



Profile and costs of secondary conditions resulting in emergency department presentations and readmission to hospital following traumatic spinal cord injury



Belinda J. Gabbe^{a,b,*}, Andrew Nunn^c

^a School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia

^b Farr Institute—CIPHER, Swansea University Medical School, Swansea University, Swansea, United Kingdom

^c Victorian Spinal Cord Service, Austin Health, Heidelberg, Australia

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ABSTRACT

Introduction: People with traumatic spinal cord injury (SCI) face complex challenges in their care, recovery and life. Secondary conditions can develop to involve many body systems and can impact health, function, quality of life, and community participation. These secondary conditions can be costly, and many are preventable. The aim of this study was to describe the type and direct costs of secondary conditions requiring readmission to hospital, or visit to an emergency department (ED), within the first two years following traumatic spinal cord injury (SCI).

Methods: A retrospective cohort study using population-level linked data from hospital ED and admission datasets was undertaken in Victoria, Australia. The incidence and direct treatment costs of readmission to hospital and ED visit within 2-years post-injury for secondary conditions related to SCI were measured for the 356 persons with traumatic SCI with a date of injury from 2008 to 2011.

Results: Of the 356 cases, 141 (40%) experienced 366 (median 2, range 1–11) readmissions to hospital for secondary conditions. 95 (27%) visited an ED at least once, within two years of injury for a secondary condition. The cost of hospital readmissions was AUD\$5,553,004 and AUD\$87,790 for ED visits. The mean \pm SD cost was AUD\$15,172 \pm \$20,957 per readmission and AUD\$670 \pm \$198 per ED visit. Urological conditions (e.g. urinary tract infection) were most common, followed by pressure areas/ulcers for readmissions, and fractures in the ED.

Conclusions: Hospitalisation for complications within two years of traumatic SCI was common and costly in Victoria, Australia. Improved bladder and pressure area management could result in substantial morbidity and cost savings following SCI.

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Introduction

People with traumatic spinal cord injury (SCI) face complex challenges in their care, recovery and life. Patients with traumatic SCI can develop secondary conditions involving the respiratory and genitourinary systems, as well as problems with pressure ulcers, bowel, cardiovascular, pain and musculoskeletal complications [1,2]. Secondary conditions impact function, quality of life, and community participation, are costly, and many are preventable [1].

Prioritisation of healthcare resources, planning and improved management require accurate and timely data about the incidence

and costs of conditions, although data about the direct costs of care for secondary conditions is limited [3]. Most studies have been limited to people sustaining SCI prior to 2007 [3–17], limiting the generalizability to current clinical practice and costs [3–10,12–16,18,19].

Recent population-based studies have focused on the initial direct care costs of SCI using emergency department (ED) [20] and inpatient [15] data in the US. Selverajah et al. reported a 20% increase in ED-related costs between 2007 and 2009 [20], while Mahabeleshkwar and Karma reported the incidence and initial hospitalization costs for SCI admissions in 2009 [15]. Similarly, Radhakrishna et al. reported the acute care costs of spinal cord injury in the first 2-years after injury for a cohort of 481 individuals with SCI in Quebec, Canada [17]. While these studies described the incidence of SCI and acute care costs across the total population of

* Corresponding author at: Department of Epidemiology and Preventive Medicine, Monash University, The Alfred Centre, 99 Commercial Rd, Melbourne, Victoria 3004, Australia.

E-mail address: belinda.gabbe@monash.edu (B.J. Gabbe).

people with SCI, none described the incidence or nature of secondary conditions, or costs of readmissions to hospital.

Other recent studies have reported the health care utilisation, readmission rates and costs of readmission following SCI but have focused on patients managed in specialist SCI centres only [14,18,19,21,22]. Hammond et al. described readmission to acute care from the rehabilitation centre only [21], while Mahmoudi et al. investigated the association between race/ethnicity and readmission to hospital post-injury [22], but neither study reported the reasons for readmission and associated costs. In contrast, Skelton et al. and de Jong et al. reported the reasons for health care utilisation after discharge from rehabilitation following SCI, but no costs were provided and these studies described the experiences of patients at a limited number of SCI centres [18,19], which will under-estimate the total costs and incidence of secondary conditions in the SCI population [10,11,21]. Therefore, the aim of this population-based study was to describe the incidence, type and direct costs of secondary conditions requiring readmission to hospital, or ED visitation, within the first two years of traumatic SCI.

Methods

Setting and study design

Victoria is the second most populous state in Australia (5.8 million, 25% of the Australian population). A retrospective cohort study of traumatic SCI patients admitted to Victorian hospitals was undertaken using routinely collected data. Ethics approval was obtained from the Monash University Human Research Ethics Committee (CF14/1512–2014000713).

Datasets and participants

The Victorian Admitted Episode Dataset (VAED) is the Victorian Department of Health's morbidity data system. Data are collected on all admitted patients from public and private hospitals including rehabilitation centres, extended care facilities and day procedure centres. The Victorian Emergency Minimum Dataset (VEMD) includes demographic, administrative and clinical data for visits to Victorian public hospital EDs.

Admissions for traumatic SCI with a date of injury (date of index admission) from 1 January 2008–31 December 2011 were included. Cases were followed up for 2-years following index admission. Traumatic SCI was defined if the principal International Classification of Diseases 10th Revision Australian Clinical Modification (ICD-10-AM) diagnosis code indicated complete or incomplete cord injury at the cervical, thoracic or lumbar level (Table 1). Cord concussion and oedema, brachial plexus, peripheral nerve, nerve root, and sympathetic nerve injuries were excluded. Multiple body region injury codes where a SCI could not be confirmed as present (i.e T06.0, T06.1), and T09.3 (injury of spinal cord, level unspecified) were also excluded. Deaths during the initial admission were also excluded.

Procedures

From the VAED, month/year of admission, age group, intensive care unit (ICU) admission, ventilated hours, hospital length of stay, ICD-10-AM diagnosis and procedure codes, mode of arrival at hospital, and discharge destination were obtained for all index admissions and readmissions. Visits to ED since the index admission were linked to the VAED cases. Data from the VEMD included visit date, triage information, mode of arrival at hospital, type of visit (e.g. emergency, planned re-visit, etc.), usual accommodation, diagnoses, procedures, discharge referrals and destination, and time in ED. The Victorian Data Linkage unit provided the de-identified linked dataset for analysis.

Early management of traumatic SCI patients often involves transfer between hospitals and discharge from acute care to inpatient rehabilitation. Consistent with the approach of other studies [4], consecutive admissions (including the first admission to inpatient rehabilitation) up to discharge to home or a long term care facility, or transfer for another acute care episode not related to the SCI, were considered as a single index admission to avoid counting component admissions as readmissions to hospital.

Urinary, bowel, skin, skeletal, respiratory, vascular, sleep and pain conditions were considered, as consistent with the literature, and their corresponding ICD-10-AM codes are shown in Table 2 [1,2,23]. Renal and bladder cancer were included as secondary conditions due to the established relationship between SCI and these cancers [24]. The secondary condition was considered the primary reason for admission if it was the principal diagnosis code.

Data analysis

Summary statistics were used to describe the cohort and readmission rates. Data are presented as proportions, mean \pm SD, or, where variables did not conform to a normal or near-normal distribution, median and interquartile range (IQR). Inpatient costs were derived using a case-mix approach based on Australian National Diagnosis Related Groups (AN-DRG) cost weights from the relevant financial year, with all costs scaled up to 2012 Australian dollars (AUD) using the health consumer price index. For ED presentations, the presenting diagnosis, triage category and admission status were mapped to the national Urgency Related Group (URG) and cost weights allocated to the URGs. For admissions to hospital via the ED, inpatient costs do not include ED costs.

Multivariable negative binomial regression was used to identify predictors of the number of readmissions to hospital, or number of ED visits, for secondary conditions within 2-years of injury. The variables entered into the multivariable model were those demonstrating a significant association on univariate testing. Negative binomial modelling was used due to overdispersion in the data. A zero-inflated negative binomial model was tested but provided no better data fit. Adjusted incidence rate ratios (IRR) and corresponding 95% confidence intervals (CI) are presented. Models were adjusted for the total index admission length of stay

Table 1
Definition of traumatic spinal cord injury using ICD-10-AM^a codes.

Injury	ICD-10-AM diagnosis code/s
Complete or incomplete injury of cervical spinal cord	S14.1, S14.10, S14.11, S14.12, S14.13, S14.7, S14.70–S14.78
Complete or incomplete injury of thoracic spinal cord	S24.1, S24.10, S24.11, S24.12, S24.13, S24.7, S24.70–S24.77
Complete or incomplete injury of lumbar spinal cord	S34.1, S34.3, S34.7, S34.70–S34.76

^a ICD-10-AM, International Classification of Diseases 10th Revision Australian modification.

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