G Model
JINJ 7685 No. of Pages 7
ARTICLE IN PRESS

Injury, Int. J. Care Injured xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Time to CT head in adult patients with suspected traumatic brain injury: Association with the 'Shorter Stays in Emergency Departments' health target in Aotearoa New Zealand

Peter Jones[a,b,*,1], Waheedah Athaullah[a,1], Alana Harper[a,1], Susan Wells[c,2], James LeFevre[a,1], Joanna Stewart[c,2], Elana Curtis[d,3], Papaarangi Reid[d,3], Shanthi Ameratunga[c,2]

[a] Adult Emergency Department, Auckland City Hospital, Auckland District Health Board, Auckland, New Zealand
[b] Department of Surgery, University of Auckland, Auckland, New Zealand
[c] Section of Epidemiology and Biostatistics, University of Auckland, Auckland, New Zealand
[d] Te Kupenga Hauora Māori, University of Auckland, Auckland, New Zealand

ARTICLE INFO

Keywords:
Traumatic brain injury
Computerised tomography
Emergency department
Crowding

ABSTRACT

A national health target for length of stay in emergency departments (ED) was introduced in 2009 to reduce crowding and improve quality of care. We aimed to determine whether the target was associated with changes in time to CT and appropriateness of CT imaging, as markers of care quality for suspected acute traumatic brain injury (TBI). We undertook a retrospective review of the case records of a random sample of people aged ≥15 years presenting to the ED with TBI from 2006 to 2013. General linear models were used to investigate changes in outcomes along with routine process times before and after the introduction of the target. Among 501 eligible cases the median (IQR) time to CT was 136 (76–247) pre target versus 119 (59–209) minutes post target, p = 0.014. The proportion of appropriate imaging was similar between periods: 77.9% (95% CI 71–83%) versus 76.6% (95%CI 72–81%), p = 0.825. Interactions suggested that the time to CT and appropriateness of imaging before and after the introduction of the target varied by ethnicity, although the changes were not clinically important. Time to assessment and length of stay did not change importantly. We found no evidence of a clinically important change in time to CT or appropriateness of imaging for suspected TBI in association with the introduction of the SSED time target. Additional research with larger cohorts of Māori and Pacific participants is recommended to understand our observed patterns by ethnicity.

Introduction

Traumatic Brain Injury (TBI) is a leading cause of death, hospitalization and disability worldwide [1]. Optimal management of TBI patients involves the swift identification of intracranial injury, evacuation of any significant haematoma and prevention of secondary insults that can have a significant effect on the final outcome of a patient [2,3]. Computed tomography (CT) is the imaging modality of choice for traumatic brain injury because of its widespread availability, rapid imaging time, low associated costs and safety [4]. Patients who require life-saving decompressive surgery are recommended to undergo surgery as soon as possible after injury [5], with some guidelines recommending surgery within 4 h [6]. Thus time to CT imaging is considered critical in diagnosing a TBI and facilitating rapid surgical intervention [7].

* Corresponding author at: Adult Emergency Department, Auckland City Hospital, Auckland District Health Board, Auckland, New Zealand.
E-mail addresses: peterj@adhb.govt.nz (P. Jones), waheedah84@doctors.org.uk (W. Athaullah), AlanaH@adhb.govt.nz (A. Harper), s.wells@auckland.ac.nz (S. Wells), JamesLeF@adhb.govt.nz (J. LeFevre), jo.al.stewart@vodafone.co.nz (J. Stewart), e.curtis@auckland.ac.nz (E. Curtis), p.reid@auckland.ac.nz (P. Reid), s.ameratunga@auckland.ac.nz (S. Ameratunga).
[1] Adult Emergency Department, Auckland City Hospital, Park Road, Grafton, Auckland 1142, New Zealand.
[2] Section of Epidemiology and Biostatistics, University of Auckland, Tamaki Campus, 261 Morrin Road, St Johns, Auckland 1072, New Zealand.
[3] Te Kupenga Hauora Māori, University of Auckland, Tamaki Campus, 261 Morrin Road, St Johns, Auckland 1072, New Zealand.

https://doi.org/10.1016/j.injury.2018.05.011
0020-1383/

The process of completing a CT head in a severely injured patient is complex and involves staff from multiple disciplines (emergency, radiology, surgery, intensive care). As such, the time taken to complete a CT scan is a marker of healthcare quality and performance. Aotearoa New Zealand (NZ) introduced a the Shorter Stays in Emergency Department (SSED) target, a mandatory national time target for ED Length of Stay (LOS) in July 2009 in order to reduce ED crowding and its associated harms [8]. Time to CT has been identified as one of the challenges to improving acute patient flow towards meeting the SSED target in NZ hospitals [9]. Time to cranial CT for TBI was also identified as an important trauma quality indicator to monitor the impact of the SSED target by a healthcare stakeholder group established as part of the SSED National Research Project. This project aimed to determine whether an ED LOS target would influence the provision and timeliness of important processes of care. The stakeholder group was independent of the research team and included 25 participants from different sections of the health-care system: primary care, secondary care, older people's health, paediatrics, long-term residential care, public health, Australasian College for Emergency Medicine (ACEM) and College of Emergency Nurses of NZ, Māori and Pacific health care [10].

Processing patients faster in response to a LOS target may result in shorter times to CT. It is also possible that more CT scans are done in the desire to move patients more quickly through the ED. However, access to timely radiology is a key “bottle-neck” for all ED patients, so it is also possible that CT scans may be delayed if staff were occupied with other urgent radiological referrals generated by the desire to reduce lengths of stay for patients more generally.

This project sits within the Institute of Medicine quality framework [10] and aims to investigate the timeliness of CT scanning (access to care) for patients who present to ED with acute TBI (primary outcome) before and after the introduction of the SSED target. The secondary outcomes were: appropriateness of CT, time from arrival to assessment by a doctor, ED LOS, Hospital LOS, time to operating theatre, and mortality.

Methods

Setting

This was a single centre study at Auckland City Hospital over eight years from 1st January 2006 to 31st December 2013. Auckland City Hospital is a tertiary trauma referral centre with neurosurgical services on site. It is the sole neurosurgical centre serving the Auckland region of NZ with a catchment of approximately 450 000 adults (>14 years old). The annual number of ED presentations is 65,000. All acute trauma receiving hospitals in NZ are publically funded.

Case selection

The hospital data warehouse containing information on all patients presenting to the ED was searched for cases with a primary diagnosis for TBI based on International Classification of Disease (ICD) version 10 Nature of Injury codes: S02.0, S02.1, S02.3, S02.7, S02.8 - S02.9, S04, S06.00, S06.01-05, S06.1, S06.20-23, S06.28, S06.30-34, S06.38, S06.4, S06.5, S06.6, S06.7, S06.8, S06.9, S07.1, S07.8, S07.9, S09.7, S09.8, T02.0, T04.0, T06.0. Cases were excluded if this visit was not a TBI, a re-presentation for previous TBI or an inter-hospital transfer. Only those who had a CT were eligible for the primary outcome, however all cases were eligible for the secondary outcome of appropriateness of CT (or not).

Sample size calculations were based on pilot data from the index site (n = 50). From the pilot study approximately 10% of cases retrieved had moderate or severe head injury (defined below based on Glasgow Coma Scale). For those with mild head injury, to detect a difference in time to CT of 60 min between the two time periods with a power of 90% and alpha 0.05, 540 cases were required. For those with moderate or severe head injuries, 50 cases were required to detect a difference in time to CT of 30 min with a power of 90% and alpha of 0.05. Approximately two thirds of notes retrieved in the pilot were eligible for inclusion. To achieve the required sample size we randomly selected 820 cases from the hospital data warehouse for screening using the random number generator in Microsoft Excel^{TM} (IBM Corporation, Armonk, New York, USA).

Data collection

A unique patient identifier (National Health Index number) was used to link electronic hospital records for each patient. A standardised data extraction form was developed and piloted using a Microsoft Excel^{TM} spread sheet with inbuilt logic to reduce data entry errors and rules to objectively assess whether CT scans were appropriate. Information collected included: demographic data, factors in the history to determine the need for CT scan, co-morbidities, time of presentation, triage and disposition from the ED, time and result of CT scan, need for neurosurgical interventions, and in-hospital mortality. Ethnicity was classified using a prioritised approach, where a single ethnic group is allocated to each individual using a priority system (Māori, Pacific, Asian, Other, NZ European) [11]. Data were collected by trained extractors and 10% of charts were checked independently by a second extractor to verify accuracy. Discrepancies were resolved by further review of charts and final adjudication by the lead author. Data definitions and rules around missing data were set a priori [12]. Data collectors were not blinded to either the purpose of the study or the date of presentation to hospital.

Statistical methods

Proportions with 95% Confidence Intervals (CI) and medians with Interquartile Range (IQR) were used to describe the data as appropriate. Unadjusted analyses were undertaken using Chi squared tests for proportions and the Mann Whitney U test for skewed continuous data (times). To investigate change in time to CT from pre to post the target introduction a general linear model was fitted with the log of the time to CT as the outcome. Data from 2009 were excluded from the model as this was the intervention year. The explanatory variables were period (pre or post the target), ethnicity (coded as Māori, Pacific or European/Other), deprivation index (a 10 point scale of social deprivation based on small areas of domicile in NZ which was fitted as a continuous linear term, after the assumption of linearity was confirmed using a scatterplot), severity of injury (mild versus moderate or severe). The interaction between ethnicity and period was explored and removed if not significant. The secondary outcomes of ED LOS and hospital length of stay (all log-transformed) were similarly investigated. The back transformed least square means and 95% confidence intervals were formed for the time to events with time in minutes except for hospital LOS which is in hours. As only 16 individuals were operated on in the study period, time to operation was not analysed.

Logistic regression was used to investigate changes in the proportion who died and time to assessment ($\leq$15 min versus $>$ 15 min), pre and post the introduction of the target. The explanatory variables included were the same as used for the general linear model above. CT appropriateness was analysed similarly but restricted to those where severity was mild and the period ethnicity interaction was included. Unadjusted descriptive analysis was performed using SPSS v21, Armonk, New York, USA.

Please cite this article in press as: P. Jones, et al., Time to CT head in adult patients with suspected traumatic brain injury: Association with the 'Shorter Stays in Emergency Departments' health target in Aotearoa New Zealand, Injury (2018), https://doi.org/10.1016/j.injury.2018.05.011