Impact of a national time target for ED length of stay on patient outcomes

Peter Jones, Susan Wells, Alana Harper, James Le Fevre, Joanna Stewart, Elana Curtis, Papaarangi Reid, Shanthi Ameratunga

ABSTRACT

AIM: The impact of national targets for emergency department (ED) length of stay (LOS) on patient care is unclear. This study aimed to determine the effect of New Zealand's six-hour time target (95% of ED patients discharged or admitted to hospital within six hours) on a range of quality indicators.

METHODS: A nationwide observational study from 2006 to 2012 modelled differences in changes over time before and after target introduction in 2009. The observed model estimates in 2012 were compared to those predicted if pre-target trends had continued. Differences are absolute values except for morality, which is presented as a relative change.

RESULTS: There were 5,793,767 ED presentations and 2,082,374 elective admissions from 18 out of a possible 20 district health boards included in the study. There were clinically important reductions in hospital LOS (-0.29 days), EDLOS (-1.1 hours), admitted patients EDLOS (-2.9 hours), ED crowding (-26.8%), ED mortality (-57.8%), elective inpatient mortality (-42.2%) and the proportion not waiting for assessment (-2.8%). Small changes were seen in time to assessment in the ED (-3.4 minutes), re-presentation to ED within 48 hours of the index ED discharge (-0.7%), re-presentation to ED within 48 hours from ward discharge (+0.4%) and acute admissions (+3.9%). An increase was observed in re-admission to a ward within 30 days of discharge (1.0%). These changes were all statistically significant ($p<0.001$).

CONCLUSION: Most outcomes we investigated either improved or were unchanged after the introduction of the time target policy in New Zealand. However, attention is required to ensure that reductions in hospital length of stay are not at the expense of subsequent re-admissions.

In May 2009, the Ministry of Health formally announced six national health targets for public hospitals in New Zealand.[1] One of these was the 'Shorter Stays in Emergency Departments' target, stipulating that 95% of patients will be admitted, discharged or transferred from an emergency department (ED) within six hours of arrival.[2] This policy was introduced on the basis of international evidence that suggested an association between ED and hospital crowding and worse outcomes for patients, including an association with increased mortality.[3–6] The causes of ED crowding are multifactorial, but mostly due to delays in the flow of patients requiring admission to hospital acutely from the ED to hospital wards.[7] Long waits for admission to hospital from ED are synonymously termed 'Access' or 'Exit' Block[8] and are a marker of ED crowding.

Time-based ED targets were initially introduced in the UK's National Health Service (NHS) in 2003[9] and have since been introduced both in New Zealand[1] and in Australia.[10] There is debate as to whether or not targets are helpful or harmful,[11] and it is unclear what impact these have on patient care. Some studies suggest better outcomes for patients,[12,13] and others suggest that focusing on a time target for separation from ED has the potential to distort clinical or management priorities, diverting attention from other aspects of care within the system.[14,15]

The Shorter Stays in ED (SSED) National Research Project is a mixed-methods study within public hospital EDs in New Zealand investigating the relationship between the introduction of a time target for the completion of care in ED and the quality

of care in ED and the whole hospital.[16] The project uses a Kaupapa Māori Research approach, with a lens on ensuring that the target did not widen inequities in health outcomes for ethnic groups, especially the indigenous population. There was involvement by Māori as integral members of the research team from the inception to the completion and reporting of the project.[17]

Key research questions for this paper were: Is there any change in clinically relevant outcomes after the target was introduced? And were there different impacts for at-risk ethnic and age groups?

In order to answer these questions, quality indicators were identified from a literature review and stakeholder analysis.[18] The indicators selected were a mixture of process and outcome measures to provide a balanced view of the influence of the target on the quality of care. The primary outcomes were ED and hospital length of stay (LOS) to reflect efficiency of care, with re-presentation to ED and re-admission to hospital to reflect effectiveness of care. For patients admitted to a hospital ward from the ED, the proportion of patients who had an ED LOS more than eight hours prior to admission (Access Block) was used as the measure of ED crowding. Secondary outcomes were mortality, the proportion not waiting to complete care, the time to assessment by a treating clinician in the ED and the rate of admission to hospital and short-stay wards. Other secondary outcomes relating to specific clinical conditions described in the protocol[16] are being analysed and addressed separately.[19,20,21]

Methods

Study design and setting

This was a cohort study in which the rate of change of selected quality of care markers over time was investigated at a national level in New Zealand for three years before and three years after the introduction of the target (the intervention) in July 2009.

Study population

All ED visits and non-emergency (elective) hospital admissions from 1 January 2006 to 31 December 2012 in New Zealand were identified from the central database of the New Zealand Health Information Service (NZHIS). Hospitals without an ED were excluded. The visit date, demographic data and date of death were extracted from NZHIS and then linked to local district health board (DHB) databases holding times for the patient journey (presentation, triage, assessment, admission and discharge times) in each hospital for each event using a unique patient identifier, the National Health Index (NHI) number. In New Zealand when more than one ethnicity for a person is recorded on arrival, ethnicity is defined by DHBs according to a national prioritisation protocol for major ethnic groups in the following order; Māori, Pacific, Asian, New Zealand European and finally all other ethnicities.[22] Duplicate events were identified and removed prior to data analysis. The linked database was used to determine re-presentation and re-admission to any hospital in the country regardless of which hospital was the site of the index visit. A data dictionary was developed a-priori and contains a full description of the data collection process and definitions of all variables. This is available alongside the study protocol, which has been published previously.[16] The definitions of outcomes pertinent to the current study are provided below.

Intervention

The 'Shorter Stays in Emergency Departments' target is a mandatory target that all DHBs were expected to meet from 1 July 2009. The target stipulates that 95% of patients will be admitted, discharged or transferred from an emergency department (ED) within six hours of arrival[2] and was implemented through a wide variety of process, staffing and structural changes at different hospitals from 2009.[23] Although the target was not accompanied by extra funding to DHBs for implementation, it is estimated that changes made to facilitate meeting the target cost in the region of 52 million New Zealand Dollars.[23]

Definitions

For each outcome, a clinically important difference was determined by consensus, as it was anticipated that due to the large number of participants in the study, small differences that may not be clinically important would be found to be statistically significant. This is shown in Table 1 and is an absolute change unless specified otherwise. In the results section, differences are reported if they met the clinically important threshold for the outcome.

Statistical analysis

The data for each of the outcomes was recorded by twelve-month period to avoid the need to model for seasonal changes. As we included all hospitals (rather than a sample of hospitals) and all their data for the time period of interest was included, hospital was included in the analyses as a fixed rather than a random effect. To compare the rate of change in continuous measures pre- to post-target and whether any change was influenced by age or ethnic group, a general linear model was used. The length of time outcomes were transformed (log base e), and the explanatory variables were hospital, ethnic group (Māori, Pacific, Asian, European, Other), age group (categorised as under five years, 5–14 years, 15–24 years, 25–64 years and 65 years and older), deprivation score (NZDep, a standard measure of socioeconomic deprivation used in New Zealand based on small geographic areas of domicile[24]) entered as a continuous variable centred on NZDep 6, year (coded as 1 to 7 for 2006–2012 representing the pre-intervention change over time), whether pre or post the intervention (a binary variable coded as 0 pre 2009, 1 otherwise, representing the step at target introduction) and a variable to measure the change in slope from pre- to post-intervention (coded as 0 pre 2010, 1, 2 or 3 for 2010, 11 and 12 respectively). As the target was a nationwide target, the first interest was the influence on outcomes nationally. Therefore, changes in the total sample from pre to post the target were investigated first. Estimates of the change over time in all of the outcomes of interest were modelled. The slope over time pre-target, the magnitude of the step change at 2009 when the target was introduced and the slope over time post-target were formed. The difference in the modelled estimate in 2012 from that which would have been obtained if the pre-target pattern had continued was determined. We also determined the difference between the modelled estimates for the year 2012 compared to the immediate pre-target year, 2008.

To investigate if changes differed depending on specific demographic factors of interest, the analyses were also run including the two-way interactions of ethnic group or age, with year, pre-post and change in slope. Estimates as above within ethnic group and within age group were obtained. These estimates were for comparative use and were evaluated at the reference values for the covariates (European, age 15–64, NZDep 6 and Auckland hospital). For the binary outcomes, the analyses were the same with the exception that a generalised linear model was used with a binary distribution and a log link. For some analyses where the outcome was rare, the number of age or ethnic groups needed to be reduced. Data were analysed using SAS/STAT version 9·3 SAS Institute, Cary, NY, USA and SPSS version 22, IBM Corporation, Armonk, NY USA using PROC GLM for the continuous outcomes and PROC GENMOD for binary outcomes. The study funder, the Health Research Council of New Zealand, had no role in the conduct or reporting of the study.

Ethical approval for the study was granted by the Multi-regional ethics committee of New Zealand's Health and Disabilities Ethics Committees MEC 10/06/60.

Results

Of 20 eligible DHBs, 18 participated in the study. One DHB did not reply to multiple requests to supply data and the other was unable to provide the required data due to problems with their database. The 18 DHBs manage 25 hospitals providing care for 3.88 million people (91.7% of the population of New Zealand). Over the study period there were 5,793,767 ED presentations and 2,082,374 elective admissions to the participating DHBs.

Table 2 shows the baseline characteristics of the patients presenting to the participating EDs during the study period. There were more presentations over time with a trend towards increasing age and increasing urgency to be seen according the Australasian Triage Scale (ATS). The use of short stay units (SSU) also increased after the introduction of the target, with <5% of ED presentations placed in SSU prior to 2009 compared to almost 13% in 2012. The proportion of inpatient ward admissions changed little, while target performance improved after 2009, although the target threshold of 95% was not met.

Table 3 shows the raw outcome data by year. Table 4 shows how the model estimates of the indicators in 2012 differed

Table 1: Outcome definitions.

Outcome		Clinically important difference	Definition
Emergency department length of stay (ED LOS)		30 minutes	The interval between ED presentation time and ED departure time. The reported ED LOS does not include the time spent in an ED short stay unit (SSU) and is the time reported by DHBs to the MOH for target compliance. An ED SSU provides short-term (usually <24 hour) assessment and/or treatment for specific conditions in order to streamline the episode of care. This can be led by the emergency medicine or inpatient specialists or both. The total ED LOS includes the time spent in SSU. In this study we used total ED LOS as a balance measure to determine whether SSU were being used to 'stop the clock' for target compliance, in which case total ED LOS would not be expected to change (or may increase).
Access block		10%	The proportion of patients who require hospital admission to an in-patient ward from the ED who have a total ED LOS >eight hours. An in-patient ward is an area of the hospital where ongoing secondary care is provided by a named medical or surgical specialist, usually for more than 24 hours.
Hospital length of stay (LOS)		0.25 days	For admitted patients, the interval between presentation to the hospital and discharge from the hospital.
Re-presentation		1%	The proportion of patients who presented to any ED within 48 hours of discharge from either an ED or a hospital ward, excluding arranged inter-hospital transfers.
Re-admission		1%	The proportion of patients who were admitted to any hospital within 30 days of discharge from a hospital ward.
Mortality		10% (relative change)	The proportion of patients who died: *ED patients:* either in the ED or within 10 days of ED discharge. *Admitted patients:* those that died on the ward or within 30 days of ward discharge. Relative change was used for this outcome as the baseline mortality was low and varied depending on whether patients were discharged (<0.5%) or admitted (≈5%).
Did not wait to be seen or to complete assessment in ED (DNW)		1%	The proportion of patients who left prior to completion of their assessment in the ED.
Assess time		15 minutes	The interval between ED presentation and first assessment by a treating clinician (doctor or nurse practitioner).
Admissions		5%	The proportion of patients who were admitted to an inpatient ward.
For all outcomes	**Observed 2012 estimate**	-	The model estimate of the outcome of interest in 2012 .
	Predicted 2012 estimate	-	The model estimate that would have been obtained for 2012 if the pre-target trend had continued.

Table 2: Baseline characteristics of emergency department presentations.

Year		Pre-target			Target	Post-target		
		2006†	2007	2008	2009	2010	2011	2012
N		678,410	747,135	795,761	843,840	885,093	912,053	931,475
Age	Mean (yr)	38·4	38.4	38.7	38.9	38.8	39.0	39.3
Gender	Male	51.9%	51.9%	51.7%	51.4%	51.0%	50.6%	50.5%
Ethnic group	Māori	18.5%	19.3%	19.4%	19.5%	19.4%	19.2%	19.0%
	European	64.0%	63.5%	63.4%	63.4%	63.4%	63.0%	62.5%
	Pacific	8.4%	8.2%	8.4%	8.6%	8.6%	8.9%	9.1%
	Asian	5.2%	5.1%	5.2%	5.5%	5.9%	6.2%	6.7%
	Other	1.6%	1.7%	1.7%	1.6%	1.5%	1.6%	1.6%
	Unknown	2.3%	2.2%	1.9%	1.5%	1.4%	1.2%	1.2%
Deprivation*	1	12.2%	11.7%	11.7%	12.2%	12.2%	12.4%	12.6%
	2	14.0%	13.6%	13.5%	13.9%	13.9%	14.1%	14.2%
	3	17.2%	17.2%	17.7%	18.0%	18.1%	18.3%	18.3%
	4	24.9%	25.6%	25.4%	24.9%	25.1%	25.1%	25.0%
	5	30.5%	30.8%	30.6%	29.9%	29.6%	29.2%	29.0%
	Unknown	1.1%	1.1%	1.1%	1.1%	1.0%	1.0%	0.9%
Mode of presentation	Ambulance	25.1%	22.7%	22.8%	24.8%	26.9%	25.7%	23.4%
	Self	57.2%	55.0%	53.7%	55.5%	58.4%	57.1%	57.1%
	Other	13.1%	17.8%	19.3%	15.4%	10.6%	13.0%	15.4%
	Unknown	4.5%	4.4%	4.3%	4.2%	4.2%	4.2%	4.2%
Referral by	Self	62.2%	64.5%	66.8%	68.4%	68.2%	66.3%	65.3%
	Health provider	31.2%	28.2%	27.4%	27.2%	25.1%	23.7%	23.0%
	Unknown	6.6%	7.2%	5.8%	4.4%	6.7%	10.0%	11.7%
Australasian Triage Scale**	1	0.7%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%
	2	9.8%	9.1%	9.2%	9.8%	9.7%	10.1%	10.3%
	3	37.9%	37.4%	37.3%	38.1%	38.8%	40.3%	41.3%
	4	39.6%	40.1%	40.1%	39.9%	39.8%	39.0%	39.0%
	5	12.0%	12.8%	12.7%	11.6%	11.1%	9.9%	8.8%
	Unknown	0.3%	0.3%	0.3%	0.2%	0.2%	0.1%	0.1%
Short stay unit admissions		3.6%	3.8%	4.7%	6.2%	7.4%	11.8%	12.9%
Ward admissions		31.9%	30.1%	30.1%	31.3%	31.5%	30.9%	31.4%
SSED target achievement† all patients		82.4%	81.6%	80.6%	81.9%	86.6%	90.9%	92.3%
SSED target achievement† admitted patients		70.7%	67.5%	64.9%	67.1%	74.9%	82%	85.1%

†One hospital was unable to supply data for 2006 so n is smaller for this year. *New Zealand deprivation quintiles by domicile: 1=least deprived, 5=most deprived, **Australasian Triage Scale 1=most urgent, 5=least urgent. Missing data is represented by the 'unknown' category for each variable. There were also 14 cases with age not recorded and 186 with gender not recorded over the study period. SSED=Shorter stays in emergency departments. SSED=Shorter stays in emergency departments. †Target achievement refers to the proportion of ED patients each year that were admitted to hospital or discharged from the ED within six hours of arrival in the 25 study hospitals. The target threshold for achievement was 95%.

from that predicted for 2012 if the pre-target trend had continued and the difference between the estimates in 2012 and those in the year prior to the introduction of the target in 2008. These data are shown graphically in Figures 1A, 1B and 1C. The impact of the target on different ethnic and age groups is shown in Tables 5 and 6 and supplementary material figures.

Hospital LOS

Hospital LOS reduced by 0.29 days (6.96 hours) after the introduction of the target (Table 3). All ethnic and age groups had lower than predicted post-target estimates of hospital LOS than if the rate of change pre-intervention had continued (Tables 4 and 5, supplementary material figures).

Table 3: Raw unadjusted outcome data.

Outcome	**2006** n=678,410	**2007** n=747,135	**2008** n=795,761	**2009** n=843,840	**2010** n=885,093	**2011** n=912,053	**2012** n=931,475
Hospital LOS (days†)	2.67 (1.2, 5.2)	2.74 (1.2, 5.5)	2.77 (1.2, 5.7)	2.65 (1.2, 5.3)	2.49 (1.1, 5.0)	2.40 (1.1, 5.0)	2.34 (1.1, 5.0)
Total ED LOS (hours†) all patients	2.92 (1.5, 5.1)	3.02 (1.6, 5.3)	3·18 (1.7, 5.5)	3.23 (1.8, 5.5)	3.12 (1.7, 5.2)	3.12 (1.8, 5.1)	3.17 (1.8, 5.1)
Total ED LOS (hours†) patients admitted to a ward	4.17 (2.42,6.85)	4.50 (2.67,7.28)	4.75 (2.87, 7.68)	4.68 (2.88, 7.48)	4.35 (2.67, 6.67)	4.33 (2.72, 6.28)	4.38 (2.78, 6.22)
Target reported ED LOS (hours†)	2.85 (1.5, 4.9)	2.95 (1.6, 5.0)	3.07 (1.6, 5.2)	3.07 (1.7, 5.1)	2.97 (1.6, 4.7)	2.83 (1.6, 4.4)	2.85 (1.6, 4.4)
Access block (%)	19.3%	21.3%	23.3%	22.3%	17.5%	16.0%	16.5%
Re-presentation 48 hr (%)							
from ED discharge	7.8%	8.1%	8.0%	8.0%	8.1%	7.5%	7.0%
from ward discharge	2.2%	2.1%	2.0%	2.1%	2.2%	2.1%	2.2%
Re-admission to ward at 30 days (%)	6.5%	6.1%	6.5%	7.2%	7.4%	7.4%	7.9%
Mortality (%)							
In ED	0.124%	0.126%	0.130%	0.102%	0.088%	0.070%	0.068%
Acute admissions	3.26%	3.18%	2.93%	3.15%	2.75%	2.65%	2.43%
Elective admissions	0.527%	0.557%	0.512%	0.399%	0.365%	0.369%	0.358%
ED discharge	0.152%	0.137%	0.143%	0.118%	0.124%	0.133%	0.117%
Ward discharge	1.63%	1.66%	1.65%	1.54%	1.50%	1.53%	1.49%
Time to assessment (minutes†)	33 (13, 74)	36 (14, 81)	37 (13, 86)	37 (13, 88)	37 (13, 88)	38 (14, 88)	40 (15, 91)
Did not wait for or to complete assessment (%)	3.7%	4.0%	4.5%	4.6%	4.7%	4.4%	4.0%
Admission to ward (%)	31.9%	30.1%	30.1%	31.3%	31.5%	30.9%	31.4%

LOS=Length of stay, ED=Emergency department. †Times are medians (interquartile ranges) due to the skewed underlying distributions.

ED LOS

There was a 1.1 hour decrease in the modelled estimate of total ED LOS in 2012 compared to that predicted for all patients and 2.9 for admitted patients (Table 4). All ethnic and age groups had lower estimates of total ED LOS in 2012 than those predicted from pre-target trends. Similarly, the model estimate of target reported ED LOS in 2012 was 1.6 hours less than predicted from pre-target trends (Table 4), and this was also reduced for all ethnic and age groups (Tables 5 and 6, supplementary material figures).

Re-presentation to ED

There was no clinically important change in the rate of re-presentation to ED within 48 hours of ED discharge overall pre- and post-the target (Table 4). The post-target trend was a reduction across all ethnic and age groups (Tables 5 and 6, supplementary material figures). Conversely, re-presentation to ED within 48 hours of inpatient ward discharge increased but also did not reach the clinically important threshold (Table 4).

Re-admission to a ward

The model estimated that re-admissions to a ward within 30 days of discharge in 2012 increased 1.1% over that predicted with continuation of pre-target trends (Table 4). All ethnic and age groups had higher estimates of re-admission at 30 days in 2012 than predicted from pre-target trends, although not all above the clinically important threshold (Tables 5 and 6, supplementary material figures).

Access block (ED crowding)

Access block was increasing prior to the introduction of the target then reduced after the target was introduced (Table 4, Figure 1A). All ethnic and age groups had importantly lower than predicted post-target estimates of access block (Tables 5 and 6). The pattern of change was similar for different groups, although older people were more likely to be subject to access block than younger people (Table 6, supplementary material figures).

Hospital admissions

Admission rates were trending downwards slightly prior to the target, with a step up at the introduction of the target followed by a downward trend thereafter. The net effect was that the model estimate of admission rate in 2012 was higher than predicted. However, the clinically important threshold was not reached and the estimated admission rate in 2012 was similar to that in 2008 (Table 4). The pattern of change post-target was similar across ethnic and age groups (Figure 1A). The difference between estimates of admission rates in 2012 and those predicted from pre-target trends for Pacific Peoples and the 'Other' ethnic group reached the clinically important threshold, while those for Asian, European and Māori ethnic groups did not (Table 5). The model estimates in 2012 were also importantly higher than predicted for adults as the pre-target trend was reducing and there was step-up at target introduction (Table 6, supplementary material figures).

Mortality in the ED

The observed model estimate of mortality in the ED in 2012 was 57.8% lower than predicted by the pre-target trend. This translates to ≈700 fewer deaths in the study population than predicted if the pre-target trend had continued (Table 4). The model estimates were consistent with the raw data, which showed there were 395 fewer deaths in ED in 2012 compared to 2008, a 47.3% relative decrease. The post-target pattern was consistent for all ethnic groups with no statistically significant differences for the change between these groups (Table 5, supplementary material figures). ED mortality also decreased importantly across all age groups, but more so for those under 65 years (Table 6, supplementary material figures).

In-hospital mortality

In-hospital mortality was unchanged for acute admissions, with a downward trend pre-target which continued post-target (Table 4, Figure 1B). There was no difference in the step at target introduction for acute inpatient mortality by ethnic group. However, a difference in the change in slope from pre- to post-target was demonstrated due to variation in the pre-target trends for different ethnic groups (Table 5, supplementary material figures).

For elective admissions the difference between mortality estimated in 2012 compared to that predicted if the pre-target trend had continued was 0.19% fewer. This was a 42.2% relative decrease, or ≈600 fewer deaths than predicted in 2012 if the

pre-target trend had continued. The model estimates were consistent with the raw data, which showed that there were 351 fewer deaths in 2012 vs 2008 (a 30% relative decrease). There was no difference by ethnic groups for this outcome, while there was a difference by various age groups with an increase in mortality for the 5–14 year group, due to a decreasing trend pre-target, which flattened out post-target. This group had the lowest mortality of all groups. Mortality for all other age groups was lower than predicted post-target (Tables 5 and 6, supplementary material figures).

Mortality for discharged patients

There was no detectable influence of the target in mortality for those discharged from ED (Table 4, supplementary material Figure 5) and no difference by ethnic or age groups (Tables 5 and 6) for this outcome. For those discharged from the ward there was a statistically significant reduction in mortality at 30 days that did not reach the clinically important threshold (Table 4). There were differences in the change in slopes pre- and post-target by ethnic and age group. Pacific Peoples and those in the 15-24 year age group had relative increases in mortality post-ward discharge, while other groups decreased (Tables 5 and 6, supplementary material figures).

Time to assessment

Time to assessment did not change importantly in relation to the target, with a 3.4 minute decrease between predicted and observed estimates, with no clinically important differences for different ethnic or age groups (Tables 4–6, Figure 1C, supplementary material figures).

Did not wait

The DNW rate was increasing prior to the target, then dropped after target introduction (Figure 1C). The difference between observed estimates in 2012 was 2.8% lower than predicted by the pre-target trend, which meant that the 2012 estimate was similar to that in 2008 (Table 4). All ethnic and age groups had reductions in estimated vs predicted DNW rates post-target (Tables 5 and 6, supplementary material figures).

Limitations

As this was an observational study, we are unable to attribute causality, and it is possible that factors other than the implementation of the ED target contributed to the observed changes in the outcomes measured, which is a weakness of our study. This is particularly relevant to the observed reduction in elective in-patient mortality as the introduction of two other health targets (improved access to elective surgery and faster cancer treatment) at the same time as the ED target in New Zealand may have impacted positively on this outcome.

Discussion

This study reports the impact of the introduction of the shorter stays in emergency departments target in New Zealand on a balanced suite of quality indicators at a national level. Despite the target threshold not being achieved, we found clinically important reductions in hospital LOS, ED LOS, ED crowding, ED mortality, elective mortality and the proportion of people not waiting to be seen or to complete assessment in the ED. Clinically unimportant changes were seen in time to assessment in the ED, re-presentation to ED at 48 hours from ED or ward discharge, and ward admissions. No change was seen in mortality for acute admissions or patients discharged from either the ED or hospital wards. However, an important increase was observed in re-admission to a ward at 30 days. There were no consistent patterns of difference between major ethnic and age groups for these outcomes, suggesting that the SSED target did not systematically advantage or disadvantage any groups defined by these particular demographic categories.

Although it may not be surprising that a mandatory government target for shorter ED stays resulted in the reduction in the reported ED LOS, the key question is whether such a reduction was also associated with real changes to improve the quality of care. The use of SSU increased markedly after the target was introduced. As SSU admission was a potential 'clock-stopping' device with respect to the target,

Table 4: Model estimates of change in quality of care indicators in association with the introduction of the shorter stays in ED target.[†]

Outcome	Predicted model estimate in 2012[††] compared to actual model estimate in 2012	2012 model estimate compared to 2008 model estimate	P value for change in slope post-target	P value for step at target introduction	Clinically important difference
Hospital LOS (days)	-0.29	-0.34	<0.001	<0.001	0.25
Total ED LOS (hr)	-1.1	-0.2	<0.001	<0.001	0.5
Total ED LOS admitted patients (hr)	-2.9	-0.7	<0.001	<0.001	0.5
Target reported ED LOS (hr)	-1.6	-0.9	<0.001	<0.001	0.5
Access block (%)	-26.8%	-14.2%	<0.001	<0.001	10%
Re-presents to ED at 48 hr (%) *from ED discharge* *from ward discharge*	 -0.7% +0.4%	 -0.8% +0.1%	 <0.001 <0.001	 <0.001 <0.001	1%
Re-admission to ward at 30 Days (%)	+1.0%	+1.1%	<0.001	<0.001	1%
Mortality‡ (%) *In ED* *Acute admissions* *Elective admissions* *ED discharges* *Ward discharges*	 -57.8% -4.1% -42.2% +6.4% -7.4%	 -51.0% -10.6% -29.5% -12.2% -8.9%	 <0.001 0.33 <0.001 0.18 0.97	 <0.001 0.77 <0.001 0.29 0.002	10%
Time to assessment (minutes)	-3.4	+1.8	<0.001	<0.001	15
Did not wait for or to complete assessment (%)	-2.8%	-0.5%	<0.001	<0.001	1%
Admission to ward (%)	+3.9%	+0.5%	<0.001	<0.001	5%

ED=Emergency department. [†]=The target introduced in 2009 was that 95% of people should be either discharged from the ED or admitted to hospital within six hours of presentation to ED. [††]The predicted model estimate is what would have been observed if the pre-target trend had continued. LOS=length of stay, Total=time in ED counting short stay unit time, Target Reported=reported time in ED not counting short stay unit time, [‡]Relative difference for this outcome, all others are absolute differences, hr=hour.

Table 5: Outcomes for different ethnic groups.

Outcome	Predicted model estimate in 2012 compared to actual model estimate in 2012	2012 model estimate compared to 2008 model estimate	P value for difference in step at target introduction for different ethnicities	P value for difference in change of slope after target for different ethnicities	Clinically important difference
Hospital LOS (days)					
European	-0.32	-0.32			
Māori	-0.28	-0.31	0.08	<0.001	0.25 (6 hours)
Pacific	-0.25	-0.52			
Asian	-0.08	-0.35			
Other	-0.22	-0.31			
All total ED LOS (hr)*					
European	-1.38	-0.20			
Māori	-1.00	-0.13	<0.001	<0.001	0.50 (30 min)
Pacific	-0.27	-0.35			
Asian	-0.67	-0.34			
Other	-0.34	-0.21			
Total ED LOS admitted patients (hr)*					
European	-3.4	-0.74			
Māori	-2.2	-0.53	<0.001	<0.001	0.50 (30 min)
Pacific	-1.2	-0.64			
Asian	-1.9	-0.95			
Other	-1.4	-0.49			
Reported ED LOS (hr)**					
European	-1.86	-0.90			
Māori	-1.19	-0.56	<0.001	<0.001	0.50 (30 min)
Pacific	-0.89	-1.03			
Asian	-1.33	-1.05			
Other	-0.86	-0.81			
Access block[†] (%)					
European	-28.7%	-14.7%	<0.001	<0.001	12%
Māori	-29.4%	-13.4%			
Other	-17.4%	-11.9%			
Re-presentation to ED (%) within 48 hours					
from ED discharge					
European	-0.61%	-0.77%			
Māori	-1.13%	-0.94%			
Pacific	-1.04%	-0.85%	0.30	<0.001	1%
Asian	0.72%	-0.25%			
Other	-0.09%	-0.32%			
from ward discharge					
European	0.33%	0.12%			
Māori	0.18%	-0.12%			
Pacific	0.64%	0.28%	<0.001	<0.001	
Asian	0.46%	0.34%			
Other	0.93%	0.56%			
Re-admission to ward (%) within 30 days					
European	0.91%	0.98%			
Māori	0.77%	1.49%	0.26	<0.001	1%
Pacific	2.18%	1.67%			
Asian	4.24%	4.10%			
Other	3.57%	2.97%			

Table 5: Outcomes for different ethnic groups (Continued).

Mortality[‡] (%)					
in ED					
European	-63.51%	-53.6%			
Māori	-43.90%	-49.8%			
Pacific	-63.65%	-40.3%	0.11	0.22	
Asian	87.57%	-21.3%			
Other	125.24%	-50.7%			
Acute admissions					
European	-4.11%	-11.1%			
Māori	-11.66%	-4.7%			
Pacific	26.74%	-6.1%	0.87	0.05	
Asian	-0.10%	-8.1%			
Other	-69.79%	-61.1%			
Elective admissions					
European	-46.4%	-32.6%			
Māori	-39.3%	-30.4%			10% relative change
Pacific	-25.8%	-2.7%	0.69	0.62	
Asian	13.8%	2.9%			
Other	-38.4%	-47.3%			
ED discharges (10 day)					
European	-4%	-12.89%			
Māori	38%	-15.55%			
Pacific	39%	-1.29%	0.81	0.38	
Asian	185%	7.25%			
Other	4234%	214.24%			
Ward discharges (30 day)					
European	-9.61%	-8.9%			
Māori	-6.11%	-10.1%			
Pacific	77.54%	15.3%	0.16	0.02	
Asian	-26.95%	-20.9%			
Other	-74.99%	-70.9%			
Time to assessment (minutes)					
European					
Māori	-6.6	0.7			
Pacific	-0.3	4.1	<0.001	<0.001	15 minutes
Asian	11.2	5.9			
Other	-1.0	1.6			
	-11.3	1.1			
Did not wait (%)					
European	-2.9%	-0.5%	0.61	<0.001	1%
Māori	-2.1%	0.2%			
Other	-4.4%	-1.3%			
Admission to ward (%)					
European	3.4%	0.4%			
Māori	4.8%	1.0%	<0.001	<0.001	5%
Pacific	6.2%	1.3%			
Asian	3.2%	0.9%			
Other	5.8%	-0.6%			

ED=Emergency department, LOS=Length of stay, *Total ED LOS includes time spent in a short stay unit, **Reported ED LOS does not include time spent in a short stay unit, [†]Access block is a wait more than eight hours for ward admission from ED (categories collapsed to enable model to run), [‡]Relative change for this outcome, all others are absolute change. Min=minutes.

Table 6: Outcomes for different age groups.

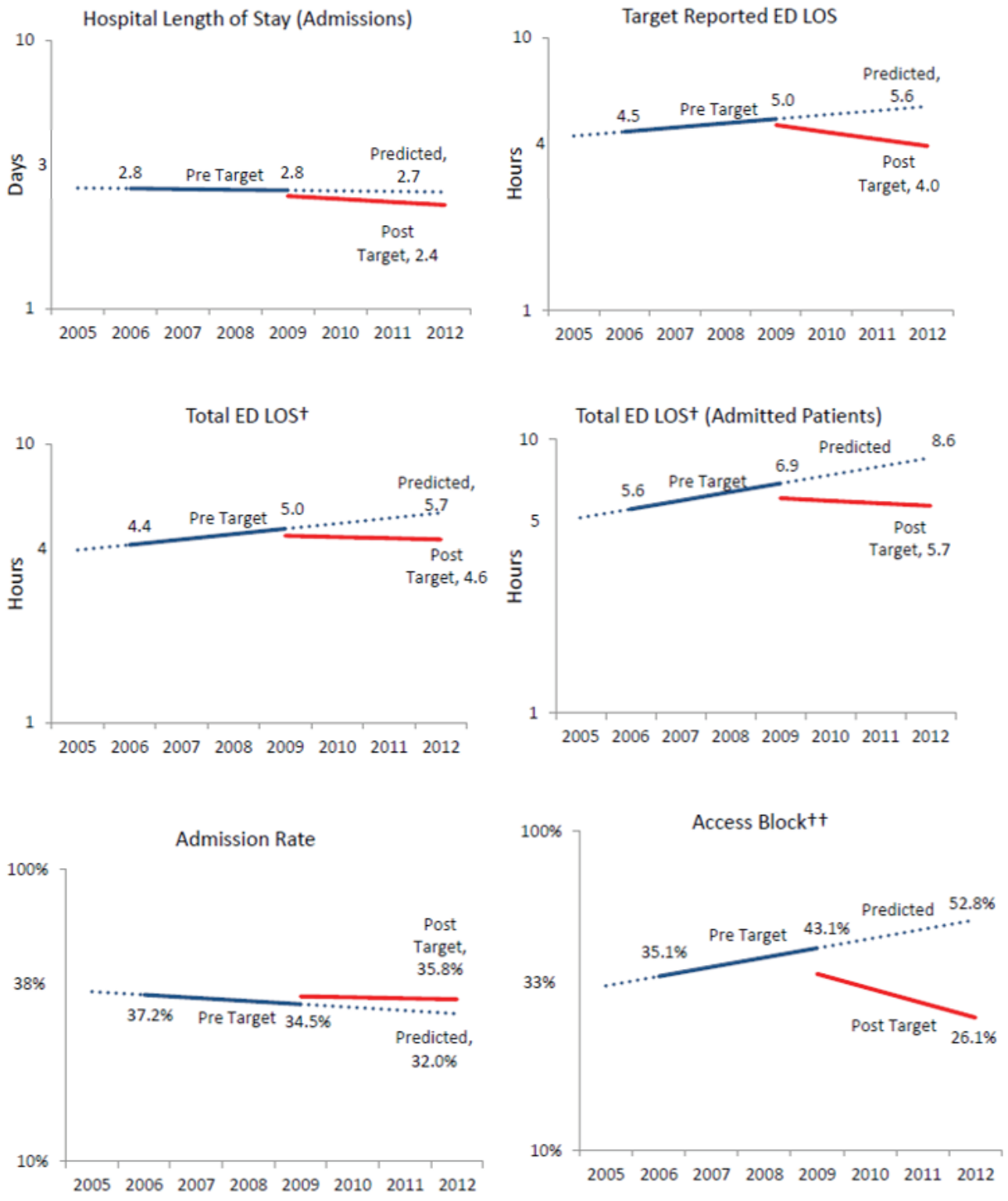
Outcome	Predicted vs estimated in 2012	2012 vs 2008 estimate	P value for difference in step at target introduction for different ethnicities	P value for difference in change of slope after target for different ethnicities	Clinically important difference
Hospital LOS (days)					
<5	-0.16	-0.24			
5–14	-0.29	-0.23	0.001	<0.001	0.25
15–24	-0.13	-0.26			(6 hours)
24–64	-0.23	-0.31			
≥65	-0.73	-0.68			
All total ED LOS (hr)*					
<5	-0.48	0.05			
5–14	-0.61	0.03	<0.001	<0.001	0.50
15–24	-0.66	-0.05			(30 min)
24–64	-1.09	-0.25			
≥65	-2.52	-0.70			
Total ED LOS admitted patients (hr)*					
<5	-0.6	0.29			
5–14	-0.8	0.04	<0.001	<0.001	0.50
15–24	-1.9	-0.63			(30 min)
24–64	-2.9	-0.89			
≥65	-4.3	-1.13			
Reported ED LOS (hr)**					
<5	-0.61	-0.13			
5–14	-0.70	-0.08	<0.001	<0.001	0.50
15–24	-0.94	-0.46			(30 min)
24–64	-1.62	-0.97			
≥65	-3.42	-2.09			
Access Block[†] (%)					
<65	-25.1%	-14.4%	0.24	0.1	12%
≥65	-64.2%	-18.9%			
Re-presentation to ED (%) within 48 hours					
from ED discharge					
<5	0.67%	-0.07%			
5–14	-0.73%	-0.54%	0.02	<0.001	
15–24	-1.54%	-0.84%			
24–64	-0.70%	-0.89%			1%
≥65	-0.57%	-0.67%			
from ward discharge					
<5	0.37%	0.30%	0.23	0.05	
5–14	-0.20%	0.11%			
15–24	0.68%	0.21%			
24–64	0.36%	0.07%			
≥65	0.29%	0.02%			
Re-admission to ward (%) within 30 days					
<5	0.331%	1.53%			
5–14	-0.157%	1.07%	<0.001	<0.001	1%
15–24	2.184%	1.70%			
24–64	1.736%	1.45%			
≥65	0.900%	1.14%			

Table 6: Outcomes for different age groups (Continued).

Mortality‡ (%)					
in ED					
<5	-63.69%	-55.5%			
5-14	-95.98%	-92.4%			
15-24	-94.61%	-89.2%	0.05	0.001	
24-64	-69.82%	-65.4%			
≥65	-41.32%	-36.4%			
Acute admissions					
<5	-53.88%	-34.9%			
5–14	-85.16%	-51.5%			
15–24	-45.28%	-20.3%	0.18	0.43	
24–64	-11.93%	-14.7%			
≥65	-1.00%	-9.3%			
Elective admissions					
<5	-12.6%	5.9%			10% relative change
5–14	122.8%	5.9%			
15–24	-53.2%	-7.7%	0.02	0.18	
24–64	-15.9%	-18.2%			
≥65	-53.9%	-39.3%			
ED discharges					
<5	11%	-23.97%			
5–14	-98%	-18.45%			
15–24	189%	20.32%	0.69	0.26	
24–64	36%	-10.60%			
≥65	-3%	-12.89%			
Ward discharges					
<5	-36.93%	-36.9%			
5–14	-90.61%	-50.6%			
15–24	312.47%	57.3%	0.09	0.04	
24–64	5.87%	-7.6%			
≥65	-10.68%	-8.9%			
Time to assessment (minutes)					
<5	-3.9	0.3			
5–14	-4.0	0.7	<0.001	<0.001	15 minutes
15–24	-6.1	2.3			
24–64	-2.3	2.7			
≥65	-2.7	1.1			
Did not wait (%)					
<5	-3.6%	-0.2%			
5–14	-2.5%	-0.3%	0.15	0.25	1%
15–24	-4.5%	-1.0%			
24–64	-2.7%	-0.6%			
≥65	-0.5%	0.0%			
Admission to ward (%)					
<5	3.9%	0.5%			
5–14	3.0%	0.0%	<0.001	<0.001	5%
15–24	5.1%	1.7%			
24–64	5.3%	1.5%			
≥65	5.0%	-0.2%			

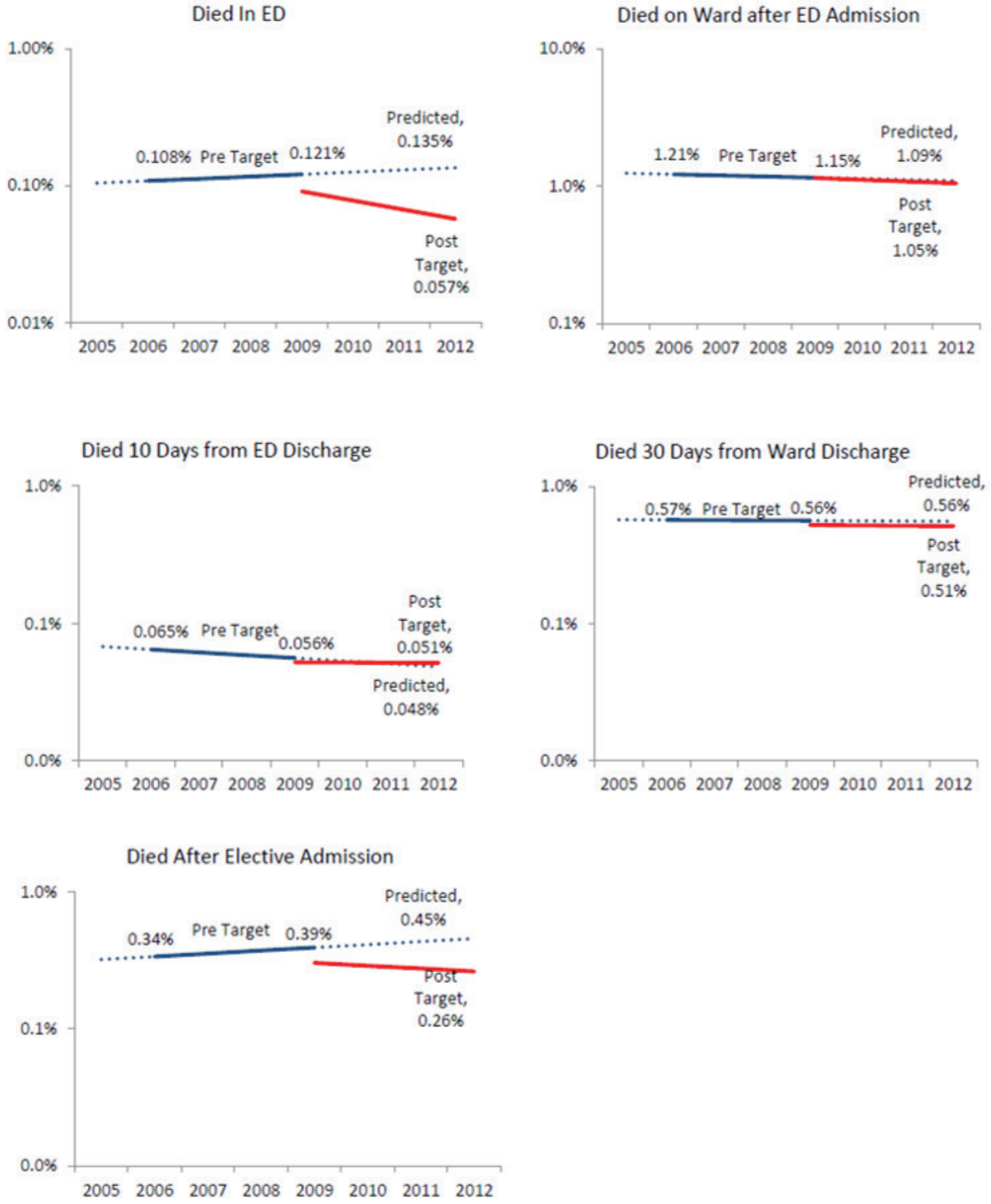
ED=Emergency department, LOS=Length of stay, *Total ED LOS includes time spent in a short stay unit, **Reported ED LOS does not include time spent in a short stay unit, †Access block is a wait more than eight hours for ward admission from ED (age categories collapsed to enable model to run), ‡Relative change for this outcome, all others are absolute change. Min=minutes.

Figure 1A: Model estimates of hospital and ED length of stay, admission rate and crowding (access block).



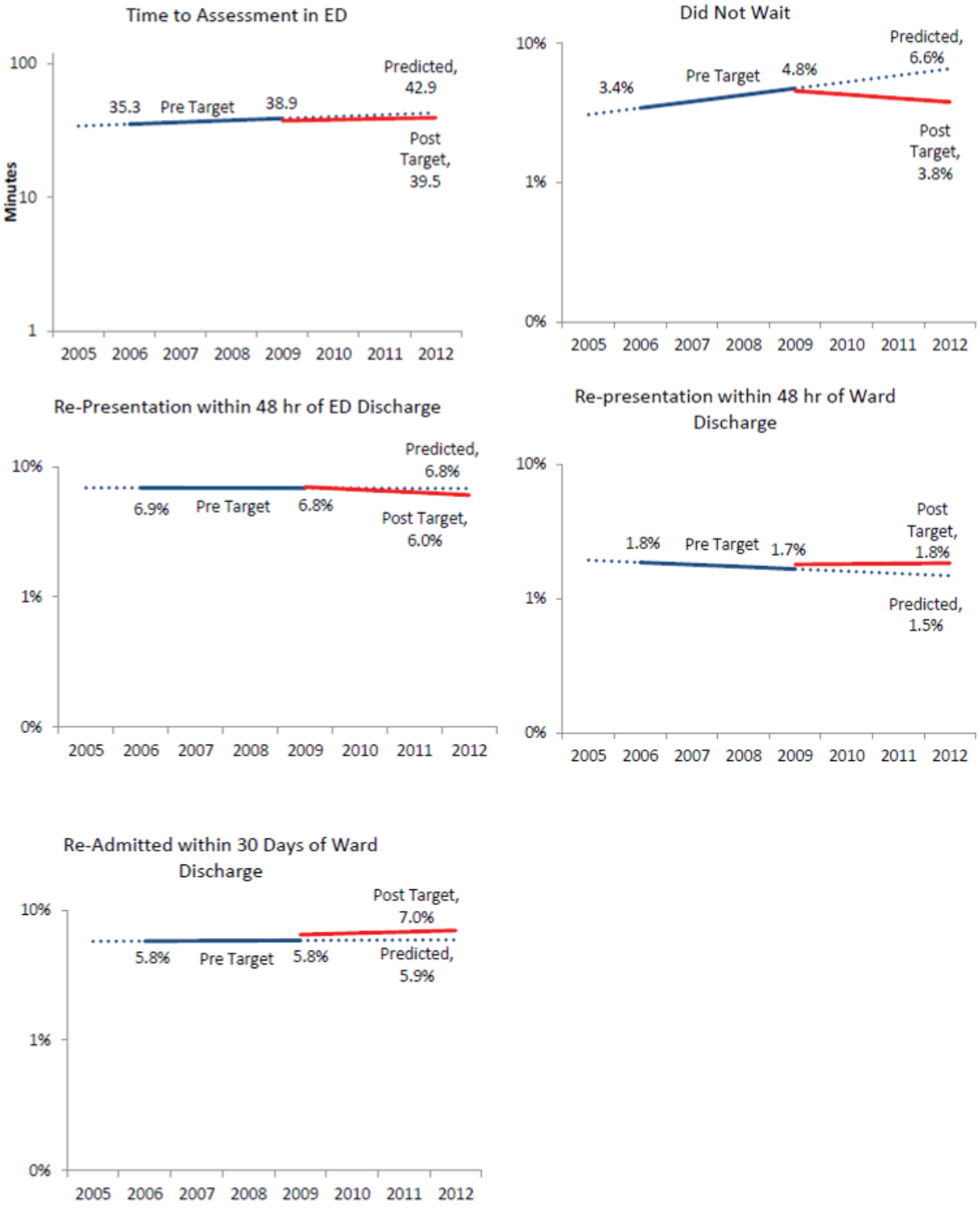
ED=Emergency department. All y-axes are logarithmic scale showing back transformed model estimates. †Total ED LOS includes time spent in a short stay unit. ††Access block is the proportion of patients admitted to a ward who spend more than eight hours in ED.

Figure 1B: Model estimates of mortality in ED, for those admitted to hospital and discharged patients.



ED=Emergency department. All y-axes are logarithmic scale showing back transformed model estimates.

Figure 1C: Model estimates of assessment time, did not wait, re-presentation and re-admission



ED=Emergency department. All y-axes are logarithmic scale showing back transformed model estimates.

we purposefully set out to measure ED LOS both when the time spent in a SSU was counted as ED time (total ED LOS) and when it was not (reported ED LOS). If SSU were used solely to 'stop the clock' for the target then we would expect either no change or an increase in total ED LOS. However, we observed a clinically important reduction in total ED LOS, which is consistent with real improvements in patient flow. Similarly, if SSU was used as a 'holding ward' for patients eventually admitted to a hospital ward, with no real improvements in the efficiency of the admission process, we would expect no change in total ED LOS for admitted patients, however, this group showed the greatest difference between observed and predicted total ED LOS in our study. A reduction in hospital LOS alongside a reduction in ED crowding and marked reduction in ED LOS for admitted patients suggests that the reduction in both reported and total ED LOS we observed may have been due to system-wide changes that facilitated patient flow out of the ED.

Reduced hospital LOS may be expected to result in increased capacity on the wards for admissions, which in turn should reduce ED crowding. Although the reduction in hospital LOS for admitted patients we observed was small for a given patient (≈7 hours per patient admitted), we believe it was clinically important at a national level, as this translates to approximately 145,000 extra bed days available nationally in the post-target period, which would plausibly account for the reduction in ED crowding we observed. This was offset by a small but important increase in re-admission to a ward within 30 days of discharge and a trend towards more ward admissions that was clinically important for adults. It is plausible that these changes may have been the result of early discharges from the ward as a result of pressure to create capacity for new admissions.[25]

The changes in patient flow we observed were associated with a marked reduction in mortality in ED, with a trend towards reduced mortality for acute admissions, with no corresponding increase in mortality for those discharged from ED or a ward and fewer deaths for elective ward admissions. This suggests that the improvement in ED mortality observed was not due to 'shifting deaths' to elsewhere in the system. Furthermore, the improvement in mortality occurred in the face of increasing triage acuity of ED presentations over time, which one would expect to attenuate any improvement in mortality in the post-target period. Previously, it was estimated that ED crowding contributed to 300–500 excess deaths per year in New Zealand[26,27] and size of the reduction in ED mortality in association with reduced ED crowding we observed are consistent with this.

At the inception of this study there was a paucity of research on the benefits and harms of mandatory national targets for ED LOS.[16,28] Subsequent research from the UK in 2012 with respect to the 'four-hour rule' from 15 purposefully selected hospitals showed that ED LOS for admitted patients increased rather than reduced,[29] with no change in mortality within the ED.[30] The authors did not explore whether mortality for those who left the ED (either discharged or admitted) changed in response to the target. The staggered introduction of the UK target in 2004–05 meant that this study captured one true pre-target and one post-target year. Another study of six hospitals in one state of Australia published in 2012, compared the unadjusted mortality for acute admissions in the year of the target introduction to the year after a 'four hour rule' introduction and found a 13% relative reduction in mortality for acute admissions in three out of six hospitals. However, in the year after the target there was also a 10% increase in presentations, which may have diluted the denominator for this outcome. Again, the mortality elsewhere in the system was not reported in this study. In both of these studies the ability to attribute the observed changes to the respective targets is also limited by the short time-frames employed in relation to before and after the intervention, and their conclusions may not be generalisable beyond the small selection of hospitals studied. In contrast, our study spanned seven years to account for secular trends before and after the introduction of the target and included 90% of hospitals nationwide, which are strengths of our study.

Although encompassing a longer time interval (six hours vs four hours) than both the UK and Australian targets, the shorter stays in ED target in New Zealand may have

been more effective at achieving the goal of improved quality of care through reduced ED crowding, despite the target not being reached nationally.[31] This might be due to a six-hour target being more achievable than a four-hour target. Similar to the UK, there was pressure on DHBs to meet the target, which was transferred to clinical staff.[25,28] In New Zealand there was also strong clinical buy-in to the principle of using the target to reduce ED crowding and a determination to not 'miss the point', at least in the emergency medicine community.[26,31]

Conclusion

On the balance of the evidence from this study, the national policy of a six-hour time target of 95% of ED patients being discharged from ED or admitted to hospital did not result in worse care and most likely led to improved care in the emergency department. However, attention should be given to ensuring efforts to discharge patients from in-patient wards are not at the expense of subsequent re-admissions.

Competing interests:
During his time as a research fellow on this study, JLF was also an elected member of one district health board. This potential competing interest was declared to all relevant parties prior to commencing the research activities, and his work was supervised directly by the corresponding author (PJ). The relevant parties and all other authors were satisfied that this potential conflict did not influence JLF's contributions to the submitted work. No other authors have any conflict of interest to declare.

Acknowledgements:
The authors would like to acknowledge Mr Dinesh Kumar for assistance with data management for this study.
The SSED National Research Project was supported by a grant of NZD1,138,000 from the Health Research Council of New Zealand (10–588). Dr Sue Wells was the recipient of a Stevenson Fellowship in Health Innovation and Quality Improvement.

Author information:
Peter Jones, Adult Emergency Department, Auckland City Hospital, Auckland District Health Board, Auckland, Section of Epidemiology and Biostatistics, University of Auckland, Auckland; Susan Wells, Section of Epidemiology and Biostatistics, University of Auckland, Auckland; Alana Harper, Adult Emergency Department, Auckland City Hospital, Auckland District Health Board, Auckland; James Le Fevre, Adult Emergency Department, Auckland City Hospital, Auckland District Health Board, Auckland; Joanna Stewart, Section of Epidemiology and Biostatistics, University of Auckland, Auckland; Elana Curtis, Te Kupenga Hauora Māori, University of Auckland, Auckland; Papaarangi Reid, Te Kupenga Hauora Māori, University of Auckland, Auckland; Shanthi Ameratunga, Section of Epidemiology and Biostatistics, University of Auckland, Auckland.

Corresponding author:
Dr Peter G Jones, Director of Emergency Medicine Research, Adult Emergency Department, Auckland City Hospital, Park Road, Grafton, Auckland 1142.
peterj@adhb.govt.nz

URL:
http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2017/vol-130-no-1455-12-may-2017/7239

REFERENCES:

1. Fewer more focussed targets. 2009. (Accessed 16/12/2015, at http://www.beehive.govt.nz/release/fewer-more-focussed-targets)
2. Ministry of Health. Health targets: Shorter stays in emergency departments. (Accessed 16/12/16, at http://www.health.govt.nz/new-zealand-health-system/health-targets/about-health-targets/health-targets-shorter-stays-emergency-departments)
3. Sprivulis PC, Da Silva JA, Jacobs IG, Frazer ARL, Jelinek GA. The association between hospital overcrowding and mortality among patients admitted via Western Australian emergency departments. Medical Journal of Australia 2006; 184:208–12.
4. Richardson DB. Increase in patient mortality at 10 days associated with emergency department overcrowding. Medical Journal of Australia 2006; 184:213–6.
5. Bernstein SL, Aronsky D, Duseja R, et al. The Effect of Emergency Department Crowding on Clinically Oriented Outcomes. Academic Emergency Medicine 2009; 16:1–10.
6. Sun BC, Hsia RY, Weiss RE, et al. Effect of emergency department crowding on outcomes of admitted patients. Annals of Emergency Medicine 2013; 61:605–11.e6.
7. Richardson D, Mountain D. Myths versus facts in emergency department overcrowding and hospital access block. The Medical Journal of Australia 2009; 190:369–74.
8. Higginson I. Emergency department crowding. Emerg Med J 2012; 29:437–43.
9. The NHS Plan: a plan for investment a plan for reform. Cm 4818-I. Report number 010481829, Department of Health. Department of Health, UK; 2000:1–147.
10. Expert Panel Review of Elective Surgery and Emergency Access Targets under the National Partnership Agreement on Improving Public Hospital Services. Australian Government, 2011. (Accessed 16/12/15, at http://www.coag.gov.au/sites/default/files/Expert_Panel_Report%20D0490.pdf)
11. Gubb J. Have targets done more harm than good in the English NHS? Yes. BMJ 2009; 338:442.
12. Geelhoed GC, de Klerk NH. Emergency department overcrowding, mortality and the 4-hour rule in Western Australia. Med J Aust 2012; 196:122–6.
13. Hauck K, Street A. Do targets matter? A comparison of English and Welsh National Health priorities. Health Econ 2007; 16:275–90.
14. Kelman S, Friedman JN. Performance Improvement and Performance Dysfunction: An Empirical Examination of Distortionary Impacts of the Emergency Room Wait-Time Target in the English National Health Service. J Public Adm Res Theory 2009; 19:917–46.
15. Wood H, Fontain P, Harvey D, Catford G, Hills A, Holland B. Investigation into Mid Staffordshire NHS Foundation Trust: Healthcare Commission; 2009 March. Report No.: ISBN: 978-1-84562-220-6.
16. Jones P, Chalmers L, Wells S, et al. Implementing performance improvement in New Zealand emergency departments: the six hour time target policy national research project protocol. BMC Health Serv Res 2012; 12:45.
17. Principles of Kaupapa Māori. 2011. (Accessed 18th December, 2015, at http://www.rangahau.co.nz/research-idea/31/)
18. Jones P, Harper A, Wells S, et al. Selection and validation of quality indicators for the Shorter Stays in Emergency Departments National Research Project. Emergency Medicine Australasia 2012; 24:303–12.
19. Jones P, Wells S, Harper A, et al. Is a national time target for emergency department stay associated with changes in the quality of care for acute asthma? A multicentre pre-intervention post-intervention study. Emergency medicine Australasia : EMA 2016; 28:48–55.
20. Harper A, Jones P, Wimsett J, et al. The effect of the Shorter Stays in Emergency Departments health target on the quality of ED discharge summaries. Emerg Med J 2016.
21. Jones P, et al. Effect of the Shorter Stays in Emergency Departments time target policy on key indicators of quality of care. NZ Med J 2017; 130(1455):35–44.
22. MOH. Ethnicity data protocols for the Health and Disability Sector. Wellington 2004.
23. Jones P, Sopina E, Ashton T. Resource implications of a national health target: The New Zealand experience of a Shorter Stays in Emergency Departments target. Emergency Medicine Australasia 2014; 26:579–84.

24. Salmond C, Crampton P, Atkinson J. NZDep2006 Index of Deprivation Wellington: Department of Public Health, University of Otago; 2007.

25. Chalmers L. Inside the Black Box of Emergency Department Time Target Implementation in New Zealand. Available from: http://researchspace.auckland.ac.nz/handle/2292/23541 Accessed 7/7/2015 [PhD]. Auckland: University of Auckland; 2014.

26. Ardagh M. How to achieve New Zealand's shorter stays in emergency departments health target. N Z Med J 2010; 123:95–103.

27. Jones PG, Olsen S. Point prevalence of access block and overcrowding in New Zealand emergency departments in 2010 and their relationship to the 'Shorter Stays in ED' target. Emergency Medicine Australasia 2011; 23:587–92.

28. Jones P, Schimanski K. The four hour target to reduce emergency department 'waiting time': A systematic review of clinical outcomes. Emergency Medicine Australasia 2010; 22:391–8.

29. Mason S, Weber EJ, Coster J, Freeman J, Locker T. Time patients spend in the emergency department: England's 4-hour rule-a case of hitting the target but missing the point? Annals of Emergency Medicine 2012; 59:341–9.

30. Weber EJ, Mason S, Freeman JV, Coster J. Implications of England's four-hour target for quality of care and resource use in the emergency department. Annals of Emergency Medicine 2012; 60:699–706.

31. Ardagh M. What have five years of the shorter stays in the emergency department health target done to us? N Z Med J 2015; 128:47–54.