

Aiming to be NEAT: safely improving and sustaining access to emergency care in a tertiary referral hospital

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Abstract

Objective. To implement and evaluate strategies for improving access to emergency department (ED) care in a tertiary hospital.

Methods. A retrospective pre–post intervention study using routinely collected data involving all patients presenting acutely to the ED of a major tertiary hospital over a 2-year period. Main outcome measures were changes in: the percentage of patients exiting the ED (all patients, patients discharged directly from the ED, patients admitted to inpatient wards); mean patient transit times in the ED; inpatient mortality rates; rates of ED ‘did not wait’ and re-presentations within 48 h of ED discharge; and selected safety indicators. Qualitative data on staff perceptions of interventions were also gathered.

Results. Working groups focused on ED internal processes, ED–inpatient unit interface, hospital-wide discharge processes and performance monitoring and feedback. Twenty-five different reforms were enacted over a 9-month period from April to December 2012. Comparing the baseline period (January–March 2012) with the post-reform period (January–March 2013), the percentage of patients exiting the ED within 4 h rose for all patients presenting to the ED (from 32% to 62%), for patients discharged directly from the ED (from 41% to 75%) and for admitted patients (from 12% to 32%; $P < 0.001$ for all comparisons). The mean (\pm s.d.) time all patients spent in the ED was reduced from 7.2 ± 5.8 to 4.4 ± 3.5 h ($P < 0.001$) and, for admitted patients, was associated with reduced in-hospital mortality (from 2.3% to 1.7%; $P = 0.045$). The ‘did not wait’ rates in ED fell from 6.9% to 1.9% ($P < 0.001$), whereas ED re-presentations within 48 h among patients discharged from the ED rose slightly (from 3.1% to 3.8%; $P = 0.023$). Improvements in outcome measures were maintained over the subsequent 12 months.

Conclusions. Multiple reforms targeting processes both within the ED and its interface with inpatient units greatly improved access to ED care over 12 months and were associated with decreased in-hospital mortality.

What is known about this topic? Prolonged stays in the ED result in overcrowding, delayed ambulance access to ED care and increased adverse outcomes for admitted patients. The introduction in Australia of National Emergency Access Targets (NEAT), which stipulate at least 70% of patients in the ED must exit the department within 4 h, have spurred hospitals into implementing a wide range of reforms with varying levels of success in achieving such targets.

What does this paper add? This study demonstrates how multiple reforms implemented in a poor performing tertiary hospital caused the proportion of patients exiting the ED within 4 h to double within 9 months to reach levels comparable with best performing peer hospitals. This was associated with a 26% reduction in in-hospital mortality for admitted patients and no clinically significant adverse effects. It demonstrates the importance of robust governance structures, executive sponsorship, cross-disciplinary collaboration, regular feedback of NEAT performance data and major redesign of existing clinical processes, work practices and bed management operations.

What are the implications for clinicians and managers? Improving access to emergency care should be regarded as a problem located and resolved both within and without the ED. It requires a whole-of-hospital solution involving interdisciplinary collaboration and significant change in culture and practice relating to inpatient units and their interface with the ED.

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Introduction

Delayed access to care in hospital emergency departments (EDs) as a result of impaired patient flow and overcrowding poses risks for patients presenting with acute illness. Access block, defined as the percentage of patients waiting more than a defined period of time (previously set at 8 h) to leave the ED by way of discharge or transfer to inpatient beds, has been associated with increased in-hospital length of stay (LOS)¹ and mortality,^{2,3} increased rates of return visits to the ED,⁴ a higher incidence of prolonged pain, patient and/or carer dissatisfaction, ambulance diversions and ramping, and reduced ED efficiency.⁵ Factors contributing to ED access block can be intrinsic or extrinsic to the ED. Within the ED, these factors include slow and inappropriate triaging and referrals to inpatient teams, poorly coordinated patient flow through acute cubicles and short-stay wards (SSWs) and mismatch between staffing levels and clinical demand. Factors external to the ED include inefficient processing of admission referrals by inpatient teams who do not accord priority to such tasks, poorly coordinated bed management processes with prolonged transfer times to inpatient wards and suboptimal inpatient unit discharge planning that prevents the early release of inpatient beds for incoming patients from the ED.^{6–8}

In recognition of the hazards of access block, the Federal Health Department in Australia introduced in 2012 the publicly reported National Emergency Access Target (NEAT) for all hospitals. In Queensland, the target was set for 2012 at 70% of all patients leaving the ED within 4 h of presentation, to be raised to 78% for 2013 and 82% for 2014. Achievement of these targets was to be linked to additional hospital funding from the 2014–15 financial year. Data gathered by the National Hospital Performance Authority in 2011 showed that Princess Alexandra Hospital (PAH), a 640-bed tertiary hospital in Brisbane, south-east Queensland, had the lowest NEAT 4-h rule compliance (33%) of all Australian hospitals, compared with an average of 54% for all major metropolitan hospitals. The PAH was averaging 150 ED presentations each day, of which approximately 50 were admitted, 60% comprising medical admissions (of which over one-third were admitted as short stays to a 30-bed medical assessment and planning unit (MAPU)).

The aims of the present study were twofold: (1) to describe the development and implementation process; and (2) to evaluate the effects on patient flow and safety indicators of various reforms enacted within PAH over a 12-month period, with the goal of increasing the percentage of patients exiting ED within 4 h of presentation.

Methods

Design, participants and setting

The present study was a retrospective pre–post intervention study using routinely collected administrative data involving all

patients presenting acutely to the ED of the PAH between 1 January 2012 and 31 March 2014. For purposes of comparative analysis and to minimise seasonal effects, the baseline (pre-reform) period was 1 January–31 March 2012, the post-reform period was 1 January–31 March 2013 and the maintenance period was 1 January–31 March 2014.

Data collection

Routinely collected data pertaining to patient transit through the ED were extracted from the ED Information System (EDIS) in deriving times of presentation to the ED and exit from the ED (including SSW as an extension of the ED) for all patients discharged from the ED. In addition, for patients admitted to inpatient wards, the following times were ascertained: first seen by ED medical officer; request for inpatient medical team review; attendance by medical team; bed booking made; and actual departure of patient from the ED. These data were used to compute mean transit times for each phase and total mean transit time from ED presentation to discharge, as well as the percentage of patients exiting the ED in under 4 h. Data on ED ‘did not wait’ rates were also extracted from EDIS. Data relating to re-presentations to the ED within 48 h of discharge from the ED, inpatient mortality rates and rapid response team (RRT) call rates for patients admitted from the ED were derived from hospital statistics maintained by the Clinical Services Evaluation Unit. Hospital standardised mortality rates (HSMR) were obtained from Health Roundtable. The numbers of complaints received about ED care were retrieved from the hospital Medicolegal Complaints Unit.

Qualitative data on staff perceptions of reforms were also gathered using semistructured questionnaires distributed to a convenience sample of nine clinicians (four nurses, two medical registrars, two ED consultants and one ED senior house officer) as well as informal comments noted by the authors during NEAT review meetings and ED ward rounds (see below) involving approximately 25 staff from ED and general medicine services.

Outcome measures

Outcome measures comprised changes in: the percentage of patients exiting the ED (all patients, patients discharged directly from the ED, patients admitted to inpatient wards); mean patient transit times in the ED; inpatient unadjusted mortality rates and HSMR; rates of ED ‘did not wait’ and re-presentations within 48 h; RRT call rates throughout the admission; and the number of complaints made to the ED. Comments made by staff that directly reflected both positive and negative perceptions of NEAT reforms were extracted from questionnaires and interviews.

Statistical analysis

Changes in proportions and HSMRs among the baseline, post-reform and maintenance periods were assessed using Chi-squared tests, whereas changes in mean values were assessed using *t*-tests. Correlations between HSMR and NEAT compliance were assessed using linear regression. Statistical significance was set at $P < 0.05$. Analyses were performed using Microsoft Excel (Microsoft, Redmond, WA, USA) or GraphPad InStat (GraphPad Software, La Jolla, CA, USA). Data collected throughout the 2-year period were also plotted graphically as an interrupted time series using monthly data points.

Ethics approval

Because this study centred on a quality improvement program and used routinely collected, anonymised data on completed episodes of care and elicited staff perceptions of the program with no reporting of identifiable individuals, the PAH Director of Clinical Governance deemed that ethics approval was not required.

Results

Design and implementation of reforms

Executives of the hospital and the Metro South Hospital and Health Service (MSHHS) instructed a working party be established to improve NEAT performance. In early 2012, a group of 20 senior clinicians and managers representing all key NEAT stakeholders at the PAH, together with data analysts, was convened. The group identified four key themes, aided by literature review^{9,10} and input from an external consultancy team that examined NEAT compliance over a 3-month period in late 2011.

First, it was recommended that a formally constituted organisational structure be created with senior executive sponsorship for engaging senior clinicians, enacting change strategies and providing resources where needed. The PAH NEAT Taskforce was established to provide oversight and direction for NEAT initiatives and monitor NEAT compliance, with specific functions assigned to four working groups (Fig. 1). The Taskforce met monthly and, in November 2012, selected members undertook site visits to two tertiary hospitals in Perth featuring the best NEAT performance nationally. Formulation of strategies was also assisted by guidance from the Queensland Health Clinical Access and Redesign Unit (CARU),¹¹ outcomes of experiments conducted in EDs of other Brisbane hospitals and published literature reviews.^{12–14}

Second, business intelligence was required to build a transparent learning collaboration whereby data on NEAT compliance and patient outcomes could be gathered, analysed and disseminated across the entire hospital on a regular basis as a stimulus for change.

Third, improving NEAT compliance needed to be seen as a whole-of-hospital patient flow problem, not just one confined to the ED, requiring full engagement of inpatient units towards improving performance.¹⁵

Fourth, major redesign of existing clinical processes, work practices and bed management operations had to occur within several departments. Meeting NEAT was framed as a sociocultural challenge requiring professional ‘grassroots’ commitment and movement.

It was calculated that if all-patient NEAT compliance at the PAH was to reach a state-wide target of 82%, then 90% of patients discharged from the ED and 50% of admitted patients would need to exit the ED within 4 h. This meant that approximately 75%–80% of ED referrals to inpatient units would have to occur within 2 h of arrival to enable admitted patients to be physically moved from the ED within 4 h.

Commencing March 2012, the Taskforce implemented 25 reforms over the subsequent 9 months, summarised in Appendix I. Apart from the resources consumed in the expansion of the ED SSW, no additional resources were made available to the Taskforce throughout the study period.

Effects of implemented reforms on outcome measures

Quantitative measures

Changes in key indicators between baseline and post-reform periods are listed in Table 1 with trends over time depicted graphically in Fig. 2. NEAT compliance rose for all patients presenting to the ED (from 32% to 62%), for patients discharged directly from the ED (from 41% to 75%), for patients admitted to the ED SSW (from 36% to 78%) and for patients admitted to inpatient wards (from 12% to 32%; $P < 0.001$ for all comparisons). Corresponding figures for the maintenance period were 72%, 86%, 90% and 36%, respectively ($P < 0.001$ for all comparisons with the post-reform period; Table 1). Comparing baseline and post-reform periods, the average time all patients spent in the ED was reduced from 7.2 to 4.4 h, and for admitted patients it was reduced from 9.7 to 6.7 h; these times decreased further in the maintenance period to 3.8 h and 6.1 h, respectively ($P < 0.001$ for all comparisons). Reforms reduced each phase of the patient journey in the ED by approximately 30%, with the exception of time from depart ready to actual ED departure (Fig. 3).

Figure 2 indicates an inflection point for the rise in NEAT compliance that coincides with the instigation of reforms. Overlaying several key reforms in temporal sequence (Fig. 4) suggests no single reform was associated with a sudden change in trend. Access block was most acute between 1500 and 2200 hours, more so on weekends. Older patients with more undifferentiated presentations and requiring more detailed work-ups and/or consultations with different speciality teams comprised the majority of ED long stays.

Between baseline and the post-reform period, in-hospital mortality for admitted patients decreased from 2.3% to 1.7% ($P = 0.045$) and HSMR for all acute admissions decreased from 93 to 72 ($P < 0.001$). Both decreased further during the maintenance period to 1.0% ($P = 0.004$) and 55 ($P = 0.019$), respectively. The reduction in HSMR was significantly inversely correlated with the rise in NEAT compliance (slope = -1.061 , $R^2 = 0.854$, $P < 0.001$; Fig. 5). This equates to a 1.3 percentage point change in mortality over a 2-year period, with number needed to treat over 1 year of 38. It is estimated that 300 fewer deaths occurred during the 2-year post-reform period compared with baseline.

Reductions were also seen in the number of ED ‘did not wait’ (from 6.9% to 1.9%; $P < 0.001$) and the number of ED complaints (from 12 to 6 per month), with no further reductions during the maintenance period. There was a slight but significant increase in

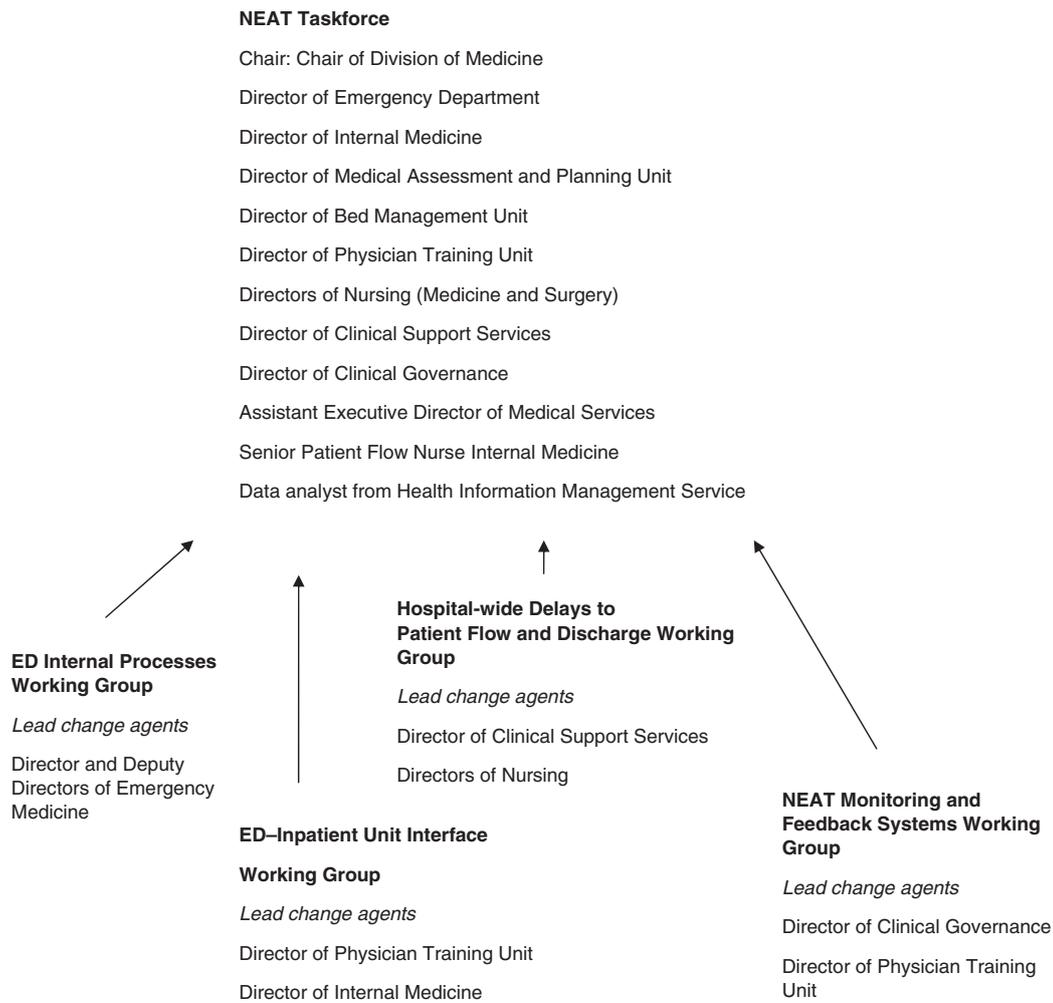


Fig. 1. Organisational structure. NEAT, National Emergency Access Targets; ED, emergency department.

re-presentations to the ED within 48 h among discharged patients (from 3.1% to 3.8%; $P=0.023$; Fig. 6) with no further increase during the maintenance period (3.7%). There was no significant increase in the rate of inpatient RRT calls within the first 24 h after admission throughout the post-reform period, although RRT calls did increase during the maintenance period to 14% ($P<0.001$).

Over the study period, the annual number of presentations to the ED increased by approximately 5%, although the percentage of patients admitted and mean hospital LOS remained unchanged, and patient acuity, as measured by Australian Triage Scheme criteria for all presentations (see <https://www.acem.org.au/getattachment/64ecf9de-866d-437a-8f0b-402c6ab32414/ACEM-Literature-review-on-the-Australasian-Triage.aspx>, accessed 14 July 2014) and diagnosis-related group (DRG)-based patient acuity and comorbidity measures (for admitted patients) did not vary significantly (data not shown). Troughs in NEAT compliance seemed to correlate with times of peak hospital bed occupancy ($\geq 95\%$) combined with peaks in numbers of presentations and admissions via the ED (>180 and >55 per day, respectively; Fig. 7) and lower levels of medical staff after hours.

Qualitative measures

Staff feedback suggested reforms were challenged initially by professional resistance to major shifts in work practices and interactions with other clinical teams, and uncertainty around the perceived worth or relevance of NEAT, compounded by a lack of formal training in new work practices. Inpatient speciality units in particular, with some exceptions, had difficulty accepting the urgency of responding to ED requests for reviews and admissions. Some ED consultants at first felt uncomfortable with general medicine teams rounding in the ED before completion of ED work-ups and issuing of formal referrals. Some ED nurses felt there was inadequate time to complete patient assessments and disagreements did arise on occasion between ED staff and inpatient ward staff around the suitability of patients being transferred from the ED and the adequacy of ED documentation relating to immediate post-ED management. Shortcomings in the available information infrastructure and the absence of a full-time dedicated data analyst prevented further analyses that may have shed more light on patient, practice and organisational factors that impeded NEAT and which new reforms could have targeted. The

Table 1. Changes in National Emergency Access Targets (NEAT) indicators comparing baseline, post-reform and maintenance periods

Data show percentages or the mean \pm s.d., with the number of patients in each group given in parentheses. ED, emergency department; SSW, short-stay ward; HSMR, hospital standardised mortality ratio; RRT, rapid response team

Variable	Baseline period (Jan–Mar 2012)	Post-reform period (Jan–Mar 2013)	<i>P</i> -value ^A	Maintenance period (Jan–Mar 2014)	<i>P</i> -value ^B
% Exiting ED within 4 h					
All patients presenting to ED	32% (13 913)	62% (14 567)	<0.001	72% (15 333)	<0.001
All patients discharged directly from ED	41% (7169)	75% (7259)	<0.001	86% (7564)	<0.001
All patients transferred to SSW	36% (272) ^C	78% (2028)	<0.001	90% (2554)	<0.001
All patients admitted from ED	12% (4768)	32% (4398)	<0.001	36% (4425)	<0.001
Time spent in ED (h)					
All patients presenting to ED	7.2 \pm 5.8 (13 913)	4.4 \pm 3.5 (14 567)	<0.001	3.8 \pm 2.9 (15 333)	<0.001
All patients admitted from ED	9.7 \pm 6.3 (4768)	6.7 \pm 4.0 (4398)	<0.001	6.1 \pm 3.5 (4425)	<0.001
In-hospital mortality (unadjusted): all patients admitted from ED	2.3% (4768)	1.7% (4398)	0.045	1.0% (4425)	0.004
Hospital standardised mortality rate: all patients admitted from ED	93 (4768)	72 (4398)	<0.001	55 (4425)	<0.019
Re-presentations to ED within 48 h of discharge: all patients discharged directly from ED	3.1% (7169)	3.8% (7259)	0.023	3.7% (7564)	0.781
Did not wait in ED: all patients discharged directly from ED	6.9% (7169)	1.9% (7259)	<0.001	0.7% (7564)	<0.001
RRT call rate within first 24 h of admission: all patients admitted from ED	9.2% (4768)	9.8% (4398)	0.352	14.1% (4425)	<0.001

^A*P*-values comparing the post-reform to baseline period.

^B*P*-value comparing the maintenance to post-reform period.

^CCollection of NEAT data for discharges from the SSW did not commence until the last 3 weeks in March 2012, hence the smaller sample compared with later periods.

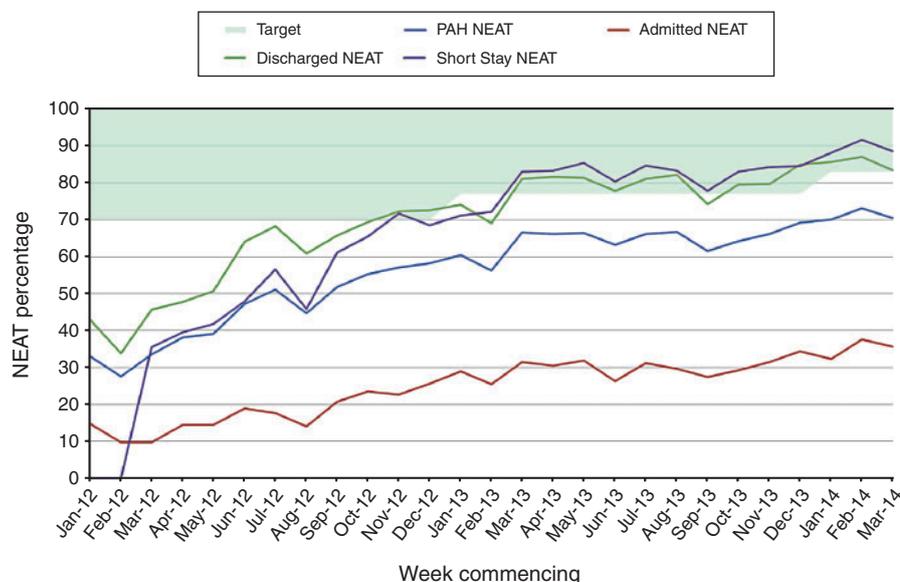


Fig. 2. Change in National Emergency Access Targets (NEAT) percentage over time (from 1 January 2012 to 31 March 2014). Note, the NEAT percentage is the proportion of patients exiting the emergency department (ED) within 4 h of presentation. Target, target set by Queensland Health; PAH NEAT, NEAT percentage for all ED presentations to the Princess Alexandra Hospital; Admitted NEAT, NEAT percentage for all patients admitted to inpatient beds; Discharged NEAT, NEAT for all patients discharged directly from the ED; Short Stay NEAT, NEAT percentage for all patients discharged from the ED short-stay ward. Short stay ward NEAT was not measured routinely prior to March 2012.

inability to have a single accountable bed management unit co-located in the ED and dedicated only to acute patients was also seen as a drawback, combined with the absence of reliably predictive bed management tools. Adherence to some strategies (e.g. avoidance of long write-ups by medical registrars,

estimated date of discharge (EDD) documentation and referral rates to hospital in the home (HITH) care), although improved compared with baseline, was less than expected. On the positive side, many staff felt the reforms had enhanced communication and collaboration between the ED and inpatient

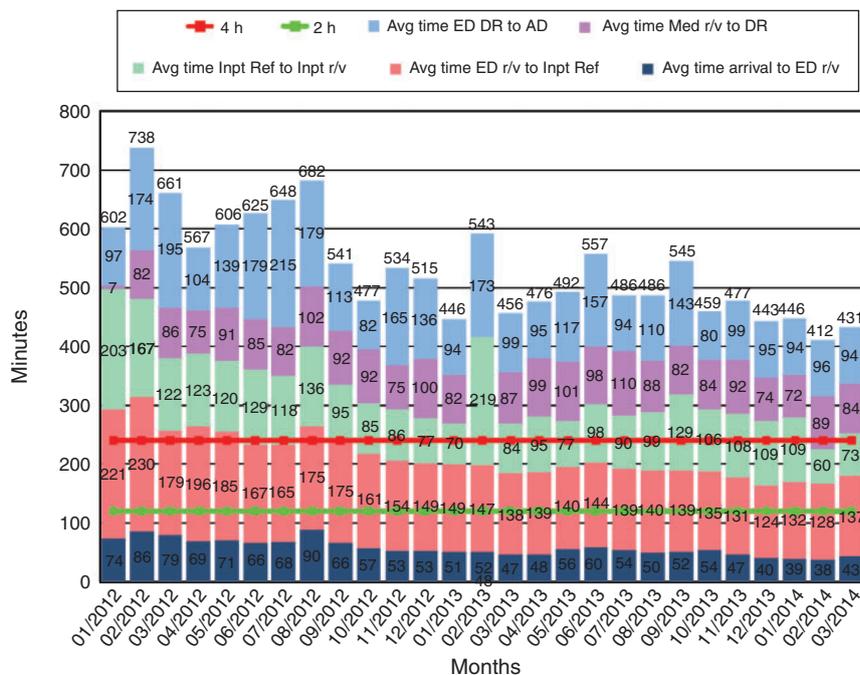


Fig. 3. Changes in time periods for each phase of the emergency department (ED) patient journey. Avg, average; DR, discharge ready; AD, actual departure; Med, medical; r/v, review; Inpt, inpatient; Ref, referral.

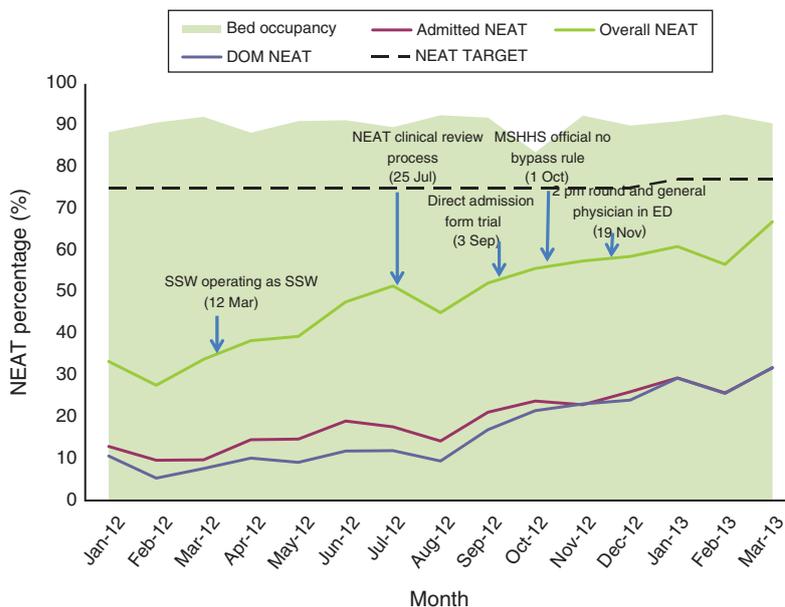


Fig. 4. Effects on National Emergency Access Targets (NEAT) performance of specific strategies. Note, the NEAT percentage is the proportion of patients exiting the emergency department (ED) within 4 h of presentation. Target, target set by Queensland Health; Overall NEAT, NEAT percentage for all ED presentations; DOM NEAT, NEAT percentage for all patients admitted to medical beds; Admitted NEAT, NEAT percentage for all patients admitted to inpatient beds; MSHHS, Metro South Hospital and Health Service; SSW, short stay ward.

units and they welcomed the reduction in ED overcrowding and improved patient satisfaction.

Discussion

Decongesting EDs and reducing access block has become a priority for all Australian hospitals with the advent of the 4-h NEAT. The PAH was the worst performer on NEAT among all Australian hospitals in 2011, but improved this to close to best performer within 12 months, with further modest improvements over the subsequent 12 months. There was a direct and highly significant inverse relationship between HSMR for acutely

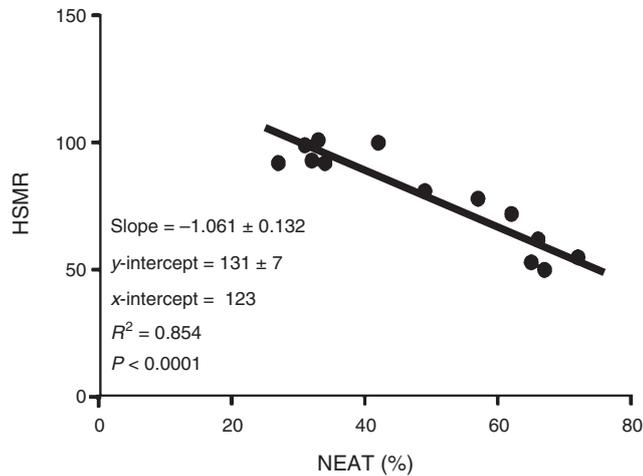


Fig. 5. Correlation between hospital standardised mortality rates (HSMR) for patients admitted from the emergency department (ED) and National Emergency Access Target (NEAT) compliance for all patients presenting to the ED.

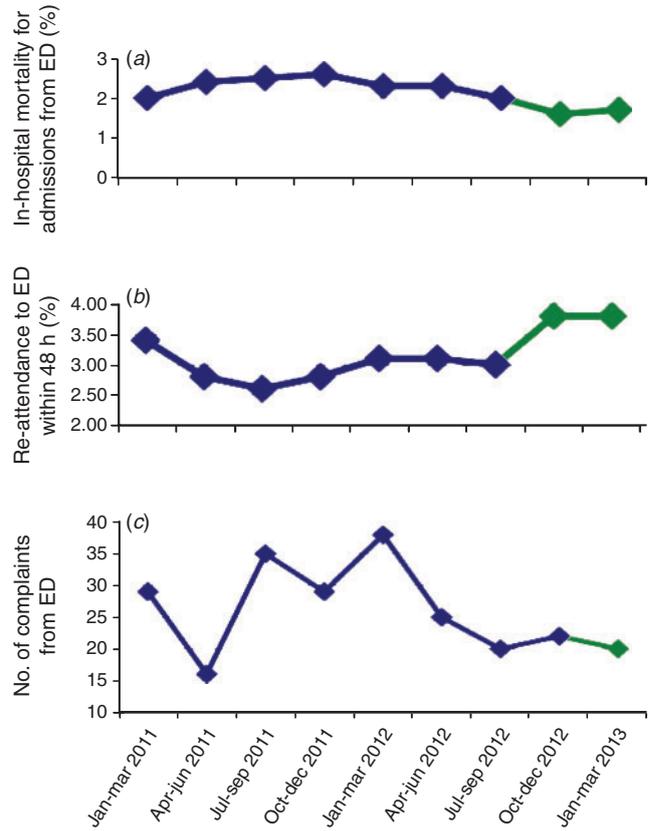


Fig. 6. Changes in patient safety indicators over time. (a) In-hospital mortality for admissions from the emergency department (ED); (b) re-attendance to the ED within 48 h of discharge; (c) the number of complaints received from ED.

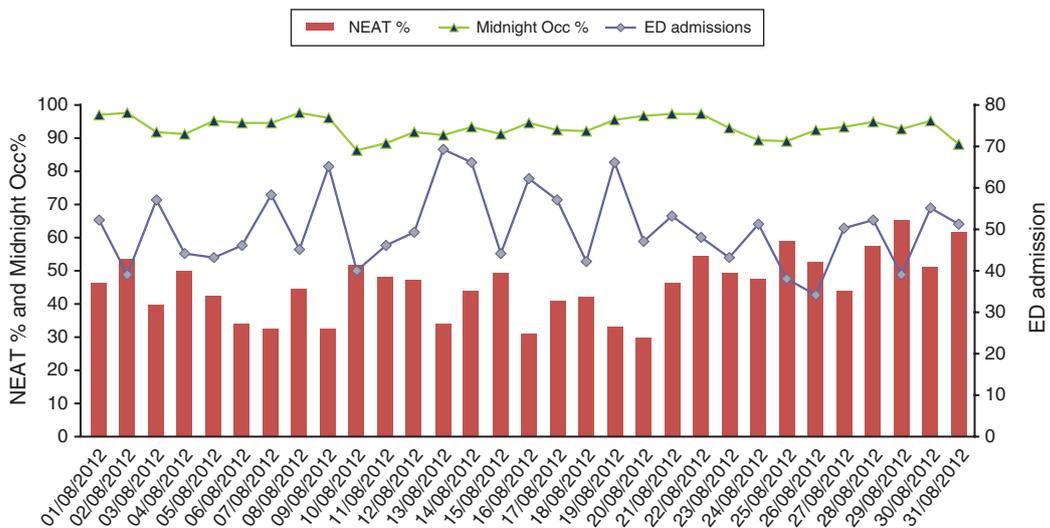


Fig. 7. Relationship between National Emergency Access Targets (NEAT) performance, bed occupancy and emergency department (ED) admission workloads. NEAT %, percentage of all patients exiting the ED within 4 h; Midnight Occ %, percentage of occupied beds at the midnight census; ED admission, number of patients admitted to inpatient beds from the ED.

admitted patients and NEAT compliance, associated with a 57% reduction in crude in-hospital mortality over the 2-year period post-reform. No clinically significant adverse effects were seen immediately following implementation of reforms, as assessed by numbers of RRT calls within the first 24 h of admission or re-presentations to the ED within 48 h of discharge from the ED. Major shifts in professional cultures and work practices occurred and were sustained, both within the ED and across the interface between the ED and inpatient units. This was facilitated by robust cross-disciplinary governance teams tasked to implement hospital-wide reforms aided by timely reporting of accurate performance data.

Relationship of findings to other studies

Significant drops in NEAT compliance occur at times when inpatient bed occupancy and numbers of ED presentations are both high. Smoothing out these twin peaks will require more evenly distributed scheduling of elective admissions, better discharge planning and greater use of hospital avoidance and substitution programs.¹⁶ Some studies have raised concerns that hasty or inappropriate exit of patients from the ED to inpatient wards can overcrowd medical assessment and planning units, increase numbers of unwarranted inpatient admissions¹⁷ or cause clinically unstable patients to be admitted to non-home wards lacking suitable levels of trained staff and monitoring, leading to avoidable adverse events and deaths.¹⁸ We did not observe any changes in patient triage category or acuity with regard to admitted patients.

Our finding of an association between improved NEAT compliance (from 32% to 72% at 2 years) and reduced in-hospital mortality (from 2.3% to 1.0%, a 56% decrease) has also been observed in a study of three tertiary hospitals in Perth.¹⁹ However, in the Perth study, baseline NEAT compliance, which was already averaging 60%, improved to 90% in tandem with a 13% reduction in mortality (from 1.12% to 0.98%). This smaller reduction in mortality may signal diminishing returns and increasing opportunity costs from further increments in NEAT compliance once thresholds around 70% have been reached.²⁰

Although the evidence base for interventions to mitigate ED access block remains limited and of low quality,^{21,22} several of our reforms have attracted supporting evidence from recent studies. Early patient assessment by a senior ED medical officer has been shown to improve NEAT compliance and reduce ED LOS for patients discharged from the ED.²³ Instigation of dedicated patient flow nurses who coordinate and expedite patient processing in the ED also improves NEAT compliance.²⁴ Banning ambulance diversion from hospitals reduces ED LOS and ambulance turnaround time.²⁵ Real-time information systems and process redesign in the ED reduce ED transit times and expedite early assessment,²⁶ as does the rapid response of inpatient teams to ED requests for review and admission.²⁷

Study limitations and strengths

This study was limited in that, relying on observational data and an uncontrolled pre-post design, associations between NEAT compliance and in-hospital mortality are not

necessarily cause-and-effect, and other explanations are possible, such as a greater hospital-wide focus on the recognition of, and response to, deteriorating patients. However, such procedures were in place at the start of the study period, a systematic review of RRT systems²⁸ revealed no more than a 10% reduction in in-hospital mortality compared with the 56% reduction over 2 years observed here and there was a strong inverse correlation between NEAT compliance and HSMR. The qualitative study of staff perceptions of reforms was limited by small samples, lack of formal thematic analyses and different ascertainment methods. The implemented reforms predominantly involved internal processes within the hospital affecting ED throughput and output, over which clinicians had a high level of control, rather than on hard to control external processes affecting ED input (e.g. limited access by patients to primary care), with the exception of ambulance diversion. Study strengths were standardised methods of data collection and prespecified outcome measures, which included safety indicators not reported in other studies.

Implications for clinical practice and future research

Overall, our program raised hospital-wide awareness of the importance of improving NEAT compliance, facilitated closer and more productive working relationships between ED and inpatient teams, strengthened the role and efficiency of the ED SSW and MAPU, and focused hospital-wide attention on ways to reduce LOS. Importantly, the program achieved its primary aim of decreasing ED access block in association with a reduction in in-hospital mortality of patients admitted via the ED to 1%. The absence of a clear indication that one or a few reforms were responsible for most of the improvement in NEAT compliance suggests that multiple reforms must be implemented in decreasing ED access block.

Our results also suggest that further improvement in NEAT compliance will be challenged by work practices and staffing levels based on a 5- rather than 7-day a week model of acute care, competing organisational demands for limited bed stock, and poorly coordinated bed management systems and scheduling of elective surgery.^{29,30} More recently, a refocusing of the PAH executive on the need to reach the National Elective Surgery Target, necessitating more hospital beds to be quarantined for surgical patients, may impact negatively on NEAT compliance. The improvements in NEAT compliance achieved at the PAH and other hospitals remain under threat and mandate constant monitoring and reinforcement by senior executives. Also of concern are soon to be enacted activity-based funding formulas, which do not currently recognise and reimburse admissions to the ED SSW, which was a key reform in decongesting the ED.

With regard to research imperatives, priority should be given to multisite collaborations that collect data on ED access block using universally agreed definitions of admissions and measures of access block and that: (1) assess differential effects on NEAT compliance of different interventions; (2) identify patient- and system-level predictors of breaching the 4 h limits to which remedial strategies could be targeted; (3) assess the opportunity costs of spending more resources on achieving incrementally higher NEATs; and (4) evaluate for

unintended negative effects of chasing high NEATs, such as manipulating data to suggest higher compliance rates and compromise in patient safety.

Conclusion

In this study of a major tertiary hospital, multiple reforms targeting processes both within the ED and its interface with inpatient units greatly improved access to ED care over 12 months. This improvement was maintained over the subsequent 12 months and was associated with decreased in-hospital mortality. Reforms were characterised by whole-of-hospital engagement, interdisciplinary collaboration, changes in culture and practice within the ED, inpatient units and their interface with the ED, and continuous performance monitoring and feedback. Challenges remain in improving NEAT compliance further in relation to the opportunity costs involved and the limited amount of high-quality research that has identified predictors of non-compliance with the 4-h rule and effective remedial interventions.

Conflicts of interest

All authors have no conflicts of interest to declare.

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Appendix I. Implemented reforms

Reforms within the emergency department (ED)

- ED consultant assigned to Ambulatory Care area 0800–1700 hours Monday to Friday to fast track patients able to be discharged home
- Changes to processing of mental health patients enabling more rapid transfer of suitable patients with behavioural problems to the mental health waiting area
- Change in admission procedures to avoid unnecessary transit of planned, clinically stable acute or elective admissions and inter-hospital transfers via the ED
- Implementation of a 'no bypass' rule for the EDs of the four hospitals (including the Princess Alexandra Hospital (PAH)) within the Metro South Hospital and Health Service (MSHHS) that disallowed regional EDs from redirecting ambulances to the PAH once their ED capacity had been exceeded, which was causing unpredictable surges in admissions at the PAH
- Explicit streaming criteria (following initial senior ED clinician assessment and triaging) of patients to short-stay wards (SSW; likely discharge within 12 h), Medical Assessment and Planning Unit (MAPU; likely discharge within 72 h), inpatient wards (>72 h admission) or critical care wards
- Expansion of the ED SSW from six to 14 beds by renovating an adjacent but underutilised procedure area, with recruitment of an additional 4.8 full-time equivalent (FTE) nurses and 1.0 FTE clinical nurse consultant at an annual cost of A\$710 000
- All patients presenting with Australian Triage Scale category 3–5 to be seen by ED staff in order of attendance, not clinician preference

Reforms involving ED–inpatient unit interface

- ED staff authorised to arrange direct to ward admissions of clinically stable patients meeting prespecified criteria in the absence of inpatient team review in the ED
- Admitting teams, not ED staff, made responsible for organising additional investigations before patient transfer from the ED
- Explicit streaming criteria for general medicine or subspecialty admission implemented with referral to general medicine for patients with unclear admission unit destination
- Requirement for inpatients teams to respond to ED referrals within 60 min of notification, and for registrars to liaise with their consultants before refusing ED requests for admission
- ED Information System (EDIS) notes to be used as primary working documents with admitting registrars adding only brief synopses of diagnosis and initial management where suitable, and not holding patients in ED while completing their write-ups
- ED referrals and admissions received by medical registrars unencumbered by other duties and processing each referral/admission in real time with no 'batching'
- Constant monitoring of EDIS screens by MAPU staff and regular (every few hours) liaison between MAPU and ED teams concerning patients eligible for rapid MAPU admission
- Daily weekday rounding at 1400 hours of all ED beds by on-take general medicine and MAPU consultants/registrars accompanied by ED consultants/registrars and patient flow nurse
- Requirement that in-patient units accept and admit patients, both new and readmit (old) cases, up to 1700 hours weekdays (previously 1400 hours) to maximise use of the daytime workforce and to lessen the load on late afternoon/evening on-call registrars
- Change in rostering of evening on-call registrars such that evening shifts finished at 0200 hours rather than 2300 hours to allow more efficient processing of evening peak in admissions

Hospital-wide interventions

- Discharge of patients from inpatient wards and the ED over extended hours (0800–2000 hours) Monday–Sunday, documentation of estimated date of discharge, criteria-led discharge and daily (Monday–Sunday) debriefing between registrars and consultants on inpatient wards
- Access gained to step-down nursing care/hospital beds ($n = 20$) in off-campus sites for patients awaiting residential care
- Establishment of on-site hospital in the home (HITH) care teams and rapid review clinics for in-patient stays
- Transferring patients back to referring regional hospitals, referring nursing homes or hospice care as soon as clinically appropriate.

Monitoring and feedback

- NEAT performance data circulated to all areas of the hospital in various forms:
 - daily morning report of all NEAT indicators over the previous 24 h
 - ED dashboard that reconciled NEAT performance with workload (numbers of presentations), casemix (triage categories) and ambulance and ED waiting times
 - monthly aggregated report of NEAT data for each individual speciality unit and each ward
 - monthly report listing times for each phase of the patient ED journey for all admissions to specific inpatient units
 - monthly bed management reports indicating delays in patient movements to wards
- Audits, case reviews and routinely collected administrative data used to ensure consistent strategy implementation
- Monthly meetings of NEAT taskforce with presentation of updated NEAT statistics and lead change agents of each working group to summarise achievements and suggest further reforms
- Weekly NEAT quality and safety review meetings comprising senior ED, MAPU and Division of Medicine (DOM) clinicians to monitor for any serious breaches in protocols relating to patient transfer from ED and unfavourable trends in safety indicators
- Safety indicators monitored on a monthly basis by the NEAT Taskforce