

## INFANT AND CHILD INJURY IN BRISBANE, MACKAY AND MOUNT ISA 1998 to 2001

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### ABSTRACT

**Objectives:** Data of injury presentations to emergency departments in the Queensland communities of Brisbane (metropolitan), Mackay (rural) and Mount Isa (remote) were analysed to assess the impact of rurality on infant and child injury. **Methods:** A retrospective descriptive study of infant (0 years of age) and child (1 to 4 years of age) injury presentation data in 13 emergency departments in Brisbane, Mackay and Mount Isa from 1998 to 2001. **Results:** The overall injury presentation rate from 1998 to 2001 for Mount Isa (22,659/10<sup>5</sup>/yr; 95% CI 22,333 to 22,958/10<sup>5</sup>/yr) was significantly higher than the rate for Mackay (10,517/10<sup>5</sup>/yr; 95% CI 10,270 to 10,768/10<sup>5</sup>/yr), which was in turn significantly higher than that for Brisbane (7,944/10<sup>5</sup>/yr; 95% CI 7,850 to 8,040/10<sup>5</sup>/yr). The admission or transfer rate from 1998 to 2001 of 1,994/10<sup>5</sup>/yr (95% CI 1,718 to 2,300/10<sup>5</sup>/yr) for Mount Isa was significantly higher compared to the rates for Mackay (1,335/10<sup>5</sup>/yr; 95% CI 1,225 to 1,453/10<sup>5</sup>/yr) and Brisbane (1,512/10<sup>5</sup>/yr; 95% CI 1,463 to 1,563/10<sup>5</sup>/yr). The estimated cost per presentation per child at risk in the population for Mount Isa (\$33/child/year) was more than twice that for Mackay (\$15/child/year) and Brisbane (\$13/child/year). **Conclusions:** The results of this analysis demonstrate that the rates and costs of injury presentations and admissions to public hospitals increase significantly with rurality in Queensland.

**KEY WORDS:** Infant; Child; Injury; Prevention; Safety; Rural; Australia.

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### INTRODUCTION

Injury is the leading cause of mortality and one of the main causes of morbidity for Australian children. Approximately half of all deaths in children 1 to 4 years of age in Australia between 1992 and 1996 were attributed to injury (Australian Bureau of Statistics, 1998a). Injury ranks fourth behind congenital and neonatal conditions, asthma and mental disorders as the cause of disease burden in children aged 0 to 14 years in Australia, accounting for 11% of the disability-adjusted life years lost (Mathers et al., 1999). In Australia in 2001, injury was the principal diagnosis for 11% of hospital admissions in the 1 to 4 years age category (Australian Institute of Health and Welfare, 2002). The estimated total cost of injury and poisoning to the health system in 1994 in this age group was \$112 million dollars (Mathers and Penm, 1999). Injury was established as a National Health Priority Area by the Commonwealth Government in 1986 (Commonwealth Department of Health and Family Services and Australian Institute of Health and Welfare, 1998) and infant and child injury have been identified as a priority area by the Queensland Government (Queensland Health, 2000; Queensland Health, 2002).

Much of the literature on the epidemiology of infant and child injury in Australia is based on mortality or hospital admission data. These data, however, can only provide an incomplete description of the injury burden for this age category as fatalities and admissions represent only a small proportion of the overall incidence of injury. There are an estimated 40 hospital admissions and 800 medical practitioner consultations for every injury death in Australia (Harrison, 1996). Consequently, knowledge of the epidemiology of less severe infant and child injuries remains sufficiently scarce for analysis of surveillance data to be identified as a research need for infant and child injury (Department of Health and Aged Care, 1999). Emergency

department data is a useful source of surveillance data to identify high-risk groups and environments as targets for intervention strategies (Lyons et al., 1995). However, no published analyses of Australian emergency department data are available that detail the rates of injury presentations in the identified high-risk group of 0 to 4 year olds.

A number of reports detailing the rates of admissions or frequencies of presentations for single issues are available. While these reports may be valuable for disseminating information of injury issues or time trends for previously identified injury causes, they provide little perspective of the burden of the specific injury cause relative to other causes and are therefore only of very limited use in identifying areas for intervention strategies. Other publications are either restricted to the frequency of injury without a population at risk denominator (Hockey and Pitt, 1997; Nirui et al., 1999; Ashby et al., 2001) or target the broader 0 to 14 years age category (Nolan and Penny, 1992; Pitt et al., 1994). Descriptions of frequencies, however, do not allow for comparisons of the injury burden between populations and analyses of broad age categorisations usually conceal the change in injury risks and injury patterns that accompany the rapid physiological and cognitive developments of early childhood (Christoffel et al., 1992). Both types of analyses are again less useful when the primary aim is to identify of areas for intervention strategies (Agran et al., 2001).

It is against this backdrop that data of infant and child injury presentations in three different levels of rurality in the Queensland communities of Brisbane (metropolitan), Mackay (rural) and Mount Isa (remote) were analysed to describe the impact of rurality on injury in this age group.

## METHODS

The Queensland Injury Surveillance Unit (QISU) collected Level 2 National Data Standards for Injury Surveillance (NDS-IS) data from thirteen emergency departments (ED) in the Brisbane, Mackay and Mount Isa regions from 1998 to 2001. Data of all initial injury presentations by children from 0 to 4 years of age were available for hospitals in Brisbane (Mater Children's Brisbane, Mater Private Brisbane, Royal Children's Brisbane, Redland, Queen Elizabeth II), Mackay (Mackay Base, Moranbah, Sarina, Clermont, Proserpine, Dysart, Mater Private Mackay) and Mount Isa (Mount Isa Base) for this period. The Hospital Administrative Software Solutions Emergency Department Module was used for patient tracking and collection of injury surveillance data via a standardised data collection form. A parent or guardian of the patient completed items relating to demographics and circumstances of the injury. The attending medical practitioner completed the items relating to diagnosis and treatment. The Level 2 NDS-IS data was coded and entered by ED staff according to the National Injury Surveillance Unit coding manual (Australian Institute of Health and Welfare, 1998a). Diagnosis data was coded according to the International Classification of Disease (ICD-9CN) coding manual (National Coding Centre, 1995).

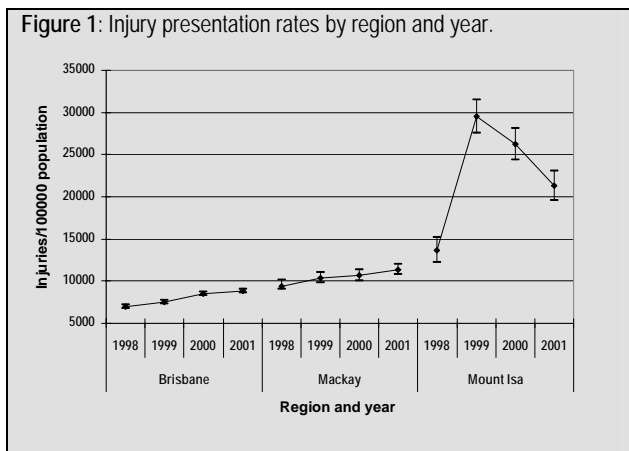
QISU conducted a validation study of NDS-IS data collected at the Mackay and Mount Isa Base Hospital ED in 1998. The case ascertainment (Mackay, 94%; Mount Isa 83%), injury data field completion (Mackay 85%, Mount Isa 65%) and coding agreement were acceptable to use the acquired data for injury surveillance (Hockey et al., 2000).

Brisbane, Mackay and Mount Isa were classified as metropolitan, rural and remote according to the Australian Institute of Health and Welfare remoteness classifications (2004). Rates were calculated using the 1998 Estimated Resident Populations for the Brisbane City Statistical Subdivision (SSD), the Mackay Statistical Division (SD) and the Mount Isa Statistical Local Area (SLA) as the population denominators (Australian Bureau of Statistics, 1998b). The 95% Confidence Intervals (95% CI) for all rates were calculated using the exact binomial method. Cost estimates were based on 1998 data for classifying and funding ambulatory services in Australia based on triage category and patient disposition. The cost per treatment encounter comprises the time spent with the patient, diagnostic, indirect (salaries and consumables), and overhead costs (Cleary et al., 1998). The data were analysed using Microsoft Excel and SPSS for Windows statistical software.

## RESULTS

Data were collected for a total of 24,231 presentations to emergency departments in the South Brisbane, Mackay and Mount Isa regions during the years 1998 to 2001. The overall injury presentation rate for the period 1998 to 2001 for Mount Isa (22,659/105/yr; 95% CI 22,333 to 22,958/105/yr) was significantly higher than the rate of Mackay (10,517/105/yr; 95% CI 10,270 to 10,768/105/yr), which was in turn significantly higher than that of Brisbane (7,944/105/yr; 95% CI 7,850 to 8,040/105/yr) (Figure 1).

**Figure 1:** Injury presentation rates by region and year.



The rates of injury presentations by region and year are detailed in Figure 1. Almost half of all injury presentations in Brisbane (45.3%; n=9,481), Mackay (42.9%; n=2,053) and Mount Isa (44.6%; n=1,007) were by 1 and 2 year olds. Males were consistently more likely to present with an injury in Brisbane (male:female=1.21), Mackay (male:female=1.22) and Mount Isa (male:female=1.26).

The admission or transfer rate from 1998 to 2001 of 1,994/105/yr (95% CI 1,718 to 2,300/105/yr) for Mount Isa was significantly higher compared to the rates for Mackay (1,335/105/yr; 95% CI 1,225 to 1,453/105/yr) and Brisbane (1,512/105/yr; 95% CI 1,463 to 1,563/105/yr). The rates of injuries of the triage category resuscitation of Brisbane (85/105/yr) and Mount Isa (81/105/yr) exceeded that of Mackay

(24/105/yr). Rates of non-urgent presentations of Mackay (2,027/105/yr) and Mount Isa (2,086/105/yr) were significantly greater than Brisbane (417/105/yr). Approximately half of all injury presentations of Mackay (47.4%) and Mount Isa (47.6%) were diagnosed as open wounds, superficial and sprain and strain injuries, compared to one-third (36.8%) for Brisbane. The Brisbane rates of fractures (894/105/yr), dislocations (453/105/yr) and near drownings or immersions (74/105/yr) exceeded the respective rates of Mackay and Mount Isa. The home was the most likely location for injury for Brisbane (79.7%), Mackay (81.8%) and Mount Isa (76.8%). Approximately one-third of all injury presentations for Brisbane (32.9%), Mackay (30.7%) and Mount Isa (32.9%) resulted from falls of less than one metre.

Table 1: Injury Presentation Rates by Region

	Brisbane n=18,250 7,944/10 <sup>5</sup> /yr (95% CI 7,850-8,040)		Mackay n=4,026 10,517/10 <sup>5</sup> /yr (95% CI 10,270-10,768)		Mt Isa n=1,955 22,659/10 <sup>5</sup> /yr (95% CI 22,332-22,956)	
Variable	rate/10 <sup>5</sup> /yr	%	rate/10 <sup>5</sup> /yr	%	rate/10 <sup>5</sup> /yr	%
<b>Age*</b>						
0 years		10.3		8.9		9.5
1 years		23.3		21.8		22.8
2 years		22.0		21.1		21.8
3 years		17.0		17.3		16.7
4 years		14.6		15.1		15.7
5 years		12.8		15.8		13.5
<b>Gender</b>						
Male	8,677	56.4	11,511	57.1	25,231	55.8
Female	7,160	43.6	9,433	42.9	20,056	44.2
<b>Triage category</b>						
Resuscitation	85	1.1	24	0.2	81	0.4
Emergency	654	8.2	376	3.6	1,113	4.9
Urgent	2,026	25.5	2,437	23.2	6,247	27.6
Semi-urgent	4,677	58.9	5,593	53.2	13,120	57.9
Non-urgent	417	5.2	2,027	19.3	2,086	9.2
<b>Mode of separation</b>						
Discharged home	6,275	79.0	8,973	85.3	20,294	89.6
Admitted	1,423	17.9	1,238	11.8	1,947	8.6
Did not wait	156	2.0	209	2.0	371	1.6
Transferred to another hospital	89	1.1	97	0.9	46	0.2
Deceased	2	0.0	0	0.0	0	0.0
<b>Intent</b>						
Unintentional	7,708	97.0	10,256	97.5	21,975	97.0
Undetermined	108	1.4	152	1.4	104	0.5
Assault/maltreatment	27	0.4	21	0.2	220	1.4
Other/unspecified	102	1.2	89	0.8	359	1.6
<b>Diagnosis</b>						
Open wound	1,585	19.9	2,591	24.6	5,934	26.2
Superficial	865	10.9	1,779	16.9	3,628	16.0
Intracranial injury	894	12.1	609	7.4	2,376	10.5
Fracture	965	11.2	778	5.8	892	3.9
Poisoning	697	8.8	593	5.6	1,159	5.1
Foreign body	590	7.4	575	5.5	1,391	6.1
Sprain/strain	480	6.0	617	5.9	1,229	5.4
Burn/corrosion	293	3.7	368	3.5	985	4.3
Dislocation	453	2.5	217	2.4	151	0.7
Eye injury	373	2.0	222	2.1	545	2.4
Drowning/immersion	74	0.4	13	0.1	46	0.2
<b>Anatomical site</b>						
Head/neck	3,496	44.0	4,786	45.5	10,083	44.5
Upper limb	1,807	22.8	2,260	21.5	4,138	18.3
Lower limb	724	9.1	1,241	11.8	3,280	14.5
Trunk	270	3.4	298	2.8	858	3.8
Multiple sites	142	1.8	201	1.9	417	1.8
Unspecified/not required	1,504	18.9	1,732	16.5	3,883	17.1
<b>Location</b>						
Home	6,933	79.7	8,600	81.8	17,408	76.8
School	370	4.7	232	2.2	452	2.0
Sport/recreation area	353	4.5	470	4.5	626	2.8
Street	199	2.5	418	4.0	765	3.4
Other specified	459	5.7	614	5.8	1,089	4.8
Unspecified	230	2.9	183	1.7	2,318	10.2

	Brisbane n=18,250 7,944/10 <sup>5</sup> /yr (95% CI 7,850-8,040)		Mackay n=4,026 10,517/10 <sup>5</sup> /yr (95% CI 10,270-10,768)		Mt Isa n=1,955 22,659/10 <sup>5</sup> /yr (95% CI 22,332-22,956)	
Variable	rate/10 <sup>5</sup> /yr	%	rate/10 <sup>5</sup> /yr	%	rate/10 <sup>5</sup> /yr	%
<b>External cause</b>						
Fall - less than 1 metre	2,616	32.9	3,229	30.7	7,452	32.9
Fall - greater than 1 metre	799	10.1	862	8.2	1,449	6.4
Contact with object	793	10.0	1,447	13.8	2,469	10.9
Poisoning - drug/medicinal	410	5.2	366	3.5	545	2.4
Poisoning - chemical	358	4.5	306	2.9	811	3.6
Cut/pierce	395	5.0	854	8.1	2,457	10.8
Exposure - hot drink/food/water	185	2.3	204	1.9	359	1.6
Exposure - hot object	123	1.6	199	1.9	626	2.8
Fire/flame/smoke	8	0.1	13	0.1	70	0.3
Animal-related (not horse/dog)	283	3.6	428	4.1	927	4.1
Contact with person	156	2.0	272	2.6	614	2.7
Bicycle	107	1.3	199	1.9	406	1.8
Drowning/submersion - pool	26	0.3	10	0.1	23	0.1
Drowning/submersion - non-pool	9	0.1	10	0.1	12	0.1
<b>Main injury factor (category)</b>						
Structure/fitting	1,205	15.2	1,782	16.9	2,654	11.7
Furnishing	1,110	14.0	1,306	12.4	2,098	9.3
Natural object/animal	832	10.5	1,617	15.4	2,735	12.1
Child product	823	10.4	1,001	9.5	1,402	6.2
Chemical	732	9.2	729	6.9	1,333	5.9
Material	412	5.2	836	7.9	2,527	11.2
Transport	328	4.1	684	6.5	1,182	5.2
Food/personal item	396	5.0	428	4.1	475	2.1
Utensil	151	0.7	306	1.4	637	1.0
Sporting Equipment	129	1.6	264	2.5	325	1.4
<b>Mechanism of injury (category)</b>						
Fall	3,174	40.0	3,856	36.7	8,194	36.2
Contact with object/person	1,600	20.1	2,652	25.2	4,671	20.6
Crush/pierce	937	11.8	1,873	17.8	5,274	23.3
Chemical effect	778	9.8	737	7.0	1,402	6.2
Thermal effect	312	3.9	434	4.1	1,008	4.5
Suffocation	291	3.7	240	2.3	440	1.9

\*ABS provided estimated resident populations for the Brisbane City Statistical Subdivision (SSD), the Mackay Statistical Division (SD) and the Mount Isa Statistical Local Area (SLA) in 5 year age categories only.

#### TRIAGE CATEGORY AND DISCHARGE STATUS

The proportion of presentations triaged as resuscitation that were admitted or transferred to another hospital was constant across the Brisbane (86.2%), Mackay (88.9%) and Mount Isa (85.7%) regions (Table 2).

Approximately two-thirds of presentations triaged as emergency for Brisbane (60.0%) and Mackay (62.7%) were admitted or transferred, compared to less than half (43.8%) for Mount Isa. A similar trend was present for the triage category urgent, where more than one-quarter of presentations in Brisbane (28.8%) and Mackay (28.1%) were admitted or transferred compared to 15.6% for Mount Isa.

#### COST

The estimated costs per injury presentation according to separation status and triage category are presented in Table 3. The total cost per child at risk in the population per year for Brisbane (\$13/child/year) and Mackay (\$15/child/year) were comparable. The estimated cost per child at risk for Mount Isa (\$33/child/year) was more than double the costs for Mackay and Brisbane.

Table 2: Discharge Status by Triage Category and Region

Region	Triage Category	Discharge Status					% of total
		Admit/Transfer		Other		Total	
		rate/10 <sup>5</sup> /yr	% within triage category	rate/10 <sup>5</sup> /yr	% within triage category	rate/10 <sup>5</sup> /yr	
Brisbane	Resuscitation	73	86.2	12	13.8	85	1.1
	Emergency	392	60.0	262	40.0	654	8.2
	Urgent	584	28.8	1,442	71.2	2,026	25.5
	Semi-urgent	430	9.2	4,247	90.8	4,677	58.9
	Non-urgent	30	7.2	387	92.8	417	5.2
	Unspecified	3	3.0	83	97.0	86	1.1
<b>Total</b>		<b>1,152</b>	<b>19.0</b>	<b>6,433</b>	<b>81.0</b>	<b>7,944</b>	<b>100.0</b>
Mackay	Resuscitation	21	88.9	3	11.1	24	0.4
	Emergency	235	62.5	141	37.5	376	3.6
	Urgent	684	28.1	1,753	71.9	2,437	23.2
	Semi-urgent	332	5.9	5,261	94.1	5,593	53.2
	Non-urgent	55	2.7	1,972	97.3	2,027	19.3
	Unspecified	8	13.0	52	87.0	60	0.6
<b>Total</b>		<b>1,335</b>	<b>12.7</b>	<b>9,182</b>	<b>87.3</b>	<b>10,517</b>	<b>100.0</b>
Mount Isa	Resuscitation	70	85.7	12	14.3	81	0.4
	Emergency	487	43.8	626	56.3	1,113	4.9
	Urgent	974	15.6	5,274	84.4	6,247	27.6
	Semi-urgent	417	3.2	12,703	96.8	13,120	57.9
	Non-urgent	46	2.2	2,040	97.8	2,086	9.2
	Unspecified	0	0.0	12	100.0	12	0.1
<b>Total</b>		<b>1,944</b>	<b>8.8</b>	<b>20,665</b>	<b>91.2</b>	<b>22,659</b>	<b>100.0</b>

Table 3: Estimated Cost per Injury Presentations According to Separation Status and Triage Category by Region

Region	Separation status	Triage Category	Cost (\$AUD)	
Brisbane	Admitted/transferred	Resuscitation	84,353	
		Emergency	243,910	
		Urgent	321,827	
		Semi-urgent	192,512	
		Non-urgent	8,955	
	Discharged home	Resuscitation	4,308	
		Emergency	114,786	
		Urgent	547,852	
		Semi-urgent	1,278,913	
		Non-urgent	79,443	
	Deceased	All categories	1,074	
	<b>TOTAL</b>			<b>2,877,931</b>
	<b>TOTAL/YEAR</b>			<b>719,483</b>
<b>TOTAL/CHILD/YEAR</b>			<b>13</b>	
Mackay	Admitted/transferred	Resuscitation	4,017	
		Emergency	24,364	
		Urgent	62,877	
		Semi-urgent	24,746	
		Non-urgent	2,725	
	Discharged home	Resuscitation	196	
		Emergency	10,365	
		Urgent	111,643	
		Semi-urgent	261,415	
		Non-urgent	68,906	
	<b>TOTAL</b>			<b>571,254</b>
	<b>TOTAL/YEAR</b>			<b>142,814</b>
	<b>TOTAL/CHILD/YEAR</b>			<b>15</b>
Mount Isa	Admitted/transferred	Resuscitation	3,013	
		Emergency	11,370	
		Urgent	20,160	
		Semi-urgent	7,015	
		Non-urgent	519	
	Discharged home	Resuscitation	196	
		Emergency	10,173	
		Urgent	75,543	
		Semi-urgent	144,856	
		Non-urgent	15,485	
	<b>TOTAL</b>			<b>288,329</b>
	<b>TOTAL/YEAR</b>			<b>72,082</b>
	<b>TOTAL/CHILD/YEAR</b>			<b>33</b>

## DISCUSSION

The observed overall injury presentation rate for the period 1998 to 2001 for Mount Isa (22,659/105/yr) was significantly higher than the rate of Mackay (10,517/105/yr), which was in turn significantly higher than that of Brisbane (7,944/105/yr) (Figure 1). The estimated costs of emergency department injury presentations per child at risk in Mount Isa (\$33/child/year) were more than double that of Mackay (\$15/child/year) and almost triple that of Brisbane (\$13/child/year) (Table 3). The results of this analysis demonstrate that the rates and costs of injury presentations and admissions to public hospitals increase significantly with rurality in system in the 0 to 4 years age category Queensland. The trend observed in this analysis of infant and child injury is similar to that for several other health states in broader age categories at a national level (Strong et al., 1998).

The trend towards increasing injury with increasing remoteness was not as marked for admission or transfer rates. Rates were highest for Mount Isa (1,994/105/yr), followed by Brisbane (1,512/105/yr) and lowest for Mackay (1,335/105/yr). The admission rates for Brisbane and Mackay are comparable to those for Australia (1,608/105/yr) (Moller and Kreisfeld, 1997) and Victoria (1,500/105/yr) (Watt and Ozanne-Smith, 1996) available from previously published studies. While hospital admission rates are subject to temporal and geographical variation because of health service availability, utilisation, policy and practice (Langley and Cryer, 2000), the observed overall and male admission rates for Mount Isa (1,994 and 2,523/105/yr) are concerning.

The higher rates of injury presentation in Mackay and Mount Isa in this analysis may be explained partially by reduced access to general practitioners. In 1996 in Brisbane there were 1,182 persons per general practitioner, compared to 1,283 in Mackay and 3,667 in Mount Isa (Glover and Tennant, 2006). Less serious injuries are more likely to present to emergency departments in regions where there are less general practitioners. This is supported by the injury patterns observed in this analysis. The proportion of relatively minor injuries such as open wounds and superficial injuries were lowest for Brisbane (32%) and increased to 42% for Mackay and Mount Isa. Similarly, the rates of more serious injuries such as fractures for Brisbane (965/105/yr) were higher than those for Mackay (778/105/yr) and Mount Isa (892/105/yr).

The gradient of the burden of injury observed in this analysis may be partially due to an accompanying gradient of socio-economic disadvantage that has been observed in population-based studies (Jolly et al., 1993; Cubbin and Smith, 2002). The 2001 Population Census Relative Socio-Economic

Disadvantage score for Mount Isa (937) was lower than Mackay (977) and Brisbane (1,036) (Australian Bureau of Statistics, 2001). This score was based on the income, education and employment attributes of individual households in geographic areas. However, little significant variation in injury patterns was observed between the three regions. The relative proportions of injury causes and factors are similar to the patterns identified in other collections of injury data for the 0 to 4 years age group in Australia. Falls and injuries at home represent the largest identifiable source of the burden of injury to the public health system in this age category. Of the more severe injuries requiring admission or transfer, poisonings and burns and scalds are identified as priority causes for intervention strategies due to their high frequency.

The presentation and admission rates for Mount Isa described in this analysis may be underestimated due to variability in ascertainment (Figure 3). The presentation (29 485/105/yr and 26 194/105/yr) and admission (2 967/105/yr and 2 040/105/yr) rates (Tables 1 and 2 respectively) for Mount Isa were highest in 1999 and 2000 when ascertainment rates were consistently above 70%. The average presentation (27 840/105/yr) and admission rates (2 504/105/yr) for 1999 to 2000 were approximately 25% greater than for the overall observation period for this analysis of 1998 to 2002. In contrast, the ascertainment rates for Mackay and Brisbane were consistently higher and more stable across the observation period. This stability was reflected by the relative consistency of the observed presentation and admission rates.

The population denominators used to calculate the rates in this analysis are the Australian Bureau of Statistics 1998 Estimated Resident Populations for the Brisbane City Statistical Subdivision (SSD), the Mackay Statistical Division (SD) and the Mount Isa Statistical Local Area (SLA) (Australian Bureau of Statistics, 1998b). The populations used for the Mackay region and Mount Isa are representative of the population at risk as injury cases are unlikely to access alternative emergency departments due to the geographical isolation of both sites. The rates for the Brisbane region may be an underestimate due to loss of patients to private hospitals in the Brisbane metropolitan area and public hospitals at Logan, Redcliffe and Caboolture. This underestimate is likely to be minimal as the Royal and Mater Childrens' Hospitals are the leading infant and child referral centres in south-eastern Queensland.

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