presentations increased over time before and after NEAT introduction with a significant increase above the projected trend in NSW after NEAT (mean ratio=1.07). Short-stay admissions increased in QLD (OR=2.60), ACT (OR=1.68) and NSW (OR=1.35). Unplanned ED re-attendances did not change significantly. Those who left at their own risk decreased significantly in NSW and QLD (OR=0.38 and 0.67).

Conclusions: ED presentations continued to increase over time in all jurisdictions. NSW and QLD, but not in ACT, showed significant improvement in time-based measures. Significant increases in short-stay admissions suggest a strategic change in ED process associated with

NEAT implementation. Rates of unplanned ED re-attendances and those leaving at their own risk showed no evidence for adverse effects from NEAT.

Under review process

Introduction

Emergency Department (ED) crowding has been identified as a major issue in health services research (1-3). Access block, leading to prolonged ED length of stay (EDLOS) for admitted patients has been associated with ED overcrowding (4, 5). Adverse effects associated with delays in ED have included: increased mortality and morbidity, delayed pain relief, longer hospital stays, increased aggression and delayed ambulance offloads with poorer response times (6-10).

The National Emergency Access Target (NEAT) policy was implemented in January 2012 by the Australian government to increase ED flow (11-14). The policy stated that 90% of patients presenting to EDs were to be admitted, transferred, or discharged within 4 hours. Countries implementing similar time target policies, such as UK and Australia (four hours) and New Zealand (six hours) have found major reductions in EDLOS (15-17). In the UK, at its zenith, 98% of all patients left EDs within 4 hours (15). New Zealand also improved with most district health boards reaching their 95% six-hour target (16). In Australia, the NEAT compliance improved from 64% in 2011-12 to 73% in 2013-14 (18). In Western Australia where an adapted version of the UK four hour target was implemented in 2009, an interrupted time series analysis showed that EDLOS was reduced significantly with the time target policy. In summary, there is limited information on trends or changes associated with NEAT policy (4). The aim of this study is to assess changes in time-based measures as proxies for ED crowding and access block before and after NEAT in NSW, ACT and QLD.

Methods

Study Design, Participants and Data Source

Time-trend analysis was conducted on a population-wide NEAT intervention in a longitudinal cohort study of patients presenting to 12 participating metropolitan hospital EDs across NSW, ACT and QLD. Data linkage methodology (19, 20) was implemented on de-identified administrative data comprising the Emergency Department Data Collection (EDDC) and Admitted Patients Data Collection (APDC) between January 2008 and December 2013.

The NSW and ACT cohorts comprised 1,279,390 persons presenting to six hospital EDs in NSW and two in ACT. Data were linked across NSW and ACT, using unique person identifiers provided by the Centre for Health Record Linkage. The QLD cohort comprised 661,859 persons presenting to the four participating hospital EDs. The Queensland Research Linkage Group provided the linked data. After removal of ineligible ED episodes (0.05%), a total of 1,940,327 (NSW), 668,247 (ACT) and 1,436,464 (QLD) ED episodes of care were retained for analysis.

APDCs were used for identification of patients who were admitted to hospital during and/or right after an ED episode by matching cohort episodes from EDDC with hospital episodes in APDC. A detailed description of this method is presented in Appendix 1.

Outcome measures and definitions

Eight outcome measures were investigated in this study:

- 1) Percentage with EDLOS ≤ 4 hours (%EDLOS ≤ 4 hours): EDLOS is the length of time between ED presentation and actual ED departure as recorded in the EDDC;

- 2) Rate of access block: Access block was defined as EDLOS >8 hrs among patients who were admitted for >24 hours;
- 3) Mean number of ED presentations per hospital per day;
- 4) Rate of short-stay admission: Short-stay admission was defined as an event where discharge from hospital was ≤ 24 hours after departure from ED. The 24-hour threshold is based on the designated use of short-stay units (SSU) for ED patients who are expected to be admitted for <24 hours (21, 22). The majority of these short-stay admissions would be SSU admissions where the patient is still effectively managed and treated by ED staff (21, 22);
- 5) Rate of >24 hour admissions: ED presentations where the patient was admitted for >24 hours from the time of actual departure from ED. The majority of >24 hours admissions would be to an inpatient ward, but a proportion of SSU admissions may also exceed 24 hours;
- 6) Rate of all admissions;
- 7) Rate of unplanned ED re-attendance within 7 days of discharge from ED or short-stay admission: Unplanned ED re-attendance was identified where time of presentation at the next ED attendance was within 7 days of discharge from ED or short-stay admission. Attendances that were discharged as a hospital transfer or as a hospital admission lasting >24 hours (i.e. not short-stay admissions), and/or where the next ED attendance was a planned visit were excluded; and
- 8) Rate of left ED at own risk (LAOR) including those did-not-wait to be seen by a ED clinician as well as those who left before ED treatment completion: While did not wait to be seen is the term used in the data dictionaries, it should be more appropriately defined as did not wait to be assessed by an ED clinician (23). This is because a short procedure such as a change of bandage is sometimes classified as

being seen by an ED clinician. To reduce potential bias associated with this misclassification, we chose to combine the categories of “left ED at own risk” and “did-not-wait to be seen” for this outcome.

Data analysis

A two level multi-level model (by hospital and presentation) was used in conjunction with segmented regression analysis. This is a recommended statistical technique for time-trend analysis of population-wide interventions (24). Numbers of ED presentations (discrete count data) were analysed using Poisson regression and the other outcomes (binary data) were analysed using logistic regression. Two periods were defined: “pre-NEAT” from 1 January 2008 to 31 December 2011 and “post-NEAT” from 1 January 2012 to 31 December 2013. The impact of NEAT on the outcome measures was assessed statistically with period (pre/post) and calendar quarters as the explanatory variables in the segmented regression model (see Appendix 1). $P < 0.05$ was used as the threshold for reporting statistical significance. The estimated coefficients are also illustrated in Appendix 1, Figure 1. To account for random variation between hospitals, intercept, slope, change in slope and change in level were entered as random effects in the multi-level model. Projected trends for post-NEAT data were calculated but the analysis period did not allow full testing of non-linear trends as we only had two years of post-NEAT data. The analyses were conducted and managed using SAS software version 9.4 for Windows (Cary, NC), Stata version 14.2 (College Station, TX) and MLwiN 2.36 (Bristol, UK).

Ethics clearance

The study received ethics clearance from Cancer Institute NSW (HREC/14/CIPHS/30), ACT Department of Health (ETH.3.14.054) and Queensland Health (HREC/14/QGC/30), as well as governance approval from the participating hospitals.

Results

Sample characteristics

The socio-demographic and clinical characteristics of the study sample are presented in Table 1. Differences between pre- and post-NEAT intervention were statistically significant for all characteristics ($p < 0.05$), except for the school holiday period in ACT. NSW had more attendances by patients residing in the most socio-economically disadvantaged area, whereas the majority of attendances to ACT EDs were from the least disadvantaged areas.

[Insert Table 1]

About a third of presentations in NSW and QLD and a fifth in ACT arrived by ambulance. NSW and QLD also had proportionally more cases in Australian Triage Categories (ATS) 1 and 2 than ACT. Over 70% of cases in all jurisdictions were in ATS 3 and 4. All jurisdictions showed an increase in the proportion of ATS 1-3 cases post-NEAT when compared with pre-NEAT.

Trend analysis for time-based outcomes

NSW and QLD showed significant reductions in ED time (% EDLOS ≤ 4 hours) during post-NEAT compared to pre-NEAT (Table 2 and Figure 1). Estimated % EDLOS ≤ 4 hours at the last quarter post-NEAT was 22.3% more than the projected estimate with no NEAT for NSW

and 27.4% more than projected for QLD, but it was only 3.8% more than projected for ACT (last column, Appendix 2). NSW and QLD also demonstrated an improvement in % EDLOS ≤ 4 hours per quarter before NEAT. Trends in % EDLOS ≤ 4 hours were relatively stable throughout the study period.

[Insert Table 2]

[Insert Figure 1]

For access block, compared with the pre-NEAT period, NSW and QLD showed both significant reductions in rate change per quarter as well as a reduction in level at the end of the study (post-NEAT) period by up to 29.8% for QLD) (Table 2 and Figure 1).

Trend analysis for other outcomes

All jurisdictions had significant increases in the number of ED presentations pre-NEAT. This continued without significant change in the post-NEAT period compared with the projected no-intervention level, except in NSW which showed a significant increase in presentations at the end of the period. For QLD, there was a significantly greater increase in presentation trend post-NEAT, and a moderate increase in level at the end (versus projected) but it was not statistically significant. ACT did not show significant changes post-NEAT intervention (Table 2 and Figure 2).

[Insert Figure 2]

Short-stay admissions in NSW and QLD showed significant increasing trends per quarter post-NEAT versus the pre-NEAT period. All jurisdictions showed significant increases in

short-stay admission rates at the end of the study compared with the projected level without intervention, being 4.2%, 2.8% and 10.4% higher than expected for NSW, ACT and QLD respectively (Appendix 2). The proportion of >24 hour admissions significantly decreased in NSW and ACT versus the pre-NEAT period, but not in QLD. All admissions had an increasing trend post-NEAT in QLD mainly from the substantial increase in short-stay admissions. No other jurisdiction showed significant changes in total admissions.

Unplanned ED re-attendances had no significant changes from trend in the post-NEAT period (Boxes 2 and 4). Those who left at own risk (LAOR) showed a significant decreasing trend post-NEAT for all jurisdictions which was greatest for NSW which changed from an increasing pre-NEAT trend. Reduced LAOR percentage versus expected levels without intervention were seen for NSW (-6.2%) and Qld (-1.3%).

Discussion

Our study covered 12 major hospitals in three Australian jurisdictions after NEAT implementation. We found that more patients were discharged from ED within 4 hours, and access block decreased in NSW and QLD, but not ACT. This improvement in time targets occurred despite continual increases in presentations and acuity. Rates of short-stay admission increased above previous trends although overall admission rates only increased in QLD. ED re-attendance rates remained unchanged whilst LAOR rates decreased in all three jurisdictions. Our general findings are consistent with our study in WA and the study conducted in New Zealand (4, 16).

This study confirmed that time targets can drive process change that addresses ED overcrowding and access block. The changes in access block were large in NSW and QLD,

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3 suggesting significant improvements in access to inpatient beds. Such changes are likely to
4 improve ED flow and patients' access to care dramatically. This reflects the value of
5 investing in ED and hospital resources. However, we cannot make inferences about quality of
6 care at the patient level. A time target is a process indicator and does not take into
7 consideration other aspects of system or clinical performance.
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15 Our data also suggests that concerns about unintended consequences such as increased ED
16 flow or efficiency driving large increases in ED attendances or rapid discharges leading to
17 increased ED re-attendances were not realised. Additionally, LAOR rates reduced in all
18 jurisdictions suggesting improved access to early care, although time to see a doctor did not
19 improve significantly.
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28 There were some changes in admission rates with significantly more short stay admissions in
29 all jurisdictions which in ACT and NSW were offset by reduced >24 hour admissions so
30 overall admissions did not increase. It seems clear that the NEAT process was associated
31 with greater use of SSUs, at least some of which look like they substituted for longer hospital
32 stays. Whether the greater use of short stay admissions is better for patients and hospital bed
33 management will require more detailed analysis in the future.
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43 *Strength and limitations*

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45 This is a large data linkage study, with population-wide information and long-time series,
46 coupled with rigorous trends analysis that enabled a more accurate depiction of the impact of
47 the NEAT intervention, compared to similar studies (25). As most of the sites were major
48 referral hospitals affected by access block, the intervention was expected to have the most
49 impact on those hospitals (5). Another strength is the wide coverage of the three jurisdictions
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with rather different features in terms of socio-economic status, geography, population size and diversity.

With administrative data collections, it is likely that individual hospitals' quality of data recording may vary. For example, identification of unplanned re-attendance is affected by accuracy in the recording of ED separation status (viz. transfer to another hospital) and purpose or type of visit (viz. planned return visit). Not all admissions could be identified from matching and not all SSU admissions could be accurately determined due to inconsistencies in ward allocations across hospitals and/or over time. Hence, we used admissions lasting ≤ 24 hours as a proxy for SSU admissions, but some of these may have been type change separations and inpatient admissions. Regardless, the relatively stable rates of admission lasting >24 hours indicated that the misclassifications would only have minimal impact on trend (i.e. changes) in short-stay admissions. Also, the observed proportion of EDLOS ≤ 4 hours was very similar to publicly available online data except for two hospitals amongst the three jurisdictions, confirming that our findings were consistent with publicly available information.

As indicated in the methods, we only had limited number of years available. We have only studied the relatively short-term impact of NEAT and continued changes may have had happened in the ED-hospital system at that time. For example, one hospital upgraded to a larger Emergency Medical Unit (that facilitated the streaming of patients to improve efficiency) in the last quarter of 2013 just when our study ended (26). As such, we are unable to conclude whether the intervention had a lasting longer-term impact.

Conclusions

Attendances to EDs increased continually and at similar rates before and after NEAT implementation. However, ED flow markers showed decreasing trends for both %EDLOS ≤ 4 hours and access block in NSW and QLD. Rates of short-stay admissions increased post-NEAT although overall admission rates did not. Stable rates of unplanned ED re-attendance and improved LAOR rates suggest that some patient outcome measures were not adversely affected or improved in association with NEAT implementation.

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		Pre-NEAT (2008-2011)			Post-NEAT (2012-2013)		
		NSW (n=1,236,159) % of total (95% CI)	ACT (n=426,959) % of total (95% CI)	QLD (n=917,509) % of total (95% CI)	NSW (n=704,168) % of total (95% CI)	ACT (n=241,288) % of total (95% CI)	QLD (n=518,955) % of total (95% CI)
Demographic							
Age^a							
	<18	19.4 (19.38,19.52)	24.2 (24.08,24.33)	15.5 (15.41,15.55)	19.2 (19.11,19.30)	23.6 (23.44,23.78)	17.8 (17.74,17.95)
	18-65	59.6 (59.52,59.69)	60.5 (60.38,60.67)	66.5 (66.37,66.56)	59.3 (59.17,59.40)	59.8 (59.61,60.00)	63.7 (63.56,63.83)
	>65	20.9 (20.88,21.02)	15.3 (15.16,15.38)	18.1 (17.98,18.13)	21.5 (21.41,21.61)	16.6 (16.44,16.73)	18.5 (18.36,18.57)
Gender (Male)		51.2 (51.07,51.25)	50.4 (50.22,50.52)	50.9 (50.84,51.05)	50.7 (50.61,50.85)	49.4 (49.16,49.56)	49.9 (49.81,50.08)
Area index of relative socioeconomic disadvantage							
	1 st quintile (most disadvantaged)	25.1 (24.97,25.13)	0.8 (0.79,0.85)	6.3 (6.23,6.33)	26.2 (26.11,26.32)	0.7 (0.67,0.74)	6.0 (5.95,6.08)
	2 nd quintile	14.3 (14.21,14.34)	2.6 (2.57,2.66)	15.4 (15.29,15.44)	12.8 (12.70,12.85)	2.5 (2.39,2.52)	14.9 (14.85,15.04)
	3 rd quintile	20.9 (20.78,20.93)	1.5 (1.42,1.49)	14.7 (14.65,14.79)	20.3 (20.20,20.38)	1.3 (1.27,1.36)	14.1 (14.04,14.23)
	4 th quintile	13.1 (13.09,13.21)	11.8 (11.75,11.95)	39.5 (39.44,39.64)	13.6 (13.49,13.65)	5.8 (5.71,5.89)	40.6 (40.42,40.69)
	5 th quintile (least disadvantaged)	25.9 (25.81,25.97)	83.0 (82.86,83.09)	20.8 (20.71,20.88)	26.3 (26.25,26.45)	89.5 (89.34,89.58)	21.3 (21.22,21.45)
	Missing	0.8 (0.77,0.80)	0.3 (0.27,0.30)	3.3 (3.27,3.35)	0.8 (0.78,0.82)	0.3 (0.25,0.29)	3.0 (2.97,3.06)
Clinical							
Arrival by Ambulance (Yes)		31.9 (31.78,31.95)	19.3 (19.22,19.45)	33.5 (33.39,33.58)	31.5 (31.39,31.60)	20.3 (20.16,20.48)	35.5 (35.32,35.58)
Triage category							
	1	1.0 (0.99,1.03)	0.5 (0.44,0.48)	1.2 (1.21,1.25)	1.1 (1.10,1.15)	0.4 (0.38,0.44)	0.8 (0.83,0.88)
	2	12.4 (12.32,12.44)	9.5 (9.42,9.59)	13.9 (13.84,13.98)	14.8 (14.73,14.90)	10.8 (10.65,10.89)	13.9 (13.85,14.03)
	3	36.1 (36.05,36.22)	31.2 (31.04,31.32)	46.6 (46.47,46.67)	36.6 (36.50,36.73)	34.2 (34.00,34.38)	48.0 (47.90,48.18)
	4	39.1 (39.06,39.23)	45.1 (44.98,45.27)	31.7 (31.62,31.82)	37.0 (36.92,37.14)	44.2 (44.04,44.43)	31.8 (31.63,31.89)
	5	11.3 (11.22,11.33)	13.7 (13.62,13.83)	6.6 (6.51,6.62)	10.3 (10.26,10.40)	10.4 (10.28,10.52)	5.4 (5.35,5.47)
Environmental							
ED shift (on arrival time)							
	Day (08:00-15:59)	44.5 (44.41,44.58)	46.4 (46.30,46.60)	46.7 (46.64,46.85)	44.7 (44.56,44.79)	46.0 (45.82,46.22)	45.7 (45.58,45.85)
	Evening (16:00-23:59)	39.7 (39.60,39.77)	39.2 (39.07,39.36)	37.0 (36.89,37.08)	40.0 (39.87,40.10)	39.7 (39.49,39.88)	38.2 (38.11,38.37)
	Overnight (00:00-07:59)	15.8 (15.75,15.88)	14.3 (14.23,14.44)	16.3 (16.19,16.34)	15.3 (15.26,15.42)	14.3 (14.15,14.43)	16.0 (15.95,16.15)
Weekend (Yes)^b		35.8 (35.70,35.87)	34.7 (34.59,34.88)	35.2 (35.12,35.32)	35.5 (35.39,35.61)	34.4 (34.19,34.56)	35.7 (35.59,35.85)
School holiday (Yes)^c		10.9 (10.86,10.97)	10.2 (10.12,10.30)	10.9 (10.86,10.99)	10.8 (10.69,10.84)	10.3 (10.14,10.39)	10.6 (10.49,10.66)

^a <0.1% were missing or indeterminate for age, gender and triage categories.

^b Weekend starts from 18:00 Friday and ends at 07:59 Monday.

^c School holiday period starts from 24th December and ends 31st January.

Odds ratio Mean ratio and 95% confidence intervals ^a				
Jurisdiction	Post-NEAT			
	Pre-NEAT slope ^b	Change in level at the beginning	Change in slope ^b	Change in level at the end
Odds ratio: % ED length of stay ≤4 hours				
NSW	0.92 (0.85, 0.99)*	1.09 (0.90, 1.33)	1.60 (1.46, 1.75)***	2.48 (1.88, 3.28)***
ACT	0.98 (0.87, 1.12)	0.92 (0.66, 1.29)	1.14 (0.98, 1.34)	1.16 (0.72, 1.88)
QLD	0.91 (0.83, 0.99)*	1.15 (0.90, 1.46)	1.81 (1.62, 2.02)***	3.24 (2.31, 4.56)***
Odds ratio: % access block (among patients admitted >24 hours as defined in this study)				
NSW	1.12 (1.00, 1.25)	0.87 (0.72, 1.04)	0.65 (0.57, 0.74)***	0.41 (0.32, 0.53)***
ACT	0.85 (0.70, 1.03)	1.02 (0.74, 1.40)	1.14 (0.91, 1.42)	1.28 (0.81, 2.01)
QLD	1.15 (1.00, 1.31)*	1.04 (0.83, 1.30)	0.41 (0.35, 0.48)***	0.22 (0.16, 0.30)***
Mean ratio ^c : Number of presentations per day per hospital				
NSW	1.03 (1.01,1.05)**	1.02 (1.00, 1.03)	1.03 (0.99,1.07)	1.07 (1.00, 1.13)*
ACT	1.05 (1.02, 1.09)**	0.99 (0.97, 1.02)	0.97 (0.92, 1.04)	0.95 (0.86, 1.06)
QLD	1.04 (1.01, 1.06)**	0.96 (0.94, 0.98)***	1.06 (1.01, 1.10)*	1.06 (0.98, 1.14)
Odds ratio: % short-stay admission (≤24 hours)				
NSW	1.04 (0.99, 1.11)	1.05 (0.88, 1.26)	1.15 (1.05, 1.26)**	1.35 (1.08, 1.69)**
ACT	1.11 (1.00, 1.22)*	1.29 (0.95, 1.75)	1.17 (0.99, 1.37)	1.68 (1.14, 2.48)**
QLD	1.05 (0.98, 1.13)	1.54 (1.24, 1.91)***	1.35 (1.20, 1.51)***	2.60 (1.98, 3.42)***
Odds ratio: % >24 hours admission				
NSW	1.01 (0.98, 1.04)	1.00 (0.97, 1.04)	0.95 (0.90, 1.00)*	0.91 (0.82, 1.02)
ACT	1.04 (0.99, 1.09)	1.02 (0.95, 1.08)	0.91 (0.83, 1.00)*	0.87 (0.72, 1.04)
QLD	1.00 (0.97, 1.04)	0.98 (0.93, 1.02)	0.95 (0.89, 1.01)	0.89 (0.78, 1.02)
Odds ratio: % all admission				
NSW	1.02 (0.99, 1.06)	1.02 (0.93, 1.12)	1.03 (0.96, 1.10)	1.07 (0.91, 1.25)
ACT	1.06 (1.00, 1.12)	1.08 (0.92, 1.26)	0.99 (0.88, 1.12)	1.06 (0.81, 1.40)
QLD	1.02 (0.98, 1.06)	1.16 (1.04, 1.30)**	1.16 (1.07, 1.27)**	1.51 (1.24, 1.84)***
Odds ratio: % unplanned ED re-attendance within 7 days ^d				
NSW	0.99 (0.96, 1.02)	1.01 (0.97, 1.05)	1.02 (0.97, 1.07)	1.05 (0.94, 1.17)
ACT	1.00 (0.95, 1.05)	1.05 (0.98, 1.13)	0.97 (0.89, 1.06)	1.00 (0.83, 1.20)
QLD	0.96 (0.93, 1.00)*	1.04 (0.98, 1.09)	1.03 (0.97, 1.10)	1.10 (0.96, 1.25)
Odds ratio: % did not wait or left at own risk				
NSW	1.13 (1.06, 1.20)***	0.80 (0.66, 0.95)*	0.65 (0.61, 0.70)***	0.38 (0.30, 0.48)***
ACT	0.97 (0.87, 1.08)	1.12 (0.82, 1.53)	0.80 (0.71, 0.90)***	0.76 (0.51, 1.13)
QLD	0.99 (0.92, 1.08)	1.02 (0.82, 1.27)	0.79 (0.72, 0.86)***	0.67 (0.51, 0.89)**

^a * denotes P<0.05, ** denotes p<0.01 and *** denotes p<0.001.

^b Slope and change in slope are interpreted on a per year basis.

^c Number of presentations is a count variable modelled in a multi-level Poisson model with mean ratio as the estimates, while all other outcome variables are binary variables modelled in a multi-level logistic model with odds ratio as the estimates.

^d Those who were admitted to hospital for >24 hours, who were transferred to another hospital, and/or whose subsequent visit was a planned visit were excluded from the denominator.

APPENDIX 1: METHODOLOGY

Method: Matching of ED episodes with hospital admission episodes

The following steps were carried out to identify the hospital admissions associated with an ED episode:

- Step 1. Admissions entirely within an ED episode were identified where both hospital admission time and hospital separation time were within ED attendance time minus 60 minutes and ED discharge time plus 60 minutes, and the ED episode and the hospital episode were both from the same facility. The 60 minutes buffer was used because of imprecision in date-time recording in EDDC. Matched APDC records were removed before carrying out the following steps.
- Step 2. Hospital admissions occurring at the end of an ED episode were identified where hospital admission time was within ED discharge time minus 60 minutes and ED discharge time plus 120 minutes. An extra 60 minutes buffer was added after ED discharge time, taking into account logistic reasons, such as time taken for finalizing hospital paperwork and/or transfer to another hospital for admission. Matched APDC were removed before carrying out the following step.
- Step 3. Remaining admissions where hospital admission time was within ED attendance time minus 60 minutes and ED discharge time plus 60 minutes. An admission within an ED episode within the same facility would have been removed at step 1, so these are predominantly admissions with hospital separation occurring after the ED episode.

Step 3 was necessary because the majority of APDC admission date-time recording in NSW were back-stamped to when the patient attended ED.

Only those admissions identified at steps 2 and 3 above (with or without an associated admission identified at step 1) are considered as an admission in this study.

Statistical method

The segmented regression model for trend analysis was fitted as a two-interaction of jurisdiction (i.e. NSW, ACT or QLD) with the following terms:

- 1) a period of analysis dummy variable (“pre-NEAT” versus “post-NEAT”);
- 2) a quarter variable that is incremental in steps of 0.25 across both periods of analysis (for the pre-NEAT slope coefficient) with zero centred on the quarter just before NEAT started, and;
- 3) another year quarter variable incremental in steps of 0.25 post-NEAT with zero for the quarters before NEAT (for the post-NEAT change in slope coefficient).

The variable for jurisdiction was also fitted in the model to estimate the level in the quarter just before the start of NEAT for each jurisdiction. Change in level at the end compared with no NEAT intervention is estimated for each jurisdiction from the model results (1). The presented coefficients are illustrated in Figure 1.

Figure 1: Definition of estimates in the analysis

References

1. Linden A. A comprehensive set of postestimation measures to enrich interrupted time-series analysis. Stata Journal. 2017;17(1):73-88.

APPENDIX 2: SUPPLEMENTARY RESULTS TABLE

Table App 1 Estimated rates with 95% CI from trend analysis for key ED outcomes

Jurisdiction	Post-NEAT				Difference between estimated and projected at last quarter ^a
	Estimated at last quarter before NEAT (intercept)	Estimated at first quarter post-NEAT	Estimated at last quarter post-NEAT	Projected with no NEAT at last quarter post-NEAT	
% ED length of stay ≤ 4hours					
NSW	40.3 (35.6, 45.2)	42.0 (37.7, 46.4)	58.5 (54.0, 62.9)	36.2 (29.6, 43.4)	22.3*** ^b
ACT	54.9 (46.3, 63.3)	52.8 (45.1, 60.3)	57.9 (49.9, 65.4)	54.1 (41.3, 66.5)	3.8
QLD	51.1 (45.0, 57.2)	53.9 (48.5, 59.3)	73.6 (69.0, 77.8)	46.3 (37.4, 55.4)	27.4***
% access block among patients admitted >24 hours					
NSW	46.8 (42.2, 51.5)	44.0 (38.0, 50.2)	31.0 (26.7, 35.6)	52.3 (44.6, 59.8)	-21.3***
ACT	49.9 (41.9, 57.9)	49.4 (38.7, 60.0)	47.7 (38.9, 56.7)	41.7 (29.6, 55.0)	6.0
QLD	38.2 (33.0, 43.8)	39.9 (32.9, 47.4)	15.1 (12.1, 18.6)	44.9 (35.8, 54.2)	-29.8***
% short-stay admission (≤ 24 hours)					
NSW	9.7 (7.8, 11.9)	10.2 (8.3, 12.5)	13.6 (11.5, 16.0)	10.4 (8.1, 13.4)	3.2*
ACT	3.7 (2.5, 5.4)	4.8 (3.3, 6.9)	7.2 (5.3, 9.8)	4.4 (2.8, 7.0)	2.8
QLD	7.2 (5.5, 9.4)	10.8 (8.4, 13.8)	18.4 (15.1, 22.2)	8.0 (5.8, 10.9)	10.4
% >24 hours admission					
NSW	24.0 (20.1, 28.3)	24.1 (20.3, 28.3)	22.7 (19.4, 26.4)	24.3 (20.2, 29.0)	-1.6**
ACT	15.1 (10.8, 20.7)	15.4 (11.1, 21.1)	14.2 (10.5, 19.1)	16.1 (11.3, 22.5)	-1.9**
QLD	18.1 (14.4, 22.5)	17.8 (14.2, 22.1)	16.5 (13.4, 20.2)	18.2 (14.2, 22.9)	-1.7***
% all admission					
NSW	33.6 (28.3, 39.3)	34.2 (29.1, 39.7)	36.2 (32.0, 40.7)	34.7 (28.7, 41.3)	1.5
ACT	18.7 (13.0, 26.1)	20.1 (14.3, 27.5)	21.4 (16.4, 27.4)	20.4 (13.6, 29.4)	1.0
QLD	25.3 (20.0, 31.5)	28.4 (22.9, 34.6)	34.7 (29.7, 40.1)	26.1 (20.0, 33.2)	8.6***
% unplanned ED re-attendance within 7 days ^c					
NSW	10.7 (9.8, 11.8)	10.8 (9.7, 12.1)	11.0 (9.9, 12.3)	10.6 (9.7, 11.5)	0.4
ACT	12.1 (10.3, 14.2)	12.7 (10.5, 15.2)	12.1 (10.0, 14.6)	12.1 (10.5, 14.0)	0.0
QLD	9.4 (8.3, 10.5)	9.6 (8.4, 11.0)	9.5 (8.3, 10.9)	8.7 (7.8, 9.7)	0.8
% left at own risk (including did not wait) ^d					
NSW	8.4 (7.3, 9.6)	6.4 (4.4, 9.3)	3.2 (1.9, 5.4)	9.4 (5.2, 16.6)	-6.2***
ACT	8.1 (3.9, 16.2)	8.3 (4.3, 15.5)	5.7 (2.3, 13.5)	7.1 (2.4, 19.0)	-1.4
QLD	5.4 (3.2, 9.1)	6.0 (3.7, 9.5)	3.2 (1.7, 6.1)	4.5 (2.1, 9.5)	-1.3**

^a 95% CI cannot be calculated for difference between estimated and projected. Statistical significance of corresponding odds ratio estimates for change in level at the end (from Box 2) is given instead. * denotes P<0.05, ** denotes p<0.01 and *** denotes p<0.001.

^b As an example, estimated at last quarter was 58.5% and projected with no NEAT was 36.2%, and the difference 58.5-36.2=22.3%.

^c Those who were admitted to hospital for >24 hours, who were transferred to another hospital, and/or whose subsequent visit was a planned visit were excluded from the denominator.

^d Crude % did not wait: NSW=6.0%, ACT=8.5% and QLD=6.0%. Crude % left at own risk (excluding did not wait for assessment): NSW=2.3%, ACT=1.0% and QLD=2.3%.