BUS RELATED INJURY STATISTICS

VICTORIA 2005/06 TO 2014/15

Report prepared by the Victorian Injury Surveillance Unit (VISU, Accident Research Centre) for Transport Safety Victoria (TSV)

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Summary of Key Findings

Bus transport related injury hospital admissions

- There were 846 admissions to Victorian hospitals as a result of bus-related injuries in the ten-year period from 2005/6 to 2014/15: an average of 85 admissions per year
- Over two-thirds (68.3%, n=578) of individuals injured in a bus-related transport accident were female
- Almost two-thirds (64.4%, n=545) of injuries resulting in hospital admission occurred amongst those aged 60 years and over
- Almost three-quarters of injuries (72.1%, n=610) were suffered by residents of the metropolitan Melbourne area
- Bus-related injury rates increased by an average 2.8% each year over the study period

Bus transport related injury cause and injury type

- Of the bus related injuries resulting in hospital admission, 44.9% (n=380) occurred on public roads; almost as many cases were not sufficiently categorised in terms of place of occurrence (44.1%, n=373)
- Bus-related injuries resulting in admission or emergency department presentation were preceded by a collision 18.4% and 28.2% of the time, respectively
- Passengers were most likely to be injured, accounting for 41.7% (n=353) of bus-related injury admissions followed by those boarding or alighting (31.1%, n=263)
- Almost half (47.5%, n=402) of all bus-related injuries were fractures
- The lower extremities were the most frequently injured body region (33.2%, n=281)
- The head was the most frequently injured body site (20.1%, n=170)

Bus transport related injury burden: admission bed days, discharge destination and cost

- Bus related injury hospital bed days per population decreased by an average 2.7% per year over the ten-year period
- Bus-related injuries resulted in an average of 6.43 bed days; 44% (n=372) of hospital stays were less than two days
- $1.25 million was the hospital admission cost of bus-related injury admissions in the two-year period 2011/12-2012/13
- Over two-thirds (68.6%, n=580) of separations from hospital were to private residences/accommodation

Bus transport related injury narrative information, from ED presentations that resulted in admission

- Passengers accounted for 23.9% (n=198) of ED presentations subsequently admitted to hospital
- 28.2% (n=234) of injuries resulting in ED presentation and subsequently admitted to hospital were directly caused by a collision or preceded by a collision

Bus transport related injury deaths

- Over the period 2007-2012, nine deaths were recorded as a resulted of bus-related injuries

Introduction

In the 2015/16 financial year, 122.5 million bus trips were taken in the metropolitan Melbourne area. Published research on bus-related injuries is scarce. However, a number of reports that are available through bodies such as Transport Safety Victoria (TSV) and the Australian Institute of Health and Welfare (AIHW) have provided insight into injuries occurring in relation to bus transport. In a nationwide transport study, Henley and Harrison (2012a) reported that over the nine-year period 2000/01-2008/09 there was a modest increase in the number of persons injured in a collision between a bus and a car, pick-up truck, or van as well as non-collision accidents. It was noted that 48% of cases resulting in an injury that represented high threat to life whilst aboard a bus were non-collision accidents. Henley and Harrison (2012b) also found that the serious injury rate for buses in Victoria was 229 per 100,000 registered vehicles. More recently, TSV (2017) reported increases in the number of collisions involving buses and pedestrians, motorcycles, trucks and other buses from 2015 to 2016. The number of slips, trips and falls were also noted to have increased in 2016 in comparison to the previous nine years.

The report that follows utilises the Victorian Admitted Episodes Dataset (VAED) and Victorian Emergency Minimum Dataset (VEMD) to investigate bus-related injury admissions over the period 2005/6-2014/15. Cause of Death Unit Record Files (COD URF) were also analysed to provide insight into deaths resulting from bus-related injury over the period 2007-2012. This report aims to:

- investigate the nature, cause, and mechanism of bus-related injuries and deaths
- determine demographic risk factors relating to bus-related injuries
- determine the burden of bus-related injuries in terms of hospital bed days and direct hospital costs
- integrate the findings and propose a number of recommendations to reduce the impact of bus-related injuries in Victoria

Hospital Admissions, 2005/06-2014/15

Over the period 2005/6 to 2014/15 there were a total of 846 admissions to Victorian hospitals as a result of bus-related injuries, of which 68.3% (n=578) were female (Table 1). A geographic breakdown revealed that 72.1% (n=610) of injured persons resided in the Melbourne Metropolitan area, whilst 20.4% (n=173) resided in regional or rural Victoria (the remaining proportion resided either interstate or overseas). With regard to the age of injured persons, older individuals were represented more often; 64.4% (n=545) of bus-related injuries resulting in hospital admission were accounted for by those aged 60 years and over.

Table 1. Demographic data for 2005/6-2014/16

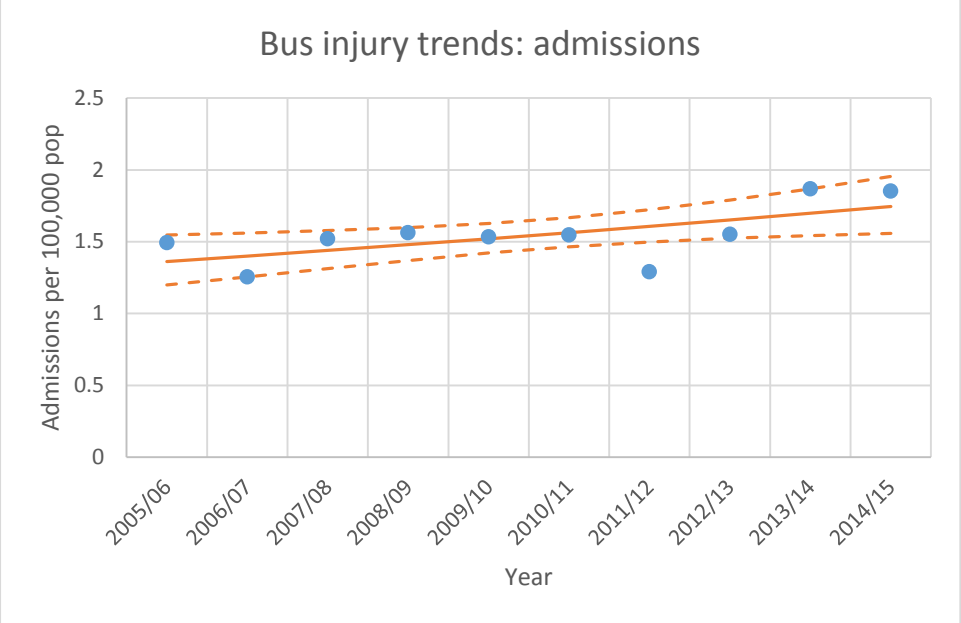
Characteristic	N	%
Sex		
Female	578	68.3
Male	268	31.7
Age		
0-14 years	29	3.4
15-29 years	83	9.8
30-44 years	60	7.1
45-59 years	129	15.2
60-74 years	205	24.2
75+ years	340	40.2
Geographic Region		
Melbourne Metropolitan Area	610	72.1
Regional/Rural Victoria	173	20.4
Interstate	47	5.6
Overseas	16	1.9

The number of bus-related injuries has risen a small amount over the ten-year period, with a minimum of 64 admissions in 2006/7 and a maximum of 109 in 2014/15 (Table 2). To determine if the changes indicate an increase in the rate of bus-related injuries per population in Victoria, a trend analysis was conducted using these data and the Victorian population data at a specific time point each year over the study period. The trend analysis revealed that bus-related injury rates increased by 2.8% each year; a statistically significant trend (p=0.017) (Figure 1).

Table 2. Number of injury admissions per financial year, 2005/06-2014/15

Financial Year	N	%
2005/06	75	8.9
2006/07	64	7.6
2007/08	79	9.3
2008/09	83	9.8
2009/10	83	9.8
2010/11	85	10.0
2011/12	72	8.5
2012/13	88	10.4
2013/14	108	12.8
2014/15	109	12.9

Figure 1. Trends for admissions for bus-related injuries (per 100,000 population), 2005/06-2014/15



Of the 846 bus-related injuries resulting in hospital admission, 44.9% (n=380) of cases were injured in a traffic accident and 11% (n=93) were injured in a non-traffic accident (Table 3). The ICD-10-AM defines a traffic accident as an accident that occurs on public roads including those accidents that begin on, terminate on, or involve a vehicle at least partially on a public road. The remaining cases fall into either 'Other' (31.1%, n=263) or 'Unspecified' (13%, n=110). The ICD-10-AM dictates that these cases should be coded as traffic accidents. However, 'traffic accident' cases primarily involve individuals boarding or alighting, or being trapped by a door or other part of the bus, so simply categorising these cases as 'traffic' cases because they occurred on a public road does not capture the essence of the circumstances surrounding the injury.

Table 3. Incident traffic type, 2005/06-2014/15

Traffic Type	N	%
Traffic	380	44.9
Other	263	31.1
Unspecified	110	13.0
Non-traffic	93	11.0
Total	846	100.0

In the majority of cases (82.6%, n=699) there was no collision causing or preceding the injury (Table 4). In 8% (n=68) of cases, a collision involving a car, pick-up, or van preceded the accident, and in 4.3% (n=36) of cases the injury was a result of a collision between a bus and a heavy transport vehicle or another bus.

Table 4. Object of collision, 2005/06-2014/15

Collision Object	N	%
Non-collision	699	82.6
Car, pick-up truck, or van	68	8.0
Heavy transport vehicle or bus	36	4.3
Fixed or stationary object	24	2.8
Other and unspecified motor vehicles	10	1.2
Pedestrian or animal	*	*
Missing	*	*
Railway train or railway vehicle	*	*

The injured individual was most likely to be a passenger (41.7%, n=353) or individual boarding or alighting (31.1%, n=263) (Table 5). Whilst it is generally the case that an individual boarding or alighting a bus will be considered a passenger, this breakdown allows for further insight into the possible causes of injury. However, data for the role of the individual injured in the accident is not well-defined; in 22% (n=186) of cases, the role of the injured individual was coded as 'unspecified'.

Table 5. Role of injured person, 2005/06-2014/15

Injured Person	N	%
Passenger	353	41.7
Person boarding or alighting	263	31.1
Any or unspecified	186	22.0
Driver	36	4.3
Person on outside of vehicle	*	*
Missing	*	*

Fractures were the most commonly recorded injury (47.5%, n=402) followed by open wounds (11.3%, n=96) (Table 6). The lower extremities were the most commonly injured body region, accounting for 33.2% (n=281) of injuries whilst the upper extremities were the least frequently injured body region

(18.1%, n=153). Further breakdown of body sites injured revealed that, despite the lower extremities being the most frequently injured broad body region, the head was the specific body site most frequently injured (20.1%, n=170) followed by the knee/lower leg (17.5%, n=148) and hip/thigh (12.9%, n=109).

Table 6. Nature and location of injury, 2005/06-2014/15

	N	%
Nature of Injury		
Fracture	402	47.5
Other & unspecified injury	156	18.4
Open wound	96	11.3
Superficial injury	61	7.2
Intracranial injury	52	6.1
Dislocation, sprain & strain	41	4.8
Injury to internal organs	17	2.0
Injury to muscle & tendon	13	1.5
Injury to nerves & spinal cord	*	*
Traumatic amputation	*	*
Eye injury - excluding foreign body	*	*
Body Region		
Lower extremity	281	33.2
Head/face/neck	218	25.8
Trunk	193	22.8
Upper extremity	*	*
Unspecified body region	*	*
Body Location		
Head	170	20.1
Knee & lower leg	148	17.5
Hip & thigh	109	12.9
Thorax	99	11.7
Abdomen, lower back, lumbar spine & pelvis	94	11.1
Shoulder & upper arm	70	8.3
Elbow & forearm	60	7.1
Neck	48	5.7
Ankle & foot	24	2.8
Wrist & hand	*	*
Unspecified body region	*	*

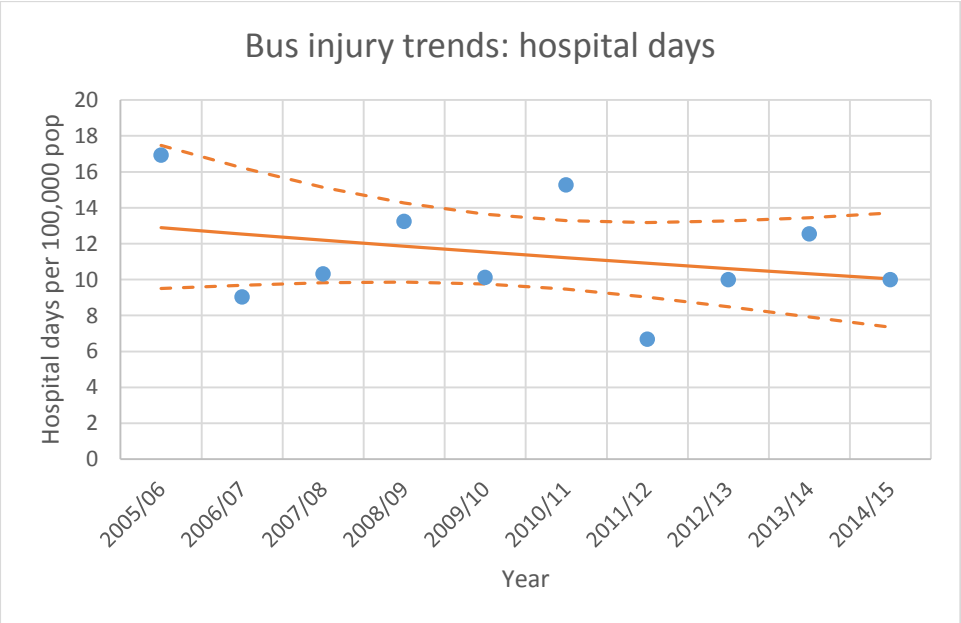
A breakdown of hospital bed days showed that, over the ten-year period, bus-related injuries resulted in a total of 6193 bed days with an average 6.43 bed days per admission (Table 7). However, this average is inflated by some cases in which the injury resulted in prolonged hospital admission (i.e., statistical outliers); in 1.2% (n=10) of cases, the length of stay was 31 or more days (Table 8). Overall, a large proportion of bus-related injuries resulted in stays of fewer than two days (44%, n=372) whilst 33% (n=279) resulted in hospital stays of 2-7 days. Bed days peaked in 2005/6 with

850 and were at a minimum in 2011/12 when only 373 bed days were utilised as a result of bus-related injuries. To determine the trend in hospital days per population over time, a trend analysis was conducted using these data, and the population data for Victoria at a specific time point each year over the study period. The trend analysis revealed that bus-related injury hospital bed days per 100,000 population decreased over the ten-year period but the trend was not statistically significant (p=0.35) (Figure 2).

Table 7. Number of hospital bed days per financial year, 2005/06-2014/15

Financial Year	N	%
2005/06	850	13.73
2006/07	461	7.44
2007/08	536	8.65
2008/09	703	11.35
2009/10	548	8.85
2010/11	839	13.55
2011/12	373	6.02
2012/13	568	9.17
2013/14	726	11.72
2014/15	589	9.51

Figure 2. Trends for hospital bed days (per 100,000 population), 2005/06-2014/15



The cost of bus-related injury admissions for the years 11/12-12/13 reached a total of $1.25 million. Over two-thirds (68.6%, n=580) of separations from hospital were to private residences or

accommodation and 24.7% (n=209) of cases resulted in separation to acute hospital or extended care (Table 9. Type of separation from hospital, 2005/06-2014/15).

Table 8. Hospital bed days (grouped), 2005/06-2014/15

Bed Days	N	%
< 2 days	372	44.0
2-7 days	279	33.0
8-30 days	185	21.9
31+ days	10	1.2

Table 9. Type of separation from hospital, 2005/06-2014/15

Separation Type	N	%
Separation to private residence/accommodation	580	68.6
Separation and transfer to acute hospital/extended care	209	24.7
Statistical Separation	27	3.2
Separation and transfer to aged care residential facility	16	1.9
Death	*	*
Left against medical advice	*	*
Separation and transfer to Transition Care bed based program	*	*

Emergency Department Presentations Subsequently Admitted, 2005/06-2014/15

In order to better understand the cause of the injury and the injured individual's role in the accident, the VEMD was analysed using optimised text narrative search strings to provide as much information as could be accurately extracted. The VAED (hospital admissions data) could not be used as these do not contain narrative text. Only ED cases that were subsequently admitted were included in this analysis, for better matching with the admissions data on which the rest of the report is based. A total of 830 ED presentations subsequently admitted to hospital were examined.

With regard to the circumstances of the injury, 23.9% (n=198) of bus-related injuries occurred while riding, boarding or alighting a bus, followed by 20.4% (n=169) being the result of a car, bicycle, or motorcycle colliding with a bus (Table 10). As is the case with much of the VEMD text narrative data, a substantial number of cases did not contain the detail necessary to allocate coding; 38.7% (n=321) of injuries were coded as 'other or unspecified' as a result.

Table 10. Circumstances of accident resulting in ED presentation, 2005/06-2014/15

Nature of Accident	N	%
Other and unspecified	321	38.7
Person injured while on public transport (includes getting on or off)	198	23.9
Cars, bikes, motorcycles in collision with public transport	169	20.4
Person (pedestrian) hit by public transport	103	12.4
Persons injured while running to catch a tram or bus	16	1.9
Assault	12	1.4
Person injured while working on public transport	*	*
Self-harm	*	*
Role of Injured Individual		
Other	335	40.4
Passenger	198	23.9
Occupant or rider of other vehicle	169	20.4
Car	*43*	*25.4*
Motorcycle	*5*	*2.9*
Bicycle	*8*	*4.7*
Other or unspecified	*113*	*67.0*
Pedestrian or bystander	119	14.3
Driver or other employee	9	1.1
Impact Status		
Collision	234	28.2
Non-collision or unspecified	596	71.8

Similarly, when investigating the role of the injured person, 40.4% (n=335) of cases made no mention of any identifier. Almost a quarter (23.9%) of injured persons were passengers and 20.4% (n=169) were an occupant or rider of another vehicle. Of those who were occupants or riders of another vehicle, 25.4% (n=43) were in a car and two-thirds (67%, n=113) of cases could not be accurately assigned a vehicle type.

Lastly, narrative data was used to determine the proportion of injuries resulting in admission which were preceded by a collision. A proportion of 28.2% (n=234) of injuries were directly caused by a collision (e.g., a bicycle rider injured due to collision with a bus) or preceded by a collision (e.g., a bus passenger thrown from their seat as a result of the bus hitting a stationary object).

Deaths, 2007-2012

Over the period 2007-2012, there were nine deaths recorded as being the result of a bus-related injury. Due to the small number of deaths, VISU is unable to provide detail on many of the circumstances involved in the accident which resulted in the death. As such, a brief summary is provided in dot point form below, containing all information which can be disclosed:

- 77.8% (n=7) of deaths occurred in traffic accidents
- 66.7% (n=6) were classified as passenger or someone boarding or alighting
- 66.7% (n=6) deaths occurred in non-collision accidents

All other information including sex, age, residence, year, and the specifics of the accident and injuries sustained resulting in death cannot be provided by VISU.

Discussion and Recommendations

The results indicated that women, persons aged 60 years and over, and those who resided in the Melbourne metropolitan area were most likely to be admitted to hospital for a bus-related injury. The latter of these three risk factors is unsurprising and easily understood in the context of the fact that bus services are much more likely to be utilised in metropolitan Melbourne. In order to determine if persons living in regional areas are at higher risk of being injured on buses in Victoria, an analysis of the injuries *per population* specific to regional vs. metropolitan Victoria is required. However, given the low number of injuries suffered by residents of rural/regional Victoria, it is unlikely that such an analysis would be required or sufficiently robust.

It is unlikely that women should be more likely to injure themselves whilst travelling by bus; therefore, it is suggested that the overrepresentation of women in bus-related injury admissions is a reflection of bus patronage; which is to say that this could be explained by women travelling by bus more frequently than men, and not that the injury rates per km travelled are necessarily higher for females than males.

For additional insight into relative risk per age and sex, injury admission rates need to be analysed in relation to transport use, e.g. rates need to be calculated as injuries per bus km travelled or per trips per year, by age and sex. This is beyond the scope of this report.

The age profile of those most frequently injured on buses is best considered taking the nature of the injury into account. Older persons are more susceptible to falls and more likely to suffer fractures upon impact with hard surfaces in comparison to their younger counterparts. Given that 82.6% of bus-related injuries did not involve a collision and 47.5% of injuries were fractures, it is reasonable to suggest that older bus passengers experienced falls due to sudden bus movements, being off balance, or tripping when getting on or off the bus and suffering fractures upon impact with the floor or possibly other fixed objects within the vehicle. This is in agreement with the findings regarding the injured body region: the lower extremities were the site most commonly injured (33.2%). Older persons are susceptible to fractures of the hip and/or thigh when falling. Therefore, a plausible scenario for bus-related injury is an older person (female)slipping, tripping or falling while on a bus, and sustaining a fracture as a result (usually to the lower extremities). This does not account for the whole picture but it does provide a potential focus for injury prevention.

Moving on to trends, an increase in bus-related injury rates resulting in hospital admission was observed over the ten-year period, 2005/06-2014/15; an average increase of 2.8% each year. Determining the factors driving this trend is beyond the scope of this report. However, given Australia's aging population, and the age profile for injured individuals as described above, it is a plausible consideration that the number of older persons travelling by bus will continue to rise over time. If this is the case then without intervention, the rate of bus-related injuries will likely continue to rise. Alternatively, bus transport use by older persons could decrease as the baby boomer generation reaches the age of 80+ years: baby boomers are more likely to (continue to) use a private vehicle, in comparison to previous generations (Koppel et al., 2016).

To gain further insight into bus-related injuries, VEMD data for ED presentations subsequently admitted were analysed. Here we see a somewhat different picture when compared to the admissions data in the VAED. Passengers including those boarding or alighting accounted for a smaller proportion of injuries than the VAED admissions data. However, the figures here are somewhat problematic to interpret given that 38.7% of cases could not be adequately coded due to

low data quality. Nevertheless, those injured whilst aboard, or while boarding or alighting a bus are the most well represented group.

A slightly different method of analysis was used to determine the role of the injured person. This also yielded incomplete results, given that in 40.4% of cases, the role of the individual could not be accurately identified. Perhaps the point of most interest here was that car occupants were those most likely to be injured in bus-related incidents as a result of a collision between a bus and another vehicle. Lastly, ED presentations subsequently admitted more often resulted from collisions when compared to direct hospital admissions. It is difficult to draw many conclusions from the ED presentations data considering limitations of the data quality and completeness. The data which has been accurately coded with regard to bus-related injury may be representative of all bus-related injuries but it may also be the case that there is a pattern or commonality with regard to cases where the description is lacking in detail. This would mean that any inferences based on the accurately coded data could not be applied to all cases; it is therefore advisable to interpret the Emergency Department presentations narrative analysis results as qualitative (i.e. providing further insight into the cause and role of injured person) rather than quantitative (i.e. the absolute numbers and proportions are much less reliable than the VAED results)

In accordance with the main findings of this report, The Victorian Injury Surveillance Unit recommends that further initiatives be developed to ensure the safety of bus passengers, with particular focus on older persons. Such initiatives may include stricter adherence to passenger limits, extra training for drivers to avoid unnecessary, sudden, or unpredictable vehicle movement, and awareness campaigns for passengers to ensure they take care when travelling on buses and when boarding or alighting, especially for those passengers who are unable to be seated during travel.

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Appendix A: Additional Tables

Table 11. Sex by year breakdown

Year	Male	Female	Total
2005/06	26	49	75
2006/07	19	45	64
2007/08	23	56	79
2008/09	28	55	83
2009/10	29	54	83
2010/11	26	59	85
2011/12	21	51	72
2012/13	32	56	88
2013/14	34	74	108
2014/15	30	79	109
Total	268	578	846

Table 12. Object of collision by year breakdown

Year	Pedestrian or animal	Car, pick-up truck, or van	Heavy transport vehicle or bus	Railway train or railway vehicle	Fixed or stationary object	Non-collision	Other and unspecified motor vehicles
2005/06	*	4	*	*	5	63	*
2006/07	*	6	*	*	*	53	*
2007/08	*	5	*	*	*	68	*
2008/09	*	*	8	*	*	68	*
2009/10	*	6	11	*	*	61	*
2010/11	*	7	*	*	*	73	*
2011/12	*	*	6	*	*	59	*
2012/13	*	8	*	*	*	77	*
2013/14	*	13	*	*	*	88	*
2014/15	*	12	*	*	*	89	*
Total	*	68	36	*	24	699	10

Table 13. Role of injured person by year breakdown

Year	Driver	Passenger	Person boarding or alighting	Person on outside of vehicle	Any or unspecified
2005/06	*	39	11	*	23
2006/07	*	24	17	*	20
2007/08	*	30	23	*	22
2008/09	6	28	31	*	16
2009/10	*	39	29	*	11
2010/11	*	35	32	*	15
2011/12	*	28	21	*	21
2012/13	*	34	34	*	16
2013/14	7	41	33	*	23
2014/15	*	55	32	*	19
Total	36	353	263	5	186

Table 14. Specific location of injury by year breakdown

Year	Head	Neck	Thorax	Abdomen, lower back, lumbar spine & pelvis	Shoulder & upper arm	Elbow & forearm	Wrist & hand	Hip & thigh	Knee & lower leg	Ankle & foot	Unspecified body region
2005/06	13	*	8	11	8	5	*	11	13	*	*
2006/07	12	*	10	*	11	*	*	5	15	*	*
2007/08	5	*	14	8	*	12	*	13	20	*	*
2008/09	10	6	6	*	8	11	*	14	16	*	*
2009/10	21	*	11	10	6	6	*	7	15	*	*
2010/11	13	10	10	10	8	*	*	9	13	5	*
2011/12	14	*	*	12	*	*	*	13	14	*	*
2012/13	20	7	10	11	10	*	*	14	11	*	*
2013/14	30	*	15	13	6	*	*	11	20	*	*
2014/15	32	9	11	10	7	12	*	12	11	*	*
Total	170	48	99	94	70	60	23	109	148	24	*

Table 15. Broad body region injured by year breakdown

Year	Head/face/neck	Trunk	Upper extremity	Lower extremity	Unspecified body region
2005/06	15	19	15	26	*
2006/07	14	14	15	21	*
2007/08	7	22	15	35	*
2008/09	16	11	23	32	*
2009/10	24	21	14	24	*
2010/11	23	20	15	27	*
2011/12	19	16	7	30	*
2012/13	27	21	12	28	*
2013/14	32	28	14	34	*
2014/15	41	21	23	24	*
Total	218	193	153	281	*

Table 16. Nature of injury by year breakdown

Year	Superficial	Open wound	Fracture	Dislocation, sprain or strain	Injury to nerves or spinal cord	Injury to muscle or tendon	Traumatic amputation	Eye injury, exc. foreign body	Intracranial injury	Injury to internal organs	Other and unspecified injury
2005/06	*	9	41	5	*	*	*	*	*	*	10
2006/07	*	7	35	*	*	*	*	*	*	*	11
2007/08	5	8	42	5	*	*	*	*	*	*	11
2008/09	8	8	49	*	*	*	*	*	*	*	9
2009/10	5	12	37	*	*	*	*	*	7	*	16
2010/11	*	7	41	8	*	*	*	*	*	*	16
2011/12	9	5	32	*	*	*	*	*	*	*	19
2012/13	*	15	34	7	*	*	*	*	7	*	16
2013/14	11	13	46	*	*	*	*	*	12	*	20
2014/15	10	12	45	*	*	*	*	*	9	*	28
Total	61	96	402	41	5	13	*	*	52	17	156

Table 17. Grouped bed days by year breakdown

Year	< 2 days	2-7 days	8-30 days	31+ days
2005/06	*	26	27	*
2006/07	*	27	18	*
2007/08	28	*	27	*
2008/09	26	32	*	*
2009/10	35	32	*	*
2010/11	34	30	*	*
2011/12	33	*	19	*
2012/13	42	31	*	*
2013/14	68	27	*	*
2014/15	68	30	*	*
Total	372	279	185	10

Appendix B: Data sources & case selection

Deaths

Data have been extracted from the VISU-held Cause of Death (COD) dataset supplied by the Australian Coordinating Registry (ACR) and based on the Australian Bureau of Statistics (ABS) cause of death data.

Cases were selected according to the following criteria:

- Victorian cases (closed cases only)
- Deaths recorded with a reference year of 2007-2012
- Death was coded as due to external cause on completion of coronial process
- The type of activity being undertaken by the person when injured was coded as V873, V875, V883, V885, or within the coding range V700-V799, which pertain to bus-related injuries

Hospital admissions

Hospital admission data were extracted from the Victorian Admitted Episodes Dataset (VAED) for the years 2005/6 to 2014/5. The VAED records all hospital admissions in public and private hospitals in the state of Victoria.

Injury incident cases were selected if the admission was for a community injury (principle diagnosis code in range of S00-T75 or T79) and included a transport accident code (V873, V875, V883, V885, or within the range V700-V799) which pertained to bus-related injuries. Those who were admitted via a statistical separation within the same hospital or transferred inward from another hospital were excluded to prevent over-counting of incident injuries.

When calculating estimates of direct hospital costs and number of hospital bed days, all cases with a principal diagnosis as an injury in the ICD-10-AM code range S00-T75.9, T79-T79.9, T89-T98.99 (these codes exclude medical injury) or was one of two relevant rehabilitation codes - Z094 (follow-up examination after treatment of a fracture) or Z509 (care involving use of rehabilitation procedure, unspecified) with an injury code (any of the diagnosis codes in the range of S00-T98) were included, to provide a more accurate estimate of the burden of injury.

Note: Frequencies less than 5 and rates based on frequencies less than 10 are suppressed and appear with an "" in the tables provided.*

Emergency department (ED) presentations

ED presentations data were extracted from the Victorian Emergency Minimum Dataset (VEMD) for the years 2005/6 to 2014/15. The VEMD records all presentations to Victorian public hospitals with 24-hour emergency departments (currently 39 hospitals – 100% state-wide coverage of these hospitals applies from 2004). ED presentations were if the presentation was for a community injury (primary diagnosis code in the range of S00-T75 or T79) with and description including the word 'bus' was found within the case description. Pre-arranged admissions (through the ED) and return visits were excluded to avoid over-counting of incident injury presentations.

Note: Frequencies less than 5 and rates based on frequencies less than 10 are suppressed and appear with an "" in the tables provided.*

Intent

Intentionally caused injuries (assault and self-harm) resulting in admission were not included in this report as ICD-10-AM coding does not specify intentionally caused bus-related injuries.

Appendix C: Analysis methods

Rates

Bus-related injury rates and bed day rates (per 100,000) were calculated using ABS population data for Victorians in the corresponding years of injury. Population data was sourced from Employment data were sourced from Australian Demographic Statistics, September 2016, copyright © Commonwealth of Australia 2017 (ABS, 2017). Crude rate and 95% confidence interval of the crude rates are shown, for ED presentation rates and hospital admission rates. Confidence intervals were calculated as:

$$\frac{100{,}000}{Population} \times \left(events \pm \left[1.96 \times \sqrt{events}\right]\right)$$

Trend analysis

Trends in the rates of bus-related injuries and bed days (per 100,000) were modelled using Poisson models, as trends in the annual number of events, with the log of the Victorian population as offset. The results are shown in figures as the observed rates over time as well as the fitted rates with 95% confidence intervals. The results are presented in a table as the modelled annual % change in rate, calculated as:

$$percentage\ change = [e^{\alpha} - 1] \times 100\%$$

where α is the estimated value from the Poisson model. The analyses were conducted using the PROC GENMOD procedure in SAS V9.4.