The four hour target to reduce Emergency Department 'waiting time': a systematic review of clinical outcomes

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REVIEW ARTICLE

The four hour target to reduce emergency department 'waiting time': A systematic review of clinical outcomes

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Abstract

Governments in Australasia are introducing emergency department length of stay (EDLOS) time targets similar to the UK 'four hour rule'. There is debate about whether this rule had beneficial effects on health-care outcomes. We sought to determine what effects the four hour time target for EDLOS had on clinically relevant outcomes in the UK by conducting a systematic search for evidence. Articles were screened by both authors independently and assessed for quality using standard tools. Differences in outcomes measured and how they were measured precluded meta-analysis. There were inconsistencies between target achievement reported by Trusts and that reported in the studies, and empirical evidence that the target might be unattainable. National Health Service spending on ED increased £820 000 000.00 (1998–2007) and emergency admissions rose overall by 35% (2002–2006), but not in all hospitals. Time to see a treating clinician and hospital mortality was unchanged. One hospital demonstrated a small reduction in return rate. The impact of the introduction of an ED time target and the associated massive financial investment has not resulted in a consistent improvement in care with markedly varying effects being reported between hospitals. Countries seeking to emulate the UK experience should proceed with caution.

Key words: *emergency medicine, health policy, time factor.*

Introduction

Long waits to be seen and long waits for admission to hospital from an ED are a worldwide problem associated with poor outcomes for patients.[1–3]

As a part of the solution to this problem, Australasian health reformers are following the lead of the National Health Service (NHS), which set up the 'four hour rule' in 2001 with the goal of ending 'inappropriate trolley waits for assessment and admission', believing that this would improve quality of care for patients.[4]

This rule mandates that 98% of ED patients are discharged or admitted within 4 h of arriving in ED, and it was very effective on face value. Those who had a length of stay (LOS) <4 h in ED (EDLOS) increased from 77% to 96% from 2002 to 2004.[5] Consequently, a 2004 report to the UK government declared: 'long waits are an enduring problem around the world . . . By contrast,

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however, the approach of the NHS in England was hailed as an exemplary success'[5] and it was believed that 'the timeliness of care in English EDs is becoming the envy of the world'.[5]

Following the lead of the NHS, Western Australia has adopted the four hour target,[6] whereas New Zealand has chosen a six hour target,[7] similar to that proposed in New South Wales, with the hope that this would help reduce morbidity and mortality related to delays to patients being admitted to the hospital from the ED.[1,2]

Given this belief, and the uptake of the time targets in Australia and New Zealand, it is interesting that recent reviews from North America examining the causes,[8] effects[1,8] and potential solutions[8] to ED 'Overcrowding', which considered over 4000 studies, found only one article relating to the NHS relevant for discussion.[9] One reason might lie in the terms used in the search strategies employed by the reviewers. North American authors label this universal health system problem as 'Crowding or Overcrowding' and this is what the reviewers searched for. However, in the UK and Australasia the terms are 'Waiting Time' and 'Access Block', respectively. Furthermore, Embase (the major European medical database) was not searched and no attempt was made to find Grey Literature. These factors limit the chances that relevant UK articles would have been found.[10] It is also possible that there is no evidence relating to the effect of the UK 'four hour target'.

Given the limitations in the recent reviews, our objective was to find evidence for improved outcomes result of the four hour target for EDLOS. The research question was: 'What is the evidence that the "four hour rule" improves clinical outcomes for patients presenting to the ED?'

Method

The search strategy (Appendix) included a systematic search of major medical databases: Cochrane (CDSR and Central), Medline, Embase and CInAHL, using the free text terms 'four hour rule or target' and multiple subject heading terms for 'Emergency Medical Staff / Services', 'Quality' and 'Outcomes'. This was supplemented by a hand search of the *Emergency Medicine Journal* and *Health Services Research*, and the reference lists of retrieved articles. The abstract lists of the conferences of the Faculty of Accident and Emergency Medicine (latterly the College of Emergency Medicine) were also searched as was the World Health Organization clinical trials registry. Hand searches were restricted to 2004–2009. There was no language restriction. Titles and/or abstracts were screened for relevance by both authors independently using a standardized data extraction form. Full text of potentially relevant articles were retrieved and reviewed. Full text of an unpublished conference abstract was sought from the author.

Selection criteria

Eligible articles were selected on the basis of predetermined criteria: ED setting, use the UK four hour target for completion time and included at least one outcome other than the time target itself. Quantitative outcomes had to be measured before and after the introduction of the final target in 2004. Qualitative articles had to discuss outcomes after the introduction of the target. Articles were excluded from the review if they were individual's opinions in newsletters, press releases, letters to the editor or editorials. All other articles were eligible for inclusion.

Study selection and quality

Both reviewers independently examined the results of the search to identify potentially relevant articles using EndNote. The full texts of potentially relevant articles were reviewed using a standard data extraction form to determine whether inclusion criteria were met. Disagreements were resolved by consensus. Included studies were assessed for risk of bias and quality using either the Cochrane Risk of Bias Tool (randomized controlled trials), the Newcastle–Ottawa Scale (non-randomized studies)[11] or the Critical Appraisal Skills Program Tool (qualitative research).[12]

Results

Figure 1 shows the search strategy results. The date and sources of articles reviewed are shown in Table 1. All relevant studies were from the NHS. Six studies met the inclusion criteria for quantitative outcomes. These were uncontrolled before and after studies or time series analyses that measured 10 different outcomes (Table 2). Two studies used hospital level data and tested this formally. One group used a regression analysis of the slope of monthly incidence curves for several outcomes at time points relevant to the introduction of the targets, building potential confounders into the model[13] and the other explored hospital

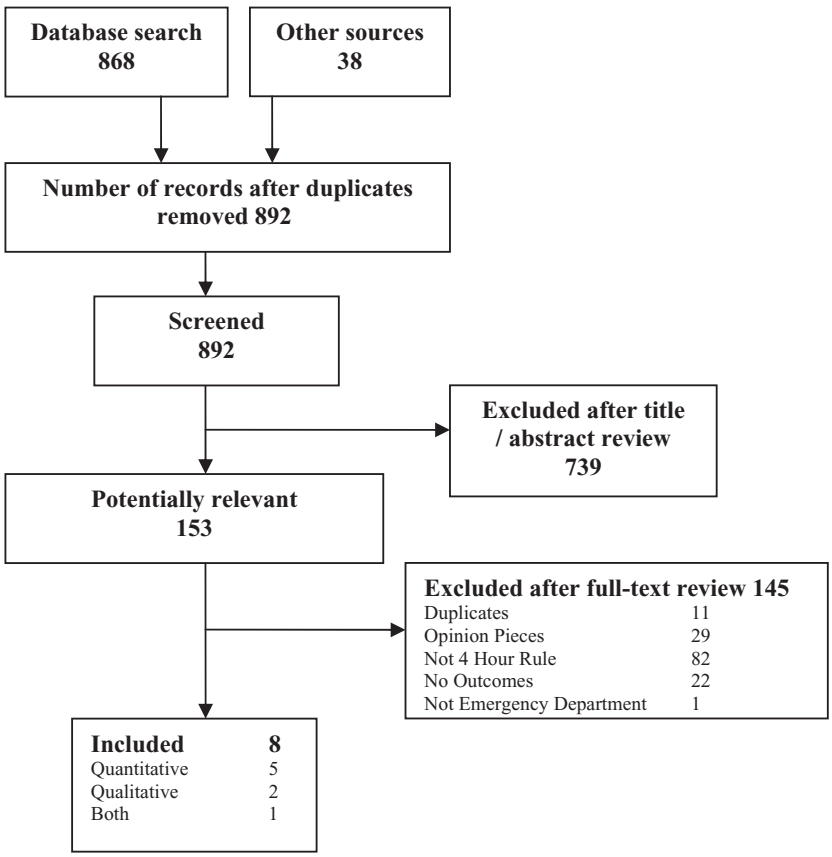

Figure 1. Search flow.

Table 1. Data sources and results of searches

Date of search	Hits	Database (portal)	Years	Potentially relevant	Finally included (reference)
2 March 2009	170	Cochrane (Ovid)	Unrestricted	2	
2 March 2009	422	Embase (Ovid)	1980–current	15	1[14]
20 May 2009	262	Medline (PubMed)	1966–current	87	
26 August 2009	14	CInAHL (Ebsco)	1937–current	11	6†
		Grey literature			
May 2009	156	BAEM/CEM conference abstracts 2004–2008	2004–2008	2	1‡
May 2009		Reports not indexed in medical databases	Unrestricted	9	5§
June 2009		Author contact	Unrestricted	5	2[13,15]
21 May 2009	336	WHO clinical trials registry	Unrestricted	0	
		Hand searches			
May 2009		Citation search of retrieved articles	Unrestricted	16	5[16–19]
		Journals (electronic)			
3–4 March 2009		*Emergency Medicine Journal*	November 2004–March 2009	13	1[20]
2 March 2009		*Health Services Journal*	1997–2008	1	

†All duplicates. ‡Author of conference abstract provided full-text article. §Found in citation search. BAEM, British Association for Accident and Emergency Medicine; CEM, College of Emergency Medicine; CInAHL, Cumulative Index of Allied Health Literature; WHO, World Health Organization.

Table 2. Clinically relevant outcomes before and after introduction of the four hour rule

Study/outcome	Quality (Newcastle–Ottawa Scale)			Time period/site/result	Statistical significance
	Participant selection (0–4)	Controls (0–2)	Outcome (0–3)		
Freeman 2010[13]	2	1	3	2000–2006 (Unless stated otherwise) Single Hospital	
Median (IQR) time to clinician				↓26 min: 57 (21–108) → 31 (11–64)	$P < 0.001$
Mean (SD) tests per patient				↑19.6%: 1.07 (1.45) → 1.31 (1.7)	$P = 0.023$
Admissions total (% per month)†				↑1.81 (1.22 to 2.41) 2000–2004	$P < 0.001$
				↓0.31 (–0.40 to –0.22) 2004–2006	$P < 0.001$
Admissions <24 h (% per month)†				↑0.041 (0.025 to 0.057) 2000–2003	$P < 0.001$
				↓0.18 (–0.24 to –0.13) 2004–2006	$P < 0.001$
Did not wait				↓2.5% (6 to 3.5)	$P < 0.001$
Return <7 days (% per month)				↓0.003 (–0.005 to –0.001)	$P < 0.001$
Mortality (%)				No change 0.18 (0.16–0.19), seasonal fluctuations	$P < 0.001$
Sibly 2007[20]	2	1	3	2002–2005 Single Hospital	
Admissions†				34% increase†	$P < 0.001$
Wood 2009[16]	2	1	3	2000–2007 Single Hospital	
Mortality				SMR >20% National average (unchanged)	$P < 0.05$
Commission for Healthcare Audit and Inspection 2008[17]	0	0	1	2000–2007 NHS Aggregate Data§	
% Treated <1 h (% median)					
(a) Time to be seen				57 (IQR 43–70), Unchanged	NA
(b) Paediatric analgesia				↑23% (57→78%) range 20–100% 2003–2007	
(c) X-ray radiograph hipfracture				↑3% (37→40%) range (0–80%) 2004–2007	
Wanless 2007[18]	2	0	1	2002–2006 NHS Aggregate Data	
Presentations				37% increase†	NA
Admissions total†				35% increase†	
Kelman 2009[15]	1	1	1	2002–2007 NHS Aggregate Data	Dependent on which of 24 exploratory regression models used to 'test' the data
Admissions† (%)				↓0.2 (18.7→18.5%) 2002–2005	
Mortality (%)				↓0.33 (1.17→0.84) 2003–2007‡	
Return <30 days (%)				↓2.27 (6.41–4.14) 2002–2005	
Orthopaedic/trauma surgery wait times (units not specified)				↓2.21 (4.52–2.31) 2002–2007	

†Emergency admissions only. ‡Ratio of deaths to number of emergency presentations by week. §Voluntary audit, incomplete data. IQR, interquartile range; NA, not applicable; SD, standard deviation; SMR, standardised mortality ratio (National Health Service [NHS] data).

admissions from ED over time.[20] Three studies presented aggregate Trust level data,[16–18] only one tested the data formally.[16] The final study experimented with many different regression models to explore the possibility that the four hour target might have lead to 'performance dysfunction' using Trust level data.[15] Single centre studies scored higher for quality than studies reporting aggregate NHS data due to better descriptions of data collection and completeness of outcome reporting, although lack of a comparison cohort or controlling for only one factor in analysis meant no studies scored highly for comparability/controls (Table 2). Of studies scoring more than zero for this element, one compared mortality at one hospital with the rest of the NHS over time,[16] and two controlled for external factors when assessing outcomes.[13,20] Heterogeneity in study design and choice of outcomes precluded meta-analysis, and might have accounted for the differences in results seen for some outcomes. Outcomes reported by more than one study are discussed below.

Number of emergency presentations and admissions

NHS data show a 37% rise in ED presentations and a corresponding 35% increase in emergency admissions from 2002 to 2006.[18,21] Interestingly, one study reports a reduction in admissions from 18.7 (standard deviation [SD] 4.77)% to 18.5 (SD 5.22)% from 2002 to 2005, apparently from the same dataset.[15] One hospital level study found an overall rise in admissions from 2002 to 2005 of 14%,[20] whereas another found admission rate varied over the period studied (2000–2006), with a reduction in admissions of 0.31% per month from the 98% target introduction.[13] Short stay (<24 h) admissions increased 34% at the first hospital[20] and reduced 0.18% per month at the second.[13]

Time to see a treating clinician

Over the whole NHS, the proportion of hospitals where the median time to see a clinician was <1 h remained static from 2000 to 2007 at 57%, with the interquartile range 43–70%.[17] In one hospital, median time to seeing a clinician fell from 57 to 31 min; however, this occurred before the target introduction, with the establishment of a minor injuries unit associated with a reduction of 11 min per annum in time to see a clinician from 2002 to 2004, with no further reduction after the 98% target was introduced.[13]

Number of representations

One study reports a fall in representations within 7 days of ED attendance of 0.1% per month from 2004 to 2005[13] and another reported a fall of 2.3% in representations within 30 days from 2002 to 2005.[15]

Mortality of emergency admissions

Kelman reported a reduction in mean (SD) in-hospital mortality of emergency admissions across the NHS from 1.17 (0.43)% to 0.84 (0.32)% from 2003 to 2007.[15] However, at single hospital level, two studies found no difference in mortality for emergency admissions. Freeman reports a low mortality (0.18% with consistent seasonal variations) despite improvement in target performance from 2000 to 2006, although the target was never met.[13] In contrast, another hospital that reported meeting the target had a consistently high and unchanged standardized mortality rate (SMR), >20% higher than the NHS average from 2003 to 2008.

Three studies met the inclusion criteria for qualitative research[14,17,19] and are summarized in Table 3. Two predominant themes emerged: the concept of the target was supported, but it was felt that patient care might be compromised if too much emphasis was placed on simply meeting the target.

Discussion

There is no clear evidence that the target to ED completion of 98% of patients in 4 h in itself has had any effect on the quality of care in ED in the UK. Given that approximately £820 000 000.00 was invested directly into EDs in the UK from 1998 to 2007,[18] this lack of evidence is quite remarkable.

One of the reasons the EDLOS target was chosen is that it was felt that the previously reported 'time to triage' and 'time for decision to admit' were open to manipulation.[22] Before 2001, the time to see a clinician (the most important time for patients) was closely associated with total time spent in the ED, and it was hoped that by focusing on EDLOS, the time to see a clinician would improve. This is not the case; despite the apparent improvement in reducing total time in ED, there has been no change in the time to see a treating clinician in the UK over the years 2000–2007.[17]

This might be because the target was not actually met in hospital EDs. There are doubts about the accuracy of the EDLOS data reported by Trusts to the NHS.

Table 3. Studies exploring attitudes and beliefs about the four hour target

Author/date	Participants (*n*)	Method/quality	Themes (quotations as examples)
Mortimore 2007[14]	Nurses++ (9)	Semi structured interviews/good	Considered that the target was 'an overall success' but there were 'concerns that the quality of care was compromised by time targets taking priority over clinical need'.
Healthcare Commission 2008[17]	Patients with complex or particular individual needs, their families and carers (90)	Structured interviews/ moderate	'. . . most people were positive about how they had been treated by staff and how quickly they had been seen . . . .some aspects of care where services had fallen short of people's expectations . . .' 'Long waits to see a doctor or nurse, referred to other services inappropriately, had to repeat details to different members of staff and different services.'†
BMA 2005[19]	All NHS A&E Consultants+ (81% response)	Questionnaire with free text response space/poor	'The four-hour target has been a huge benefit to us. We feel our service has improved.' 'Patients about to breach get a bed ahead of more seriously ill patients.' 'The four-hour target has been a huge benefit to us. We feel our service has improved.' 'Senior doctors were criticised for spending time in resuscitation area.' 'Quality should not be measured in time. Four hours is too long for many and too short for a few.'

†*All aspects of emergency care, included 'A&E'. +, whole National Health Service (NHS); ++, single hospital; A&E, accident and emergency; BMA, British Medical Association.*

The recent in-depth investigation into the failing Mid-Staffordshire Trust (rated as a high achiever with respect to the targets, yet had a SMR consistently 20% higher than the NHS average) revealed inconsistencies in what was reported to the Department of Health and what actually happened.[16] An analysis of target achievement at Trust level across the whole NHS in 2007 showed 97.6% achievement of the target; however, when analysed by individual hospitals, achievement was only 79%. This figure was consistent with patients' reporting an A&E time of <4 h, 67% in 2004 and 73% in 2007.[17] A Trust performing well, with a lower than average mortality compared with the rest of the NHS, also failed to meet the target consistently (83% met in 2003 and 88% met in 2005[13]), despite the Trust's website stating the target was met 98% of the time.[23] A survey of senior Emergency Doctors in 2005 found that only 50% of departments reported that they met the target and only 26% confirmed that the figures submitted were accurate.[19] At the same time the NHS was reporting 96% success with meeting the target.[5] These inconsistencies should be viewed in the light of both the large incentives (up to £500 000.00) for a Trust to meet the target versus public vilification through loss of 'star rating' and threats to senior management jobs if the targets were not met. There is evidence that much of the burden to meet the target was placed on the shoulders of clinical, especially nursing, staff.[14,16,24]

Theoretical modelling, validated on real patient data, suggests that in order that 98% of patients have an EDLOS <4 h, the average EDLOS needs to be just less than 1 h.[25] This might be unattainable, given that the mean EDLOS in the NHS was still almost 2 h in 2005.[17] Subsequent to the target being implemented EDLOS data in the UK showed a marked spike in admissions at exactly at 4 h, suggesting that the target might have been 'artificially' met in some cases.[26,27]

Quality of care markers measured in the retrieved studies appear to have been chosen mostly for ease of measurement (routinely collected hospital incidence data). The scope for inconsistencies in using this type of data is demonstrated by contrasting interpretations of the effect of the targets on admission rate. NHS data show a rise in emergency admissions after the target was introduced,[18,21] yet one author reports a reduction in admissions, apparently from the same dataset.[15] One hospital level study found a rise in short stay admissions of 34%,[20] whereas the other found a slight reduction in such admissions.[13]

Mortality rates reported reflect either the whole NHS or a single hospital's performance. There was a slight reduction in mortality across the NHS as a whole from 2003 to 2008;[16] however, reductions in-hospital mortality over this time are not restricted to the NHS[28] and the observed reduction is more likely to be due to the massive investment in staff and improved access to care

throughout the NHS rather than the four hour rule.[18,29] In-hospital mortality is a marker of whole hospital rather than simply ED performance; rapidly moving a patient through the ED without a proper workup might be ill-advised if care on the inpatient wards is less than exemplary.[16,30]

Returns to the ED within a certain time period were also used as a marker of poor care. This ignores the possibility that a patient might have been well enough for discharge at the time seen and given appropriate advice to return if their condition worsens. Some would regard this as good care. In settings where the patient has a choice of provider, they might not return to the place where care was perceived to have been poor, in such cases a reducing 'return' rate would represent poor care. Counting the number of investigations without consideration of whether those investigations were appropriate is also a poor marker of quality.

Major changes in provision of after-hours primary care also occurred in the NHS during the time period under consideration. These changes are believed to have contributed to the sharp increase in presentations to the ED.[18] If the rise in ED presentations and admissions were due to more primary care patients, the apparent falls in return rates and mortality might have simply been due to a change in the nature of denominator (more low acuity patients, who easier to sort out and were less likely to become sick or die). No studies reporting these outcomes factored this into their analyses.

Of the other clinically relevant markers of quality used in the retrieved studies, times to analgesia for children and time to X-ray radiograph in older patients with hip fracture, there was a wide variation between hospitals, despite virtually all hospitals reporting target success.[17] Other potentially relevant outcomes, such as time to reperfusion in acute myocardial infarction, time to/adequacy of analgesia, time to/appropriateness of antibiotics in suspected infection and trauma survival rates were not measured. As causes of and solutions to ED overcrowding might lie beyond the ED[8], markers of whole hospital flow and quality of care should also be considered, such as whole hospital LOS, time to theatre for fractured neck of femur and appendicitis.

So, where to for Australasian EDs? Will introduction of these targets lead to dysfunctional behaviours to satisfy the political desire to be seen to be achieving them? Will resources be diverted away from other aspects of care in order to meet a time target? Or will the target prove a useful lever to focus attention on reducing blocks to hospital admission from the ED?[2,3,9] Few health policy interventions are introduced on the basis of evidence.[18] Introduction of the EDLOS targets in Australasia provides a unique opportunity to develop evidence for this policy initiative by exploring effects on clinically relevant outcomes, other than attainment of the target itself. It is up to the emergency medicine and wider health communities to take on this challenge.

Conclusion

On current evidence it appears that the 98% target for ED completion within 4 h in the UK was in reality not met. The impact of the introduction of an ED time target and the associated massive financial investment has not resulted in a consistent improvement in care with markedly varying effects being reported between hospitals. Countries seeking to emulate the UK experience should proceed with caution.

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Author contributions

PJ 90%: conceived the idea, designed the search strategy and ran the searches; designed data collection forms; reviewed articles for eligibility and critically appraised included articles; drafted the manuscript and revised the manuscript after editorial review. KS 10%: reviewed articles for inclusion and critically appraised articles; commented on and proofed the draft manuscript.

Competing interests

None declared.

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