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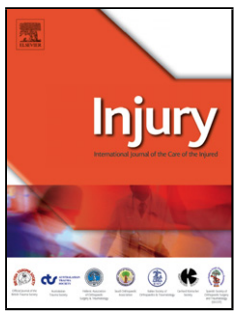

Title: PROFILE AND COSTS OF SECONDARY CONDITIONS RESULTING IN EMERGENCY DEPARTMENT PRESENTATIONS AND READMISSION TO HOSPITAL FOLLOWING TRAUMATIC SPINAL CORD INJURY

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PROFILE AND COSTS OF SECONDARY CONDITIONS RESULTING IN EMERGENCY DEPARTMENT PRESENTATIONS AND READMISSION TO HOSPITAL FOLLOWING TRAUMATIC SPINAL CORD INJURY

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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 visits 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±SD cost was AUD$15,172±$20,957 per readmission and AUD$670±$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.

KEYWORDS

Traumatic spinal cord injury; secondary conditions; costs, readmission, emergency department visit; complications

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 Mahabeleshkawar 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 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 to 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±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 (including the initial admission to inpatient rehabilitation) to account for the variability in time post-discharge available for readmission in the 2-year period. Analyses were performed using Stata Version 13 (StataCorp, College Station, Texas). A p-value <0.05 was considered significant.

RESULTS

Overview of the traumatic SCI cases

There were 356 eligible cases of traumatic SCI in the 4-year timeframe. Most patients were male and aged less than 50 years (Table 3). Falls and road transport were the main injury causes, and incomplete SCI was more common than complete SCI (Table 3). The principal SCI diagnoses for the cases were S14.11 (n=24), S14.12 (n=82), S14.13 (n=57), S24.10 (n=50), S24.11 (n=35), S24.12 (n=29), S34.1 (n=67) and S34.3 (n=12). The admission was covered by Medicare, Australia's universal healthcare system, for 53% of patients, while 27% were covered by the state's third party no fault insurer for road injury, the Transport Accident Commission (TAC). The mean cost of initial care was AUD$47,671±$46,897, with a median cost of AUD$31,789 (IQR $16,304-$61,009) and a range of AUD$7,210 to $AUD277,337. Total cost of initial care for all cases was AUD$16,970,967.

Readmissions to hospital

Of the 356 patients, 141 (39.6%) were readmitted to hospital with a secondary condition in the first 2-years since injury. The secondary condition was the primary reason for admission in 25% of cases. There were 366 readmissions to hospital, with a median of 2 (IQR 1-4) readmissions and a range of 1 to 11 readmissions. Ninety-one percent (n=334) of readmissions were to public hospitals and 8.7%

(n=32) were managed at a private hospital for management of a secondary condition. Where patients were readmitted to public hospital, 32 different public hospitals managed these cases and the number of readmissions managed at these 32 facilities ranged from 1 to 147 readmissions. Total cost of these readmissions was AUD$5,553,004. The mean, and median, cost of readmission to a hospital for secondary conditions in the first 2-years after injury was AUD$15,172 and AUD$8,488, respectively (Table 3). Urinary tract infections (UTI), pressure areas/ulcers, bowel complications, urinary incontinence, and respiratory conditions were most common (Figure 1); 106 (29.8%) cases experienced a readmission for a urological condition. The costs of hospital readmissions by type of SCI are provided as Supplementary Table 1.

Of the 69 patients readmitted with a UTI, 59% were readmitted once, 30% were readmitted twice and 11% were readmitted 3 to 6 times. The figures were similar for pressure ulcers; 58% of the 38 patients readmitted once, 34% twice, and 8% 3 to 5 times. Sixty-one percent of the 31 patients readmitted to hospital with respiratory conditions were admitted once, 16% twice and 23% 3 to 8 times. In contrast, 77% of patients readmitted for bowel conditions were readmitted once.

Most readmissions (72.4%) involved only one of the major types of secondary condition (i.e. urological, bowel, respiratory, pressure ulcer, fracture or other), while 21% involved two or more, 5.5% involved three, and 1.1% involved four. Highest mean and median costs per admission were for respiratory conditions and pressure ulcers, while total costs were greatest for urological conditions (Table 4).

On univariate testing, type of SCI, marital status, age and whether the patient experienced an inpatient rehabilitation stay in their initial care episode were associated with the number of readmissions to hospital, while compensable status, geographic residence, gender, preferred language and injury cause were not associated with hospital readmission (Table 5). Only age and type of SCI were important predictors of readmission to hospital on multivariable testing (Table 5). Compared to 18 to 39 year olds, the rate of readmission for secondary conditions was 1.6 to 3.0 times higher in the older age groups. Compared to incomplete cervical SCI, the rate of readmission was 2.4 times higher for complete thoracic SCI, and 3.4 times higher for complete cervical SCI cases (Table 5).

ED visits

Ninety-five (26.7%) patients visited the ED 131 times for a secondary condition in the first 2-years after injury. The number of ED visits per patient ranged from 1 to 5 with most (n=65, 68.4%) presenting once and 27% (n=26) presenting twice. Total cost of the ED visits was AUD$87,790. The mean and median cost per visit was AUD$670±$198, and AUD$688 (IQR $549-$836), respectively. Most ED visits (65.7%) resulted in hospital admission. Visits for urological conditions, predominantly UTI, and fractures were most common (Figure 2). Urological conditions accounted for 61% of all ED costs, with a mean cost per visit of AUD$672±$204. Fractures accounted for 11% (AUD$9,895) of the total costs of ED visits, with a mean cost per visit of AUD$618±$167. The costs of ED visits by type of SCI are provided as Supplementary Table 2.

On univariate testing, type of SCI, , age group, gender and region of residence were associated with the number of ED visits, while compensable status, preferred language, whether the patient experienced an inpatient rehabilitation episode, marital status and injury cause were not associated with the ED visitation (Table 6). Only region of residence and type of SCI were important predictors of ED visitation on multivariable testing (Table 6). Compared to incomplete cervical SCI, the rate of ED visitation was 2.3 times higher for complete thoracic SCI, and 2.5 times higher for patients with complete cervical SCI. Patients with SCI residing in regional and rural Victoria demonstrated an adjusted rate of presentation to ED that was 61% higher than patients residing in metropolitan Melbourne (Table 6).

DISCUSSION

Recent population-based studies have provided details about acute care costs of SCI [15, 17, 20], but limited information about secondary conditions, while the majority of data published to date about the incidence of secondary conditions has focused on patients managed at specialist SCI centres [14, 18, 19, 21, 22]. Our study provides detailed type, cost and incidence data about readmissions to hospital and ED visits for secondary conditions for all patients sustaining a traumatic SCI from 2008 to 2011 in a defined population. In this cohort of 356 patients with traumatic SCI, we found the total cost of readmissions and ED visits for secondary conditions within 2-years of injury was AUD$5.6M, and

AUD$87,790, respectively. The mean cost per readmission was AUD$15,172 and the mean cost per ED visit was AUD$618, highlighting the high direct costs of initial SCI management and hospital-based subsequent care. In the first 2-years after injury, 40% were readmitted and 27% visited an ED. Increasing age and complete tetraplegia or paraplegia were the predominant predictors of hospital readmission for secondary conditions. Complete tetraplegia or paraplegia, and residing in rural or regional areas of Victoria, wereassociated with an increased rate of ED visits.

Comparison with other studies is challenging due to differences in the profile of patients studied, timeframes for follow-up and differences in health care systems and costs. In our study, the incidence of traumatic SCI was 15.3 per million. Most were male and <50 years old, with falls and road transport the main injury causes. Cervical SCI was most prevalent and 17% of all cases were complete cord injuries. The incidence and profile of our patients is consistent with other SCI studies [3, 4, 25-27], although the proportion of complete cord injuries and older patients was lower than studies based on cases treated at specialist SCI centres [9, 10, 22]. Only 44% of our cohort were discharged to inpatient rehabilitation centres, highlighting the potential for underestimation of incidence and costs in studies focused on patients treated at specialist SCI centres only.

Munce et al quantified the acute inpatient, ED, inpatient rehabilitation and complex continuing care, home care services and physician visits of 559 individuals with traumatic SCI in Ontario, Canada for the first year following acute care discharge [3]. These authors found that the average cost per person per year for readmissions to hospital and ED visits was CDN$26,718 and CDN$432 in 2005, equivalent to CDN$26,718 and CDN$486 in 2012, respectively [3]. We found the average cost per readmission and ED visit was AUD$15,172 AUD and $AUD618 in 2012 dollars, respectively. Despite similarities in the Canadian and Australian dollar values, differences in the observed values could reflect variability in admission practices, coding, funding systems and reasons for readmission. Consistent with a previous US study [8], we observed variation in the mean costs per admission depending on the type of condition. The conditions resulting in readmission were not described by Munce *et al*, precluding exclusion of a difference in secondary condition profile as a potential reason

for the differences in costs observed. Other studies of direct costs have focused on all acute care costs and have not differentiated costs for rehospitalisation or secondary conditions [14, 15, 17].

Our observed readmission rate of 40% within 2-years of injury is largely consistent with previous studies of traumatic SCI. DeJong *et al* reported a readmission rate of 36% within 1-year of discharge from rehabilitation in a cohort of 951 patients with traumatic SCI in the US [18]. Cardenas *et al* found that 28% to 37% of the 8,668 patients with SCI from 16 centres in the US between 1995 and 2002 were readmitted to hospital within a year of discharge[9] while Amatachaya *et al* studied 44 patients with SCI from a single hospital in Thailand and found that 25% were readmitted to hospital in the first 6-months after discharge [28]. Similarly, Jaglal *et* al, in their population-based study of 559 patients with SCI in Canada, reported 28% were readmitted within 1-year of discharge. Skelton *et* al, in their study of 168 patients with SCI, found that 45% were rehospitalised (ED and admission) within 1-year of discharge from inpatient rehabilitation [19]. Others have reported readmission rates as high as 59%, but follow-up timeframes ranged from 6-10 years after injury or discharge from acute care [4, 10], limiting the capacity to compare with our study. Increasing age and SCI severity (i.e. complete injury) were important predictors of hospital readmission for secondary conditions, and SCI severity was also a strong predictor of the rate of ED visitation for secondary conditions, supporting the findings of previous studies [9, 25, 29]. While neither factor can be directly influenced to reduce readmission risk, the findings highlight these groups as “at risk”, and priority groups for interventions to reduce readmission rates. Patients with traumatic SCI living in regional and rural areas of the state experienced lower rates for ED presentation compared to patients living in metropolitan Melbourne. The reasons for this difference are not clear but it is possible that differences in how emergency care is delivered to people in regional areas, and distances needed to travel to access emergency care, could account for the observed variation. However, as the VEMD database includes all 24-hour public EDs, but not all private EDs or public EDs with restricted opening hours, we cannot exclude bias towards metropolitan EDs in the VEMD data. It could be that regional and rural EDs are not participating in the VEMD, accounting for the lower rate of ED presentation by rural and regional patients.

Urological conditions, particularly UTIs, were common reasons for readmission and ED visits in our study, accounting for AUD$3.3M in hospitalisation costs. Thirty percent of patients required treatment as an inpatient for urological conditions and 19% were readmitted for a UTI. Previous studies have also found that genitourinary conditions were the most common secondary condition requiring medical care or readmission to hospital [9, 10, 18, 19, 28, 29]. Whether the rate of readmission for urological conditions was higher in our population is difficult to ascertain due to differences in timeframes for follow-up [9, 10, 18, 19, 28, 29], variability in the populations studied [9, 10, 18, 19, 29] and previous studies experiencing a high proportion of missing data about the reason for readmission [9]. Middleton *et al* reported that 39% of the 253 patients studied in New South Wales, Australia from 1989-2000 were readmitted for genitourinary conditions while 14% were readmitted for UTI[10]. Direct comparison with our findings is challenging as the follow-up period for the Middleton *et al* study was not fixed, ranging from 1-9 years since initial admission. Nevertheless, urological conditions, and UTIs in particular, are a common and costly sequelae of SCI.

Readmission for care of pressure ulcers was also common in our study, with 11% of patients readmitted for this condition, and total hospitalisation costs of AUD$1.8M. Others have highlighted the prevalence and cost of secondary conditions of the skin as a significant problem in people living with SCI [8, 10, 18, 28]. Johnson *et al*, in their study of 115 patients in the US found that while urological conditions were more common than readmission for skin conditions, skin conditions were more expensive [8]. Similarly, we found that the average cost of readmissions involving pressure ulcers was $AUD31,180 compared to $AUD19,617 for readmissions involving UTI.

The major strength of this study was the use of population-based datasets in a defined region of Australia. In Victoria, Australia, the ICD-10-AM coding is used for hospital reimbursement, increasing the likelihood that relevant diagnoses and conditions will be coded, and the coders are regularly audited with low error rates previously demonstrated [30]. We included all patients with traumatic SCI, not just those managed in specialised SCI centres, potentially explaining the noted differences to previous studies in patient demographics and injury severity. Linkage of ED and readmission data enabled a detailed description of the incidence, type and costs of secondary

conditions resulting in hospitalisation. Nevertheless, probabilistic linkage of ED and admissions data was undertaken and the linkage was not perfect. A limited number of predictors could be investigated as the data used were from administrative datasets, rather than SCI or trauma specific collections. Therefore, additional factors shown previously to influence the risk of secondary conditions such as smoking status, and more detailed information about SCI (e.g. ASIA scores) and patient function, could not be studied. Clinical data such as haematological and microbiological data would also add value to the characterisation of secondary conditions. We could highlight the conditions commonly resulting in hospitalisation, and could provide the means of evaluating changes in clinical practice targeted at reducing readmissions in the future, studies undertaken in clinical settings such as specialist SCI units are better placed to inform clinical management changes. Future studies could consider out-of-hospital treatment costs (e.g. primary care), medication and equipment costs. Finally, only the first 2-years following injury was studied. However, 2-years was chosen to ensure that the data represented recently injured patients, and it has been shown previously that this timeframe represents the period of the highest rate of hospital readmission.

CONCLUSIONS

Overall, analysis of routine administrative data across a population can improve our understanding of SCI secondary conditions. In our population, hospitalisation for complications within 2-years of traumatic SCI was common and costly. The findings have provided contemporary cost and incidence data about secondary conditions across the total population of SCI, identified areas of clinical concern, and highlighted the need for implementation of strategies to minimise these conditions. In particular, improved bladder and pressure area management could result in substantial cost and morbidity savings following SCI. Repeating this study would enable measurement of any reduction in incidence and costs resulting from changes in clinical practice.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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FIGURE LEGENDS

Figure 1: Proportion of patients with traumatic SCI readmitted to hospital within 2 years of injury by secondary condition (y-axis is the type of secondary condition and the x-axis is the proportion of all patients with SCI who were readmitted to hospital with each condition within the first 2-years of injury)

Figure 2: Proportion of patients with traumatic SCI visiting an ED for a secondary condition within 2 years of injury (y-axis is the type of secondary condition and the x-axis is the proportion of all patients with SCI who visited an ED with each condition within the first 2-years of injury).

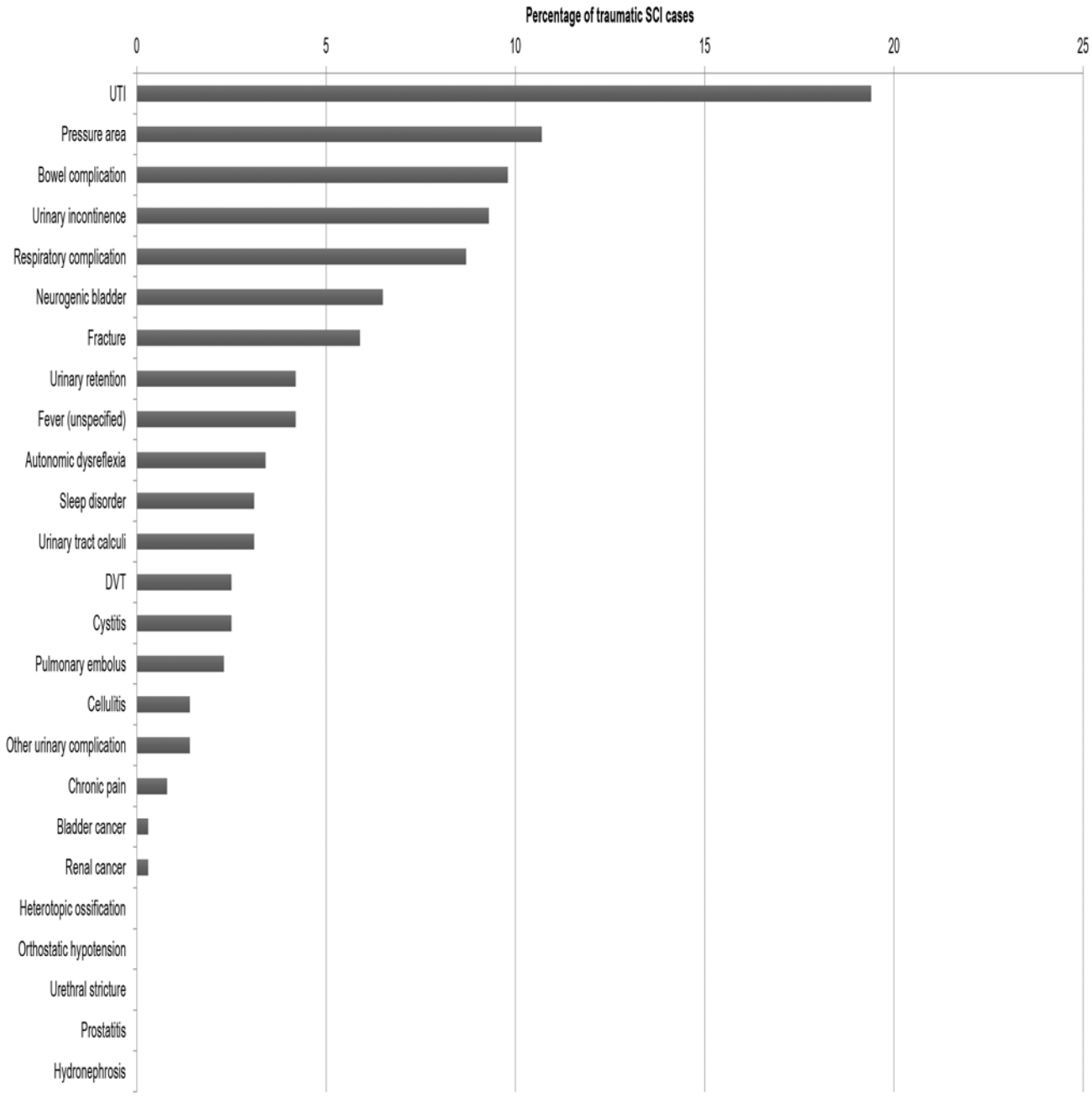

Fig 1

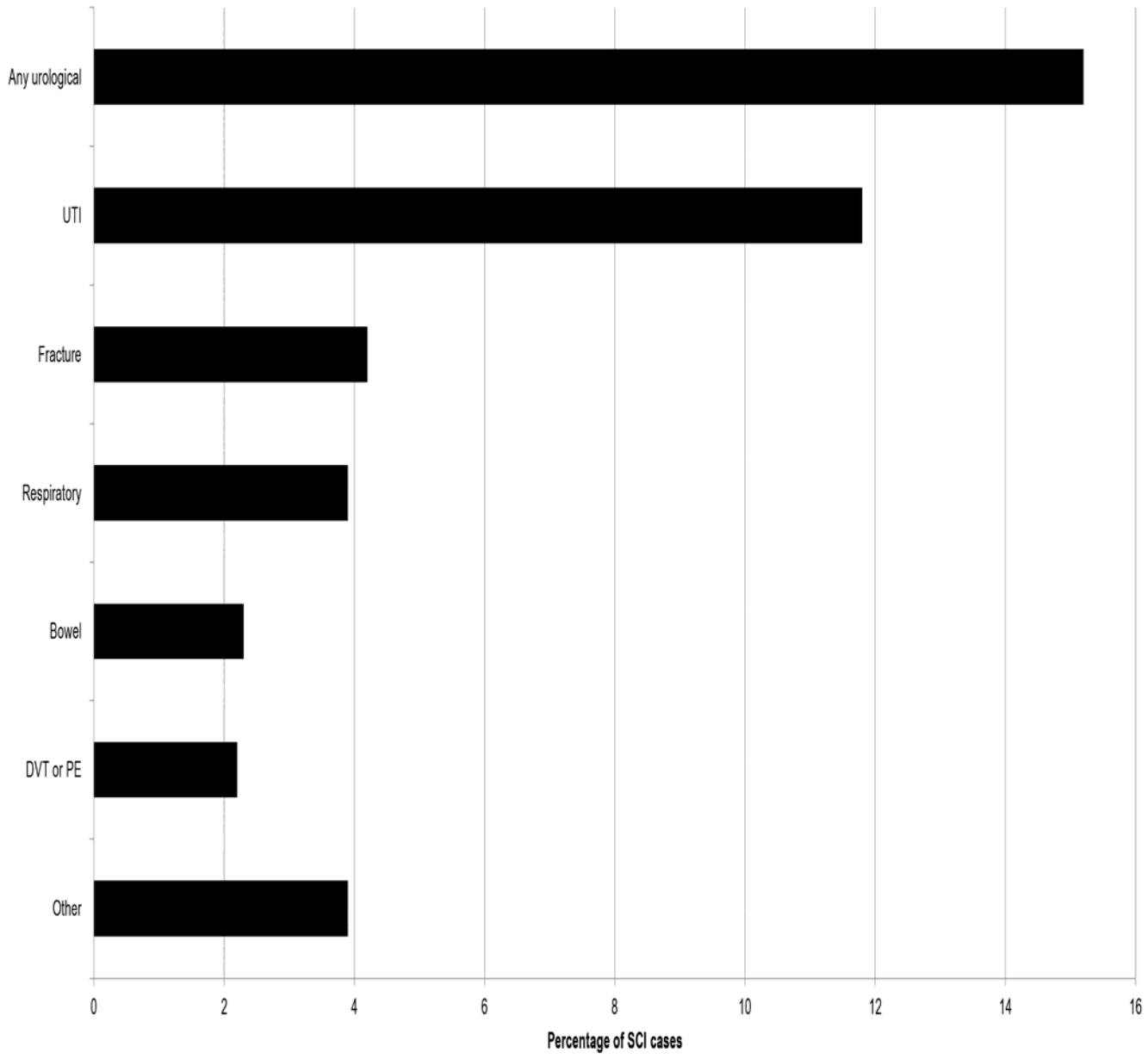

Fig 2

Table 1: Definition of traumatic spinal cord injury using ICD-10-AM[*] 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

[*] ICD-10-AM, International Classification of Diseases 10th Revision Australian modification

Table 2: Spinal cord injury related secondary conditions and corresponding ICD-10-AM codes

Complication		ICD-10-AM codes
Urinary	Urinary tract infection (UTI)	N39.0
	Urinary incontinence and polyuria	N39.3, N39.4, R30.0, R31, R32, R35, R39.8
	Urinary retention	R33
	Prostatitis	N41.0-N41.9
	Neurogenic bladder	N31.0-N31.9, G93.4, G95.8
	Urinary calculi	N20.0-N20.9, N21.0-N21.9, N42.0
	Uropathy including hydronephrosis	N13.0-N13.9
	Urethritis	N34.0-N34.3
	Cystitis	N30.0-N30.9
	Bladder cancer	C67.0-C67.9
	Renal cancer	C64, C65
	Urethral stricture	N35.0-N35.9

	Other urethral complication	N36.0-N36.9
Bowel	Functional intestinal disorders	K59.0-K59.9
	Fissures of the anal and rectal regions	K60.0-K60.5
	Abscesses of the anal and rectal region	K61.0-K61.4
Respiratory	Pneumonia	J13, J15.0-J15.9, J18.0-J18.2, J18.8-J18.9, J20.0, J20.2, J20.8-J20.9
	Pneumonitis	J69.0
	Respiratory failure and pulmonary collapse	J96.0, J96.00-J96.01, J96.90, J96.91, J98.1, J98.6
Other systems	Fever of unspecified origin	R50.9
	Heterotopic ossification	M61.2, M61.9
	Venous thrombosis	I80.0- I80.9
	Pulmonary embolus	I26, I26.0, I26.9

Pressure area or ulcer	L89, L89.0-L89.9, L02.3-L02.4, L97
Sleep apnoea and other disorders	G47.3, G47.30, G47.31, G47.32, G47.33, G47.39
Orthostatic hypotension	G90.3
Autonomic dysreflexia	G90.4
Cellulitis	L03.1, L03.10, L03.11, L03.9
Chronic pain	R52.1, R52.2, R52.9
Upper or lower limb fracture	S42, S52, S62, S72, S82, S92, S3201-S32.5, S32.7, S32.8

Table 3: Demographic, injury and index admission details of incident traumatic SCI cases in Victoria, Australia

Population descriptor		**N (%)**
Age group	<20 years	46 (12.9)
	20-29 years	60 (16.9)
	30-39 years	39 (11.0)
	40-49 years	52 (14.6)
	50-59 years	47 (13.2)
	60-69 years	42 (11.8)
	70-79 years	36 (10.1)
	80+ years	34 (9.5)
Gender	Male	264 (74.2)
	Female	92 (25.8)
Marital status*	Never married	138 (41.1)
	Married	131 (39.0)

	Widowed	22 (6.5)
	De facto	22 (6.5)
	Divorced or separated	23 (6.9)
Preferred language[†],	English	331 (94.3)
	Language other than English	20 (5.7)
Residential region[‡]	Metropolitan Melbourne	223 (63.0)
	Regional Victoria	131 (37.0)
Cause of injury[§]	Fall	132 (42.0)
	Motor vehicle	49 (15.6)
	Motorcycle	40 (12.8)
	Struck by/collision with (inc. assault)	24 (7.6)
	Pedal cyclist	21 (6.7)
	Other road transport	8 (2.6)
	Other non-road transport	18 (5.7)

	Other specified cause	22 (7.0)
Compensable status	Medicare/not compensable	189 (53.1)
	Transport Accident Commission (TAC)	96 (27.0)
	Private insurance/Department of Veterans' Affairs	43 (12.1)
	Worker's compensation or other compensable	28 (7.8)
Injury type	Incomplete cord injury cervical spine	139 (39.0)
	Incomplete cord injury thoracic spine	79 (22.2)
	Lumbar spine cord injury	79 (22.2)
	Complete cord injury thoracic spine	35 (9.8)
	Complete cord injury cervical spine	24 (6.7)
ICU admission	N (%) Yes	141 (39.6)
	Median (IQR) days admitted to ICU	4.8 (1.8-11.3)
Rehabilitation admission	N (%) Yes	157 (44.1)
	Median (IQR) days admitted to rehabilitation	42 (17-98)

Acute care length of stay	Median (IQR) days admitted to acute care	13 (5-32)

* n=20 (5.6%) missing; † n=5 (1.4%) missing; ‡ n=2 (0.6%) missing; § n=42 (11.8%) missing;

Table 4: Mean cost per admission and total costs for readmissions within two years of SCI by condition group

Secondary condition group	Mean±SD cost (AUD$) per admission	Median cost (AUD$) per admission	Total costs (AUD$)
Any urological condition	$15,347±$21,898	$8,673 ($3,197-$16,019)	$3,268,933
Urinary tract infection	$19,617±$26,985	$14,145 ($7,199 -$32,238)	$2,216,681
Pressure ulcer	$31,180±$34,546	$32,238 ($13,356-$32,238)	$1,839,603
Respiratory	$27,362±$36,441	$14,329 ($7,199-$32,238)	$1,587,008
Bowel	$21,507±$31,153	$10,989 ($7,199-$32,238)	$976,799
Fracture	$15,724±$13,939	$8,861 ($5,883-$24,753)	$644,684
Other	$19,022±$32,006	$8,137 ($6,020-$17,575)	$1,502,737
All conditions	$15,172±$20,956	$8,488 (IQR $4,887-$16,019)	$5,553,004[†]

* IQR, interquartile range; [†] Sum of individual conditions exceeds total costs as patients can have more than one condition on each admission and only a single cost for the admission can be defined

Table 5: Predictors of the rate of readmission for any secondary condition within two years of injury

Population descriptor		N (%) readmitted in each group	Incidence rate ratio (95% CI) -unadjusted	p-value	Incidence rate ratio (95% CI) - adjusted	p-value
Age group	18-39 years (reference)	40 (27.6)	1.00	<0.001	1.00	<0.001
	40-59 years	31 (31.3)	1.70 (1.07, 2.70)		1.62 (0.99, 2.65)	
	60+ years	70 (62.5)	2.52 (1.62, 3.90)		2.95 (.72, 5.06)	
SCI type	Incomplete cord injury cervical spine (reference)	58 (41.7)	1.00	<0.001	1.00	<0.001
	Incomplete cord injury thoracic spine	23 (29.1)	0.72 (0.43, 1.19)		0.85 (0.51, 1.39)	
	Lumbar spine cord injury	22 (27.9)	0.83 (0.51, 1.36)		1.15 (0.70, 1.88)	
	Complete cord injury thoracic spine	23 (65.7)	2.03 (1.16, 3.71)		2.36 (1.32, 4.21)	
	Complete cord injury cervical spine	15 (62.5)	2.87 (1.46, 5.66)		3.36 (1.76, 6.41)	
Inpatient rehabilitation stay	No (reference)	66 (33.2)	1.00	0.03	1.00	0.61
	Yes	75 (47.8)	1.51 (1.03, 2.20)		0.89 (0.57, 1.39)	
Marital status	Never married (reference)	40 (29.0)	1.00	0.02	1.00	0.85
	Married or de factor relationship	74 (48.4)	1.75 (1.16, 2.64)		0.93 (0.58, 1.49)	
	Widowed, separated or divorced	24 (53.3)	1.73 (0.96, 3.11)		1.07 (0.57, 2.01)	
Gender	Male (reference)	105 (39.8)	1.00	0.45		
	Female	36 (39.1)	0.84 (0.54, 1.31)			
Preferred language	English (reference)	127 (38.4)	1.00	0.66		
	Language other than English	10 (50.0)	1.20 (0.53, 2.72)			
Region of residence	Metropolitan Melbourne (reference)	92 (41.3)	1.00	0.79		
	Regional Victoria	47 (35.9)	0.95 (0.64, 1.41)			

Compensable status	Medicare (reference)	76 (40.2)	1.00	0.80
	Transport Accident Commission	37 (38.5)	0.95 (0.61, 1.49)	
	Private insurance/Veteran's affairs	19 (44.2)	0.97 (0.53, 1.77)	
	Workers' compensation or other compensable	9 (32.1)	0.68 (0.31, 1.45)	
Cause of injury	Fall (reference)	59 (44.7)	1.00	0.24
	Road transport	40 (33.9)	0.82 (0.53, 1.27)	
	Other	26 (40.6)	0.63 (0.37, 1.08)	

*adjusted for the index admission length of stay, age group, inpatient rehabilitation stay, marital status, and type of SCI

Table 6: Predictors of the ED visitation rate for any secondary condition within two years of injury

Population descriptor		N (%) presented to ED in each group	Incidence rate ratio (95% CI) -unadjusted	p-value	Incidence rate ratio (95% CI) - adjusted	p-value
Age group	18-39 years (reference)	30 (20.7)	1.00	0.16	1.00	0.09
	40-59 years	27 (27.3)	1.50 (0.92, 2.46)		1.55 (0.96, 2.48)	
	60+ years	38 (33.9)	1.52 (0.94, 2.44)		1.61 (1.00, 2.58)	
SCI type	Incomplete cord injury cervical spine (reference)	33 (23.7)	1.00	<0.001	1.00	0.002
	Incomplete cord injury thoracic spine	19 (24.1)	0.94 (0.55, 1.61)		1.09 (0.64, 1.87)	
	Lumbar spine cord injury	13 (16.5)	0.66 (0.36, 1.21)		0.93 (0.51, 1.70)	
	Complete cord injury thoracic spine	17 (48.6)	2.12 (1.20, 3.75)		2.33 (1.33, 4.08)	
	Complete cord injury cervical spine	13 (54.2)	2.70 (1.46, 5.00)		2.50 (1.37, 4.57)	
Gender	Male (reference)	74 (28.0)	1.00	0.12	1.00	0.34
	Female	21 (22.8)	0.67 (0.42, 1.11)		0.79 (0.49, 1.28)	
Region of residence	Metropolitan Melbourne (reference)	71 (31.8)	1.00	0.01	1.00	0.02
	Regional Victoria	24 (18.3)	0.57 (0.37, 0.89)		0.61 (0.40, 0.94)	
Inpatient rehabilitation stay	No (reference)	50 (25.1)	1.00	0.43		
	Yes	45 (28.7)	1.17 (0.79, 1.75)			
Marital status	Never married (reference)	36 (26.1)	1.00	0.21		
	Married or de factor relationship	46 (30.1)	1.14 (0.75, 1.75)			
	Widowed, separated or divorced	10 (22.2)	0.59 (0.28, 1.26)			
Preferred language	English (reference)	87 (26.3)	1.00	0.43		
	Language other than English	8 (40.0)	1.37 (0.63, 2.98)			

Compensable status	Medicare (reference)	54 (28.6)	1.00	0.41
	Transport Accident Commission	28 (29.2)	1.12 (0.72, 1.76)	
	Private insurance/Veteran's affairs	9 (20.9)	0.73 (0.37, 1.46)	
	Workers' compensation or other compensable	4 (14.3)	0.56 (0.23, 1.40)	
Cause of injury	Fall (reference)	37 (28.0)	1.00	0.38
	Road transport	33 (28.0)	0.97 (0.60, 1.55)	
	Other	11 (17.2)	0.65 (0.34, 1.22)	

*adjusted for the index admission length of stay, age group, inpatient rehabilitation stay, marital status, and type of SCI