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Acute costs and predictors of higher treatment costs of trauma in New South Wales, Australia

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ABSTRACT

Background: Accurate economic data are fundamental for improving current funding models and ultimately in promoting the efficient delivery of services. The financial burden of a high trauma casemix to designated trauma centres in Australia has not been previously determined, and there is some evidence that the episode funding model used in Australia results in the underfunding of trauma.
Aim: To describe the costs of acute trauma admissions in trauma centres, identify predictors of higher treatment costs and cost variance in New South Wales (NSW), Australia.
Materials and methods: Data linkage of admitted trauma patient and financial data provided by 12 Level 1 NSW trauma centres for the 08/09 financial year was performed. Demographic, injury details and injury scores were obtained from trauma registries. Individual patient general ledger costs (actual trauma patient costs), Australian Refined Diagnostic Related Groups (AR-DRG) and state-wide average costs (which form the basis of funding) were obtained. The actual costs incurred by the hospital were then compared with the state-wide AR-DRG average costs. Multivariable multiple linear regression was used for identifying predictors of costs.
Results: There were 17,522 patients, the average per patient cost was $10,603 and the median was $4628 (interquartile range: $2179–10,148). The actual costs incurred by trauma centres were on average $134 per bed day above AR-DRG costs-determined costs. Falls, road trauma and violence were the highest causes of total cost. Motor cyclists and pedestrians had higher median costs than motor vehicle occupants. As a result of greater numbers, patients with minor injury had comparable total costs with those generated by patients with severe injury. However the median cost of severely injured patients was nearly four times greater. The count of body regions injured, sex, length of stay, serious traumatic brain injury and admission to the Intensive Care Unit were significantly associated with increased costs ($p < 0.001$).
Conclusion: This multicentre trauma costing study demonstrated the feasibility of trauma registry and financial data linkage. Discrepancies between the observed costs of care in these 12 trauma centres and the NSW average AR-DRG costs suggest that trauma care is currently underfunded in NSW.

Background

Traumatic injury accounts for 11% of global mortality and is a leading cause of physical and psychological disability in all ages.[1] The economic burden of trauma is substantial[2] costing an estimated US$518 billion globally.[3] In Australia, injuries are one of the top six most costly disease groups,[4] responsible for over half a million hospitalisations, making it the second highest in-hospital cost following cardiovascular disease.[5]

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Previous international evaluations have highlighted the economic burden of treating trauma.[6–11] Trauma systems, which mandate that trauma patients be transported to designated specialist trauma centres, are fundamental to providing a consistent systematic approach to trauma care and improving patient outcomes.[12–14] Following the implementation of a trauma system in New South Wales (NSW), Australia, trauma centres in NSW receive proportionally higher volumes of trauma and currently admit more trauma patients than any other state/territory in Australia.[15] The financial burden of a high trauma casemix to designated trauma centres in Australia has not been accurately determined.

In an environment of increasing health care costs and competition for finite resources, accurate economic data relating to the cost of treating injury is fundamental to ensure cost-effective informed development strategies and delivery of services. NSW hospitals are allocated a budget based on Acute, ICU and ED funding models, using an episode (casemix) funding model.[16] The episode funding model uses Australian Refined Diagnostic Related Groups (AR-DRGs) to describe the patient's illness or injury. Each admitted patient is allocated an AR-DRG classification after hospital discharge, and alongside this an estimate of the actual costs incurred by the hospital for patient treatment. These data are submitted to respective Health Departments. The state-wide average patient costs for each AR-DRG are then determined and form the basis of hospital funding. Within each AR-DRG however there can be a wide range of diagnoses, injuries, complexity and severity.[17] For instance, many of the AR-DRGs to which trauma patients are allocated are not unique to trauma patients. There is some evidence that episode funding results in underfunding of trauma.[17–19]

Aims

The aims of this study were to:

1 Describe the actual costs of acute trauma treatment in NSW major trauma centres.
2 Identify factors associated with higher costs.
3 Quantify any difference between the total actual cost and the total Australian Refined Diagnostic Related Group (AR-DRG) costs.

Materials and methods

Data capture, costing methods and linkage

All 12 hospitals (3 paediatric, 9 adult) designated major (Level I) trauma centres by the NSW Ministry of Health at the time of the study collaborated on this project.[20] Following ethics approval from each site, a minimum data set was collected on all trauma patients admitted between 1 July 2008 and 30 June 2009 from existing trauma registries (Table 1). Due to the variance in site databases, the descriptors or codes within each variable required manual review and recoding. The trauma database inclusion criteria varied at each site. For example, some sites collected data on all trauma patient admissions and others only those severely injured (ISS > 12) or admitted for more than 24 h. Medical record numbers and admission dates from the trauma data were provided to the casemix or performance units at each health service or hospital to link costing data. Discrepancies were individually resolved using a manual review. The Power Performance Management Reporting System[21] was used for all patient costing in NSW. Patient costing, including indirect expenses (i.e. overheads, human resources using staffing head count, cleaning expense using floor space) was conducted in accordance with 2008–2009 NSW Program and Product Data Collection.[22]

Table 1
Trauma data fields.

Field	Filter
Date of arrival	01/07/2008–30/06/2009
Discharge route from ED	Exclude discharged home
Medical record number (for casemix linkage)	
Date of birth (for casemix linkage)	
Age	
Sex	
Postcode of injury	
Place of injury	
Postcode of residence	
Inter-hospital transfer?	
If yes, where from?	
Mechanism of injury	
Injury severity score	
New injury severity score (if collected)	
All abbreviated injury codes	
All abbreviated injury scores	
All injury descriptions	
Hospital length of stay (LOS)	
Intensive care LOS	
Discharge date	
Discharge route	
Place of death	

A list of AR-DRGs allocated to trauma patients was generated. The 2008–2009 state-wide average costs for those AR-DRGs were obtained from the NSW Ministry of Health Inter-Government and Funding Strategies Branch.[23] The actual hospital level cost data were then compared with the reported AR-DRG average costs of NSW hospitals of similar size and resources (i.e. peer group). This was conducted to determine any difference between the actual costs incurred by the trauma patient and the average costs of all patients with the same AR-DRGs. All costs are presented in Australian dollars (2008–2009). The 2008–2009 average exchange rates for the US dollar and British pound were 0.76 cents and 0.47 cents respectively.[24]

AIS version mapping

Two versions of the Abbreviated Injury Scale (AIS) classifications were supplied: AIS98[25] or AIS05.[26] The AIS codes were validated following which AIS98 codes were mapped to AIS05 equivalents.[27] Following these processes, the Injury Severity Scores (ISS), new Injury Severity Scores and maximum AIS scores for each patient were recalculated using both original and mapped data. There was little variance in mean, median and total costs when comparing patient injury severity using the new Injury Severity Score versus ISS, hence ISS was used in the final analysis.

Analysis

Data were analysed using SPSS 17.0.[28] Descriptive analyses were conducted followed by multivariable analyses to identifying predictors of costs of hospitalisation due to trauma. Variables of interest were mechanism of injury,[8,18] age,[8] sex,[6] count of body regions injured[10,19] and injury severity,[10,29] diagnosis of traumatic brain injury with an Abbreviated Injury Score >2 (definition of serious traumatic brain injury[12]) and Intensive Care Unit (ICU) admission. Regression analyses were conducted to examine relationships between all continuous variables. A level of significance of $\alpha = 0.05$ was used for variable selection for inclusion in the multivariable analysis. A backward elimination approach was used for model reduction. A type I error rate of $p < 0.05$ was used for the test of hypotheses. The decision to retain a factor was based on its