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Tertiary paediatric hospital admissions in children and young people with cerebral palsy

Abstract

Background

Many previous studies that have investigated hospital admissions in children and young people with cerebral palsy lack information on cerebral palsy severity and complexity. Consequently, little is known about factors associated with the frequency and type of hospital admissions in this population. This study used hospital admission data available for all children and young people known to a population-based cerebral palsy register to describe the patterns of use of tertiary paediatric hospital services over a five-year period.

Methods

This was a retrospective cohort analysis of routinely-collected admission data from the two tertiary paediatric hospitals in the Australian state of Victoria. Data on admissions of individuals born between 1993 and 2008 registered on the Victorian Cerebral Palsy Register were analysed (n=2,183).

Results

Between 2008 and 2012, 53% of the cohort (n=1,160) had at least one same-day admission and 46% (n=996) had one or more multi-day admissions. Those with a moderate to severe motor impairment and those with a co-diagnosis of epilepsy had more admissions, and for multi-day admissions, longer lengths of stay; $p<0.05$. Across all severity levels, respiratory and musculoskeletal diseases were the most frequently reported reasons for medical and surgical admissions respectively. All-cause readmission rates for urgent multi-day stays within 7-, 30- and 365-days of an index admission were 10%, 23% and 63% respectively.

Conclusions

The reasons for hospital admissions reported here reflect the range of comorbidities experienced by children and young people with cerebral palsy. This study highlights priority areas for prevention, early diagnosis and medical management in this group. Improved primary and secondary prevention measures may decrease non-elective hospital admissions and readmissions in this group, and reduce paediatric inpatient resource use and healthcare expenditure attributable to cerebral palsy.

Key points

- Those with a mild motor impairment were more frequently admitted to hospital for factors relating to their movement problem; the administration of botulinum toxin-A injections comprised a substantial proportion of same-day admissions in independently ambulant children and young people.
- Although musculoskeletal conditions represented the most common reason for surgical admissions in children with moderate-severe motor impairment, disorders of the nutritional and respiratory systems also represented a substantial proportion of both surgical and non-surgical admissions in this group.
- For clinicians involved in managing patients with cerebral palsy, respiratory health should continue to be an important focus and where possible, preventive measures should be implemented to reduce respiratory-related morbidity and subsequent hospital admissions.

Introduction

Cerebral palsy (CP), a disorder of movement and posture resulting from an injury or disturbance to the developing brain (Rosenbaum *et al.* 2007), is the most common cause of permanent physical disability in children. It affects around 2 per 1,000 live births in developed countries worldwide, its prevalence inversely associated with gestational age (Oskoui *et al.* 2013). Affected children can experience frequent illness due to their increased risk of epilepsy, gastrointestinal and nutritional problems, and respiratory disorders compared to the general childhood population, with those children who are the most severely motor impaired at the greatest risk (Pruitt and Tsai 2009, Shevell *et al.* 2009). Furthermore, children with CP are at risk of developing progressive musculoskeletal pathologies (Graham and Selber 2003), and many are technology dependent, including around one in ten reliant on a gastrostomy feeding tube (Dahlseng *et al.* 2012).

The proportion of all paediatric hospital admissions attributable to chronic health conditions has increased over the past few decades, the reasons for which are multifactorial (Simon *et al.* 2010, Berry *et al.* 2012b). The increased prevalence of children with such conditions in the population today, due to advances in neonatal medicine and the increased survival of children born pre-term or with life-limiting conditions (Doyle and the Victorian Infant Collaborative Study Group 2004, Kaiser *et al.* 2004), may be playing a role. Other factors, including the increasing number of surgical procedures performed on these children, and the scarcity of community-based medical professionals that can manage paediatric chronic illness in many regions, are also implicated (Berry *et al.* 2012a). In addition to having more hospital admissions than their typically-developing peers, previous research tells us that children and young people with CP are more likely to die during a hospital admission, experience longer lengths of stay, have more diagnoses and undergo more procedures per admission, and accrue higher hospital charges (Young *et al.* 2007, Murphy *et al.* 2006). This group are also more likely to experience recurrent readmissions to hospital (Berry *et al.* 2011), with the associated significant costs for health services and for patients and their families (Nakamura *et al.* 2014). Disorders of the respiratory and nervous systems have been reported to account for the majority of hospital admissions in this population, followed by disorders of the musculoskeletal and gastrointestinal systems (Murphy *et al.* 2006, Young *et al.* 2011).

Overall, studies that have examined inpatient resource use specifically in the CP population are scarce, and are limited by a number of factors including the inclusion of particular age-groups only (Young *et al.* 2007, Young *et al.* 2011), the use of diagnosis codes to identify individuals with CP (Murphy *et al.* 2006), and a lack of clinical information on CP severity and complexity (Murphy *et al.* 2006, Young *et al.* 2011). This study used hospital admission data available for all children and young people known to a population-based CP register to evaluate the main reasons for tertiary paediatric hospital admissions in this group and to identify clinical factors associated with the frequency and type of admissions. Secondary aims were to identify factors associated with multi-day length of stay and 7-, 30- and 365-day rates of all-cause readmissions.

Methods

Study design and setting

This study was a retrospective cohort analysis of routinely-collected admission data from the two tertiary paediatric hospitals in the Australian state of Victoria: the Royal Children's Hospital, Melbourne (RCH) and Monash Children's Hospital (MCH). Data pertaining to the same-day and multi-day admissions of all individuals born between 1993 and 2008 registered on the Victorian Cerebral Palsy Register were included for analysis. The Victorian Cerebral Palsy Register is a database of individuals with CP born or living in Victoria, born from 1970 onwards. Clinical and demographic data on registered cases is obtained primarily from the medical records, but also from families and treating clinicians. The study was approved by the Human Research Ethics Committees of both hospitals; a waiver of informed consent was granted.

Procedures

For each member of the cohort, data were obtained on admissions to RCH and MCH between 2008 and 2012. Health Information Services personnel from both hospitals were provided with a list of the hospital unit record numbers of all members of the cohort, following which they extracted the relevant data. Variables included admission date, discharge date, same-day flag, admission type (emergency, elective, other), primary diagnosis code, secondary diagnoses codes, primary procedure code, Australian Refined Diagnostic Related Groups (AR-DRG), and local government area of residence. Variables available from the CP register included date of birth, epilepsy status and Gross Motor Function Classification System (GMFCS) level. The GMFCS is a five-level classification tool, used to describe the gross motor abilities of individuals with CP on the basis of their self-initiated movement with particular emphasis on sitting, walking, and wheeled mobility across four age bands: I/II = independently ambulant; III = ambulates with aids; IV-V = not independently ambulant (Palisano *et al.* 1997). Epilepsy was defined as two or more unprovoked seizures outside the neonatal period.

The standard grouping of International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) codes was used to categorise the principal diagnosis for each admission (World Health Organisation 2011). The analysis focused on the primary diagnoses only. In a small number of cases, CP was listed as the primary diagnosis and a secondary diagnosis was available; in these cases, the secondary diagnosis was used. If no secondary diagnosis was available, CP was used. Primary procedures were categorised using the Australian Classification of Health Interventions (ACHI), the national standard for procedure and intervention coding in Australian hospitals (Commonwealth of Australia 2010). The AR-DRG, an Australian admitted patient classification system which provides a clinically meaningful way of describing a hospital's case-mix, was used to differentiate between surgical and medical admissions (Australian Institute of Health and Welfare 2014).

Every admission was counted as a separate index admission, and was the starting point for follow-up to check for readmissions. An admission did not require a "clean period" with no admissions to constitute an index admission. As such, an admission could be both a readmission for a prior admission, and the index admission for a subsequent readmission. A readmission was defined as a subsequent multi-day admission for any diagnosis within 7, 30 or 365 days of the discharge date of an index admission. For 7-day readmissions, the discharge date for the index admission must have occurred prior to 24th December 2012, and for 30-day and 365-day readmissions the discharge date must have occurred prior to 1 December 2012 and 31 Dec 2011 respectively. This approach ensured adequate follow-up periods.

Statistical analysis

Descriptive statistics were used to summarise the study cohort and admission characteristics. GMFCS levels were dichotomised (levels I-II as mild motor impairment, and levels III-V as moderate to severe motor impairment). Mann-Whitney tests were used to investigate differences in the total number of admissions and in length of stay for multi-day admissions (which both demonstrated a non-normal distribution pattern) across the dichotomous categories of GMFCS, epilepsy and AR-DRG type. Primary diagnoses and procedures were tabulated, and chi squared analysis was used to test for equality of percentages between GMFCS sub-groups. Chi-squared analysis was also used to test for variation in readmission rates between GMFCS sub-groups. Readmission rates were calculated by dividing the total number of multi-day stays with at least one subsequent hospital stay within 7/30/365 days by the total number of multi-day stays that took place over the relevant time period. P-values were defined as the probability that differences between sub-groups as large as, or larger than, that observed in this cohort could have arisen due to random chance alone; a value of less than 0.05 was considered to provide strong evidence of difference. All data analysis was carried out using Stata 13.1 (StataCorp. 2013).

Results

Study cohort

The cohort comprised 2183 children and young people with CP. Fewer than 5% (n=102) were aged 0-4 years in December 2012, and 32%, 33% and 31% were aged 5-9, 10-14 and 15-19 years respectively. The proportions classified as functioning at GMFCS levels I, II, III, IV and V were 34% (n=750), 26% (567), 10% (n=223), 13% (n=277) and 13% (n=283) respectively; data on GMFCS was missing for 4% of the cohort (n=83). Overall, 29% (n=623) had a co-diagnosis of epilepsy and 68% (n=1476) did not; data on epilepsy was missing for approximately 4% (n=84) of the cohort.

Of the 2183 members of the CP cohort, 1443 (66%) had ≥1 tertiary paediatric hospital admission between 2008 and 2012. Overall, 53% of individuals (n=1,160) had ≥1 same-day admission and 46% (n=996) had ≥1 multi-day admission. Compared to those who had had no admission over the study period, children and young people who had at least one admission were younger, and were more likely to have a co-diagnosis of epilepsy and to be classified as GMFCS III-V (p<0.001).

Total admissions

Members of the CP cohort had a total of 7177 admissions. Fifty-two per cent (n=3737) were same-day admissions, of which 92% (n=3444) were elective. Of the 3440 multi-day admissions, 52% were elective (n=1784). Factors strongly associated with a greater number of both same-day and multi-day admissions were GMFCS level and epilepsy, with those children who were more severely motor impaired (GMFCS III-V) and those with a co-diagnosis of epilepsy having a greater number of admissions; p<0.001. (Table 1)

Multi-day admissions

Children classified as GMFCS III-V accounted for 68% (n=2324) of all multi-day admissions, and 75% of the total number of admitted nights (n=16523). The median length of stay for this group (4 days) was significantly longer than that of individuals classified as GMFCS I-II (2 days); p<0.0001. Of the 3,440 multi-day admissions, medical and surgical AR-DRGs were responsible for 48% (n=1636) and 37% (n=1269) respectively; the remainder (15%) were comprised of other or unknown DRG types. (Table 2)

Respiratory diseases were the most frequently reported diagnoses for medical multi-day admissions across all GMFCS levels, but represented a higher proportion in children classified as GMFCS III-V compared to children classified as GMFCS I-II (24% vs 12%; p<0.001). Among surgical multi-day admissions, diseases of the musculoskeletal system were the most common primary diagnoses across all GMFCS levels, representing 47% and 43% of surgical multi-day admissions in children classified as GMFCS I-II and GMFCS III-V respectively. (Table 3)

Procedures

Musculoskeletal procedures represented the primary procedure in one-half (n=1857) of all same-day admissions and one-quarter (n=877) of all multi-day admissions. (Table 4) For same-day admissions, the administration of an agent (most frequently botulinum toxin-A) into a musculoskeletal site was the most common musculoskeletal procedure (n=1757), while for multi-day admissions, procedures performed on the hip (n=321) and leg (n=211) were the most common. With the exception of musculoskeletal procedures and those categorised as “non-invasive, cognitive and other interventions”, relatively few children classified as GMFCS I-II had other types of procedures carried out during admissions. In contrast, children classified as GMFCS III-V had a digestive system procedure in over 10% of all admissions, and were also more likely than those classified as GMFCS I-II to have had procedures related to the nervous system (3%) and respiratory system (4%). (Table 4)

Readmission rates

For non-elective multi-day admissions, the 7-day, 30-day and 365-day readmission rates were 10%, 23% and 63% respectively. GMFCS level was strongly associated with 30-day and 365-day admission rates, children classified as GMFCS III-V having significantly higher 30-day and 365-day readmission rates than those classified as GMFCS I-II. Admissions due to diseases of the digestive and respiratory systems had the highest rates of readmission. (Table 5)

Discussion

This study investigated the patterns of use of tertiary paediatric inpatient services by a population cohort of children and young people with CP. Key findings were that 1) children and young people who were more severely motor impaired and those who had a co-diagnosis of epilepsy experienced a greater number of admissions, and for multi-day admissions, had longer lengths of stay, 2) respiratory diseases and musculoskeletal conditions were the most common reasons for medical and surgical admissions respectively, 3) individuals classified as GMFCS I-II were more frequently admitted to hospital for factors relating to their movement problem, while nutritional needs and respiratory complications drove a substantial amount of both surgical and non-surgical admissions in those classified as GMFCS III-V, and 4) admissions due to diseases of the digestive and respiratory systems were among those with the highest rates of all-cause readmissions.

Studies reiterate the need for adequate information sharing between hospitals and community-based healthcare professionals, and emphasise the benefits of care-coordination and accessible care plans in reducing medical service use in medically-complex children (Quigley *et al.* 2014, Adams *et al.* 2013, Antonelli *et al.* 2008, Cohen *et al.* 2012). However, the design of health systems is often such that the focus is on addressing acute episodes of care, and chronic disease management and care continuum are rarely prioritised (Quigley *et al.* 2014). When individuals require the resources that only inpatient care can provide, admission to hospital is appropriate. However, where possible, avoiding hospitalisations is desirable, given the disruption it causes to individuals and their families (Nakamura *et al.* 2014).

It is important that clinicians are aware of the most common reasons for hospital admission in individuals with CP and the risk factors for frequent admission, so that areas for prevention can be identified. While a certain amount of morbidity in this group is not preventable (e.g. musculoskeletal pathologies), it is important that factors that may have the potential to be changed (e.g. nutritional status and pulmonary aspiration risk) are identified and managed early (Murphy *et al.* 2006). Respiratory illness is the leading cause of mortality in individuals with CP (Reid *et al.* 2012), and the finding that it was the main reason for non-surgical hospital admissions in this CP cohort was not surprising. However, it does suggest that the respiratory health of children and young people with severe CP in particular should remain an important focus for clinicians and a priority area for research. While many factors that contribute to respiratory morbidity in this group are not avoidable, complications such as kyphoscoliosis and malnutrition should be monitored, and it is recommended that individuals with CP receive seasonal influenza vaccines, and that prophylactic antibiotics are considered in certain cases (McCrea *et al.* 2013).

Readmissions to hospital within 30 and 365 days of an index admission have been reported to occur in children at rates of around 6% and 20% respectively (Berry *et al.* 2011, Berry *et al.* 2013). Readmission rates in children with medical complexity are known to be higher, with one group reporting a 30 day readmission rate of 11% for children with CP and other neurological conditions (Berry *et al.* 2013). The 30-day readmission rate of 23% in this study was higher than that previously reported in the literature. However, some of this variation may be accounted for by differences in methods of calculation, specifically differences in what defines an index admission, and whether or not readmissions for any cause or readmissions for the same diagnosis of the index stay were counted. Regardless, rates of readmission for all causes in this group were higher than expected.

Traditionally viewed as indicators of care quality (Ashton *et al.* 1997), it is now accepted that readmission rates are affected by factors external to hospitals, and for reasons that are multifactorial (Alverson and O' Callaghan 2013, Bardach *et al.* 2013, Nakamura *et al.* 2014). Factors influencing paediatric readmissions include parent preferences, distance of the child's home from the hospital and availability of primary care and other health care services in the child's area of residence (Alverson and O' Callaghan 2013). As such, as well as ensuring children are well enough for discharge, high-quality discharge planning which takes these factors into account and adequate communication between hospitals, families and community-based health care practitioners involved in the care of these children, play an important role in preventing readmissions in the group. Given that reasons for readmissions are often different from the reason for the initial admission (Berry *et al.* 2013), it is important that post-discharge care planning focus attention not just on the primary diagnosis of the admission, but also on individuals' comorbidities.

Strengths and limitations

Potential inconsistencies in coding mean that diagnosis and procedure data need to be interpreted carefully. For example, for those admissions that had a discharge diagnosis of CP, the exact reason for the admission was unknown. In addition, many admissions did not have any diagnosis code or procedure code available. It is possible that individual GMFCS level might change over time and the level recorded on the CP register at the time of data extraction may differ from the functional ability of the child or young person at each admission. This analysis was limited to data from tertiary paediatric hospitals only; patterns of use of these hospitals are likely to differ from that of non-paediatric hospitals. The high rate of elective and surgical admissions are reflective of this. The available data did not enable the identification of preventable readmissions, nor do we not have information on readmissions to different hospitals which likely leads to an undercounting of readmissions. As such, investigating the patterns of admission to all hospitals is an important area for future research. It would offer a greater insight into the frequency and type of admissions and readmissions in the CP population, and could inform strategies to reduce unnecessary inpatient resource use in this group.

The strengths of this study lie in the use of a population-based CP register as a sampling frame and the availability of data on CP severity and complexity. Such data would not have been available had we used administrative data only and identified children with CP via ICD codes. This study adds to the existing literature by providing new information on risk factors for frequency and type of hospital admissions in the CP population. It offers new insights into the use of inpatient services by children and young people with CP in Australia, and highlights priority areas for prevention, early diagnosis and management as well as future research, thus having implications for researchers and clinicians.

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Tables

Table 1: Number of admissions, 2008-2012, by GMFCS level and epilepsy

	GMFCS level									
	I/II (n=1317)				III-V (n=783)					
	Min.	Max.	Median	IQR	Min.	Max.	Median	IQR	Wilcoxon's Z #	*p*-value #
All	0	36	1	0 - 3	0	50	3	1 - 7	-13.634	<0.0001
Same-day	0	32	0	0 - 2	0	26	1	0 - 3	-6.286	<0.0001
Multi-day	0	14	0	0 - 1	0	50	2	0 - 4	-18.362	<0.0001
	Epilepsy									
	No (n=1476)				Yes (n=623)					
	Min.	Max.	Median	IQR	Min.	Max.	Median	IQR	Wilcoxon's Z #	*p*-value #
All	0	50	1	0 - 4	0	41	3	1 - 7	-9.674	<0.0001
Same-day	0	32	0	0 - 2	0	30	1	0 - 3	-5.673	<0.0001
Multi-day	0	50	0	0 - 1	0	39	1	0 - 4	-12.308	<0.0001

Members of the cohort for whom data on GMFCS level and epilepsy were missing were excluded from analysis.

From Mann-Whitney test

GMFCS, Gross Motor Function Classification System; Min, minimum; Max, maximum; IQR, interquartile range: indicates range from 25th to 75th percentile.

Table 2: Multi-day admissions: number of admitted nights, and median length of stay by GMFCS, epilepsy status and AR-DRG type

	Multi-day admissions		Admitted nights		Length of stay (days)					
					Min.	Max.	Median	IQR	Wilcoxon's Z #	*p*-value #
	n	(%)	n	(%)						
Total	**3440**	**(100.0)**	**21955**	**(100.0)**	**1**	**242**	**3**	**1 - 3**		
GMFCS									-10.953	<0.0001
I/II	994	(30.0)	4600	(21.0)	1	132	2	1 - 5		
III-V	2324	(70.0))	16523	(75.3)	1	242	4	2 - 7		
Unknown	122									
Epilepsy									-2.457	0.014
Yes	1792	(53.0)	11585	(52.8)	1	173	3	2 - 7		
No	1590	(47.0)	10085	(46.0)	1	242	3	1 - 6		
Unknown	58									
AR-DRG type									- 4.037	0.0001
Medical	1636	(56.3)	9508	(43.3)	1	242	3	1 - 6		
Surgical	1269	(43.7)	8571	(39.0)	1	211	4	2 - 6		
Other/Unknown	535									

Admissions with missing data on GMFCS level, epilepsy and AR-DRG type were excluded from analysis.

From Mann-Whitney test

GMFCS, Gross Motor Function Classification System; AR-DRG, Australian-Refined Diagnostic Related Group; Min, minimum; Max, maximum; IQR, interquartile range: indicates range from 25th to 75th percentile.

Table 3: Variation in primary diagnosis of multi-day admissions according to GMFCS level

	AR-DRG type			
	Medical [a] (n=1572)		Surgical [b] (n=1237)	
	GMFCS I/II	GMFCS III-V	GMFCS I/II	GMFCS III-V
	n (%)	n (%)	n (%)	n (%)
All [#]	**405 (25.8)**	**1167 (74.2)**	**453 (36.6)**	**784 (63.4)**
Infectious and parasitic diseases	**17 (4.2)**	**82 (7.0)**	**0 (0)**	**7 (0.9)**
Nervous system diseases	**63 (15.6)**	**185 (15.9)**	**43 (9.5)**	**56 (7.1)**
Cerebral palsy	13 (3.2)	36 (3.1)	25 (5.5)	34 (4.3)
Epilepsy	33 (8.1)	114 (9.8)	1 (0.2)	2 (0.3)
Other nervous system	17 (4.2)	35 (3.0)	17 (3.8)	20 (2.6)
Respiratory diseases	**49 (12.1)**	**275 (23.6)**	**11 (2.4)**	**35 (4.5)**
Disease of the upper respiratory tract	12 (3.0)	41 (3.6)	10 (2.2)	14 (1.8)
Diseases of the lower respiratory tract	37 (9.2)	221 (19.0)	1 (0.2)	13 (1.7)
Other respiratory	0 (0)	13 (1.1)	0 (0)	8 (1.0)
Digestive diseases	**16 (4.0)**	**68 (5.8)**	**11 (2.4)**	**48 (6.1)**
Musculoskeletal diseases	**7 (1.7)**	**35 (3.0)**	**195 (43.1)**	**366 (46.7)**
Contracture of muscle or tendon	0 (0)	5 (0.4)	111 (24.5)	181 (23.1)
Joint derangement	0 (0)	4 (0.3)	25 (5.5)	81 (10.3)
Acquired deformity	1 (0.3)	0 (0)	50 (11.0)	57 (7.3)
Scoliosis	0 (0)	1 (0.1)	0 (0)	37 (4.7)
Other musculoskeletal	6 (1.5)	25 (2.2)	9 (2.0)	10 (1.3)
Symptoms, signs & abnormal findings, NEC	**39 (9.6)**	**158 (13.5)**	**4 (0.9)**	**18 (2.3)**
Symptoms & signs involving digestive system & abdomen	9 (2.2)	56 (4.8)	0 (0)	4 (0.5)
Convulsions	6 (1.5)	23 (2.0)	0 (0)	0 (0)
Other symptoms or signs	24 (5.9)	80 (6.9)	4 (0.9)	14 (1.8)
Injury, poisoning and consequences of external causes	**17 (4.2)**	**41 (3.5)**	**47 (10.4)**	**54 (6.9)**
Factors influencing health & contact with health services	**62 (15.3)**	**112 (9.6)**	**33 (7.3)**	**63 (8.0)**
Other orthopaedic follow-up care	3 (0.7)	9 (0.8)	27 (6.0)	52 (6.6)
Care involving rehabilitation procedures	40 (9.9)	51 (4.4)	0 (0)	0 (0)
Attention to artificial opening or implanted device	2 (0.5)	8 (0.7)	6 (1.3)	7 (0.9)
Other factors	17 (4.2)	44 (3.8)	0 (0)	4 (0.5)
Other *	**43 (10.6)**	**89 (7.6)**	**48 (10.6)**	**66 (8.4)**
No diagnosis listed	**92 (22.7)**	**122 (10.5)**	**61 (13.5)**	**71 (9.1)**

Admissions with missing data on GMFCS level were excluded from analysis.

[a] χ^2 (9, N=1572) = 76.13, p<0.001 (for test of difference in major diagnostic category of overnight medical admissions between individuals classified as GMFCS I/II and those classified as GMFCS III-V).

[b] χ^2 (9, N=1237) = 32.69, p<0.001 (for test of difference in major diagnostic category of overnight surgical admission between individuals classified as GMFCS I/II and those classified as GMFCS III-V).

* Neoplasms; diseases of the blood and blood forming organs and immune mechanism; endocrine, nutritional and metabolic diseases; mental and behavioural disorders; diseases of the eye and adnexa; diseases of the ear and mastoid; circulatory system diseases; genitourinary system diseases; diseases of the skin and subcutaneous tissue; certain conditions originating in the perinatal period; and congenital anomalies

AR-DRG, Australian-Refined Diagnostic Related Group; GMFCS, Gross Motor Function Classification System; NEC, Not elsewhere classified; GI, Gastrointestinal.

Table 4: Primary procedures

	Length of admission [a]				GMFCS level [b]			
	Same-day (3737)		Multi-day (3440)		I/II (3050)		III-V (3920)	
	n	(%)	n	(%)	n	(%)	n	(%)
Musculoskeletal procedure	**1857**	**(49.7)**	**877**	**(25.5)**	**1639**	**(53.8)**	**1053**	**(26.8)**
Administration of agent into musculoskeletal site	1757	(47.0)	34	(1.0)	1264	(41.4)	498	(12.7)
Procedure on hip	8	(0.2)	321	(9.3)	91	(3.0)	235	(6.0)
Procedure on leg	13	(0.4)	211	(6.1)	137	(4.5)	85	(2.2)
Spinal procedure	0	(0)	38	(1.1)	0	(0)	37	(0.9)
Other application, insertion or removal procedure	36	(1.0)	121	(3.5)	57	(1.9)	97	(2.5)
Procedure on upper limb	13	(0.4)	10	(0.3)	18	(0.6)	5	(0.1)
Other musculoskeletal procedure	29	(0.8)	142	(4.1)	72	(2.4)	96	(2.5)
Procedure on digestive system	**321**	**(8.6)**	**164**	**(4.8)**	**64**	**(2.1)**	**412**	**(10.5)**
Application, insertion or removal procedure on stomach	227	(6.1)	80	(2.3)	20	(0.7)	281	(7.2)
Panendoscopy	77	(2.1)	14	(0.4)	16	(0.5)	75	(1.9)
Fundoplication	0	(0)	36	(1.0)	0	0	33	(0.8)
Other procedure on digestive system	17	(0.5)	34	(1.0)	28	(0.9)	23	(0.6)
Procedure on nervous system	**35**	**(0.9)**	**161**	**(4.7)**	**62**	**(2.0)**	**131**	**(3.3)**
Revision of intracranial cerebrospinal fluid shunt	0	(0)	54	(1.6)	29	(1.0)	25	(0.6)
Cranial tap or puncture	21	(0.6)	27	(0.8)	15	(0.5)	31	(0.8)
Insertion of spinal catheter, infusion device or pump	0	(0)	26	(0.8)	2	(0.1)	24	(0.6)
Revision procedures on spinal canal or spinal cord	0	(0)	17	(0.5)	0	(0)	17	(0.4)
Other procedure on nervous system	14	(0.3)	37	(3.7)	16	(0.4)	34	(0.9)
Procedure on respiratory system	**8**	**(0.2)**	**174**	**(5.1)**	**23**	**(0.8)**	**155**	**(4.0)**
Ventilatory support	2	(0.1)	130	(3.8)	16	(0.5)	113	(2.9)
Airway management	2	(0.1)	19	(0.6)	3	(0.1)	18	(0.5)
Other procedure on respiratory system	6	(0.1)	25	(0.7)	4	(0.2)	24	(0.6)
Dental procedure	**165**	**(4.4)**	**20**	**(0.6)**	**49**	**(1.6)**	**135**	**(3.4)**
Non-invasive, cognitive and other interventions, NEC	**336**	**(9.0)**	**763**	**(22.2)**	**280**	**(9.2)**	**805**	**(20.5)**
Intervention involving device, aid or equipment	107	(2.9)	22	(0.6)	61	(2.0)	67	(1.7)
Generalised allied health intervention	8	(0.2)	584	(17.0)	90	(3.0)	498	(12.7)
Administration of pharmacotherapy	145	(3.9)	24	(0.7)	43	(1.4)	125	(3.2)
Other non-invasive, cognitive and other interventions	76	(2.0)	133	(3.9)	86	(2.8)	115	(2.9)
Imaging services	**86**	**(2.3)**	**115**	**(3.3)**	**70**	**(2.3)**	**126**	**(3.2)**
Other *	**166**	**(4.4)**	**167**	**(4.9)**	**177**	**(5.8)**	**154**	**(3.9)**
No procedure listed	**763**	**(20.4)**	**999**	**(29.0)**	**686**	**(22.5)**	**949**	**(24.2)**

Admissions with missing data on GMFCS level were excluded from analysis.

[a] χ^2 (8, N= 7177) = 939.17, p = <0.001 (test for difference between same-day and multi-day admissions in category of primary procedure carried out during admission).

[b] χ^2 (8, N= 6970) = 761.95, p = <0.001 (for difference between individuals classified as GMFCS I/II and those classified as GMFCS III-V in category of primary procedure carried out during admission).

* Procedures on endocrine system; eye and adnexa; ear and mastoid process; nose, mouth and pharynx; cardiovascular system; blood and blood-forming organs; urinary system; male genital organs; gynaecological procedures; dermatological and plastic procedures; and breast.

GMFCS, Gross Motor Function Classification System; NEC, not elsewhere classified.

Table 5: 7-day, 30-day and 365-day all-cause readmission rates for all multi-day emergency admissions

	7-day	30-day	365-day
All	10.2%	22.6	63.4%
Age (years) at admission	X^2 (3, N=1630) = 3.49, p = 0.322	χ^2 (3, N=1609) = 7.79, p = 0.051	χ^2 (3, N=1340) = 9.62, p = 0.022
0-4	10.2%	24.1%	66.9
5-9	11.4%	24.6%	63.3
10-14	8.2%	17.8%	61.2
15-19	12.3%	24.5%	51.5
GMFCS level	X^2 (1, N=1561) = 0.01, p = 0.916	χ^2 (1, N = 1541) = 12.22, p < 0.0001	χ^2 (1, N=1281) = 52.11, p < 0.0001
I/II	10.2%	15.5%	44.9%
III-V	10.4%	24.4%	68.1%
AR-DRG type	X^2 (1, N=1339) = 0.49, p = 0.486	χ^2 (1, N=1320) = 1.95, p = 0.163	χ^2 (1, N = 1109) = 0.50, p = 0.479
Medical	10.5%	23.9%	64.5%
Surgical	12.4%	28.9%	61.4%
Primary diagnosis category of index admission	X^2 (8, N=1407) = 33.44 p < 0.0001	χ^2 (8, N=1,389) = 19.86, p = 0.011	χ^2 (8, N = 1147) = 32.38, p < 0.0001
Infectious and parasitic diseases	5.6%	22.4%	55.4%
Nervous system diseases	6.9%	18.9%	64.1%
Respiratory system diseases	9.3%	22.0%	71.4%
Digestive system diseases	11.3%	22.1%	53.4%
Musculoskeletal diseases	5.4%	18.9%	50.0%
Symptoms, signs and abnormal findings NEC	19.9%	32.5%	70.6%
Injury, poisoning and consequences of external causes	15.6%	26.5%	57.0%
Factors influencing health and contact with health services	0%	3.7%	34.8%
Other	10.8%	23.4	60.9%

Admissions with missing data on GMFCS level, AR-DRG type and primary diagnosis category of index admission were excluded from analysis.

X^2 testing for differences between sub-groups of age, GMFCS, AR-DRG, and primary diagnosis category in the proportion of 7-, 30-, and 365-day readmissions: X^2 (degrees of freedom, sample size) = X^2 statistic, p-value

GMFCS, Gross Motor Function Classification System; AR-DRG, Australian Refined Diagnostic Related Group; NEC, not elsewhere classified