THE NATIONAL TRAUMA REGISTRY CONSORTIUM
(Australia & New Zealand)

REPORT 2005

CONROD
CENTRE OF NATIONAL RESEARCH
ON DISABILITY AND REHABILITATION MEDICINE

National Trauma Registry Consortium (Australia & New Zealand) A collaborative initiative of the Royal Australasian College of Surgeons, the Centre of National Research on Disability and Rehabilitation Medicine and the Australasian Trauma Society.
Acknowledgements

This fourth bi-national (Australia and New Zealand) report is testament to the commitment of many dedicated individuals who have been involved in the care and management of seriously injured trauma patients throughout Australia and New Zealand and who have recognised the importance of the collection of quality trauma data. Members of the Executive and Steering Committees of the National Trauma Registry Consortium (NTRC) and the Royal Australasian College of Surgeons (RACS) Systems Performance Improvement and Registries Committee gratefully acknowledge the clinical, administrative and managerial staff at each of the hospitals and organisations within Australia and New Zealand, who have contributed to the development of this fledgling bi-national trauma registry project.

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NTRC (Australia & New Zealand) Steering Committee Members:
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The following trauma registries have generously contributed data for this report.

Central Registries
New South Wales Institute of Trauma and Injury Management
Queensland Trauma Registry
South Australian Trauma Registry
Victorian State Trauma Registry (VSTORM)

Individual Hospital Registries
Auckland City Hospital (New Zealand)
Fremantle Hospital (Western Australia)
Middlemore Hospital (New Zealand)
Princess Margaret Hospital (Western Australia)
Royal Perth Hospital (Western Australia)
Sir Charles Gairdner (Western Australia)
Starship Children’s Hospital (New Zealand)

Please refer to the individual acknowledgements at the end of this report for a more comprehensive list of those involved. We have made every attempt to include all collaborators. If however, we have inadvertently omitted anyone please accept our sincere apologies.
Foreword

In presenting this fourth successful report on 2005 data from participating trauma registries in Australia and New Zealand, I would particularly like to emphasize the outstanding financial contribution that CONROD (University of Queensland) has made to this project. Without its support, the project could not have continued and developed over these last five years. The NSW Institute of Trauma and Injury Management, and the Australasian Trauma Society have also been instrumental in facilitating the ongoing work of the NTRC.

We have continued our discussions with the Australian Commission on Safety and Quality in Health Care and are hopeful that we will be able to secure funding for a pilot study of the bi-NTR. Calls for expressions of interest for this project are anticipated to be made by the Commission toward the end of 2008. The bi-NMDS has progressed and it is proposed that we will trial it in a number of centres later this year, using the Collector database. The benchmarking study has also made substantial inroads, with the study team, including Professor Rod McClure, Dr Cate Cameron, Professor Philip Schluter, and Ms Tamzyn Davey, having obtained tremendous support from trauma registries in New Zealand, the USA, Germany, and Canada.

For the fourth consecutive year we have been fortunate to have the support of all existing trauma registries across Australia and New Zealand. The staff at these registries have given of their expertise and time beyond their usual responsibilities to collaborate with the NTRC in the production of the annual reports. For this we are truly grateful. We are also most grateful to the members of the NTRC Executive and Steering Committees, and the Systems Performance and Registries Subcommittee of the RACS, for their time and dedication to the project. I especially would like to thank Ms Tamzyn Davey for her magnificent effort as well as Ms Mary Solomon of the RACS Trauma Committee.

The time for a bi-National Trauma Registry is now and I believe we are on the cusp of developing it.

C.W. Pollard (FRACS)
Chair
National Trauma Registry Consortium (Australia & New Zealand)
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Executive Summary

This publication is the result of a collaborative initiative of the Royal Australasian College of Surgeons (RACS), the Centre of National Research on Disability and Rehabilitation Medicine (CONROD) and the Australasian Trauma Society (ATS). The National Trauma Registry Consortium project was initially funded jointly by the above institutions and in 2005 the New South Wales Institute of Trauma and Injury Management (ITIM) also became a funding partner. The Consortium Steering and Executive Committees, and the RACS Systems Performance Improvement and Registries Committee recognised the importance of a national approach to the monitoring of injury in Australia and New Zealand and undertook to facilitate the work required to achieve this goal.

This is the fourth regional (Australia and New Zealand) report to provide an overview of severe injury characteristics within both countries. The report is based on de-identified aggregate data provided by all trauma registries currently operating in Australia and New Zealand. Only injury victims who presented live to a trauma registry hospital for the treatment of injury with an Injury Severity Score (ISS) greater than 15 were included in the data set. The present report does not include:

- Data on injury victims who died at the scene of the injury event, or who were dead on arrival at a trauma registry hospital
- Data on injured patients who were treated at hospitals which did not have an associated trauma registry
- Data on injured patients who were treated at a trauma registry hospital but who had an ISS < 16

The following summary describes the salient features of injury (ISS > 15) treated in trauma registry hospitals in Australia and New Zealand in 2005:

- A total of 6939 injury patients with an ISS > 15 were identified in this cohort
- These injuries resulted in a mortality rate of 12% prior to acute hospital discharge
- Males comprised 72% of the injury cohort
- Survival rates to acute hospital discharge for females and males were not equal with females 31% more likely than males to die during hospital admission for the treatment of injury
- Persons between the ages of 15 and 24 years were more frequently injured (n = 1448) in 2005 than any other age group
- The highest death rate was recorded in the 85+ age group (36%)
- Road traffic crashes accounted for almost half of all major injuries for which a specific external cause of injury was recorded
- Pedestrians were more likely to die following admission for the treatment of their injuries than any other “Road traffic crash” sub category (20% of cases did not survive to hospital discharge)
- The average length of stay in hospital following admission for the treatment of a injury was 16 days
- Over half of all patients required admission to an intensive care unit (ICU) for the treatment of their injuries
• Generally the patterns and distributions of injury in terms of injury characteristics, patient management, and outcomes were similar from 2004 to 2005.

The formation of the National Trauma Registry Consortium (Australia and New Zealand) provides a feasible framework to develop a bi-national trauma registry. The results of the four annual reports provide a starting point for the collection and evaluation of injury data in the region. The submission of data over the four year period is testament to the commitment of the registries in the region, to working together toward the development of a bi-national trauma registry (Australia and New Zealand). The establishment of a bi-national trauma registry is essential to the goal of improving the outcome of injured patients and as such ought to be a national priority.
Introduction

Background

The National Trauma Registry Consortium (NTRC) was established in 2003 with the primary aim of linking together all the relevant stakeholders across Australia and New Zealand who have an interest in working together toward the establishment of a bi-national trauma registry (bi-NTR). Since that time the NTRC has developed and maintained strong collaborative relationships with all existing registries across Australia and New Zealand. The commitment by all the existing trauma registries toward the goal of establishing a bi-NTR is evident in the willingness to provide aggregate data annually for the last four years.

Since inception, the NTRC has also established a working party for the development of a bi-national minimum data set (bi-NMDS) and data dictionary, with representation from across Australasia. This group has produced several drafts of the bi-NMDS which will continue to undergo a process of refinement until a general consensus is reached by the working party, the NTRC Executive and Steering Committees, and the RACS Systems Performance Improvement and Registries Committee. Plans are also underway to pilot the bi-NMDS at the earliest opportunity in those States/regions who agree to do so, and who are using the Collector database – a widely used database solution for trauma registries and one which would be the most likely choice for a bi-NTR, once established. The NTRC have also begun a collaborative program of research to develop Australasian and International benchmarks for trauma care outcomes. Currently, there are no contemporary benchmarks nationally or internationally against which the management of trauma in Australasia can be judged.

Temporary funding for the NTRC has been exhausted. Funds are urgently required to continue the work that is currently being done to prepare for the establishment of a bi-NTR. Essential tasks include maintaining the support of all existing registries in Australasia through the production of annual aggregate reports; piloting the bi-NMDS; and establishing contemporary Australasian and International benchmarks for trauma care outcomes (through the collaborative research program). Efforts to secure long-term funding for a bi-NTR are ongoing.

Problem being addressed

The burden of injury in Australia is well recognised with injury prevention declared a National Health Priority Area in 1997. Over the 2000-01 period alone injuries accounted for four billion dollars of the health expenditure. This figure is necessarily a conservative estimate of the actual financial burden as it does not take into consideration the costs of injury outside of health expenditure such as loss of productivity following injury or loss of quality of life. In 2004 injury was the leading cause of death in Australians up to the age of 45 years and an estimated 344,849 people were hospitalised in this period as a result of injury. Of those who were hospitalised in this period 52,750 were admitted with injuries that posed a high threat to life (six percent or greater probability of dying during hospital treatment) and 65,400 people were living with severe disability as a result of injury. In New Zealand hospital admissions for injury are proportionally more than double that in New Zealand.
Australia with 16% and seven percent (respectively) of all public hospital admissions as a result of injury in 2003.\textsuperscript{3-5}

Trauma registries have existed in either a state-based or individual hospital-based form in Australia and New Zealand for more than a decade.\textsuperscript{6} These registries address the burden of injury by providing a detailed data source to:

- Inform injury prevention
- Monitor the changing patterns of injury
- Monitor the management of injury within their respective health systems
- Facilitate comparison of the management of injury across the institutions which are within their jurisdiction, and most importantly
- Audit and improve the management of injury

Auditing and performance improvement at the current trauma registry level in Australasia is not systematic and there is no data to adequately benchmark the standard of injury management across Australasia.\textsuperscript{6} A bi-NTR is urgently needed in Australasia to:

- Provide a repository of pooled data from the current registries to allow for the development of contemporary bi-national normative data with which to benchmark injury management
- Describe the incidence, management and outcome of injured patients from a bi-national perspective
- Inform injury prevention strategies from a bi-national perspective

**Objectives**

The National Trauma Registry Consortium (Australia and New Zealand) aims to:

- Foster the relationships which have been established between the Consortium and the relevant stakeholders in Australia and New Zealand who have an interest in improving the treatment and management of injury
- Continue to collect and collate bi-national data according to current national data availability
- Continue to publicise the concept of a bi-national trauma registry through publications and presentations
- Continue to seek out long-term financial support for the project
- Establish the process of eliciting primary level data from the registries to enhance the level of statistical analysis of collated data
- Establish a process of data acquisition which upholds privacy and data security legislation
- Pilot the bi-national minimum data set and data dictionary which will form the basis of the bi-national trauma registry
- Complete the process of establishing a bi-national and international benchmarking system to allow individual registries to compare their performance against national and international standards (‘best practice’)
- Formally establish and launch a bi-national trauma registry in collaboration with the long-term funders
Methods

Design

The study used a retrospective cohort design.

Sample Population

De-identified data from 2005 were supplied in aggregate form from the participating trauma registries across Australia and New Zealand. The sample population was approximately 25,300,000 (Population of Australia and New Zealand combined) with the existing trauma registries representing approximately 82% of the total injury case load (with an ISS > 15) in the region. This figure is based on a combined calculation of the population in each state or region and the approximate number of trauma cases (ISS > 15) that are taken into account by the associated trauma registries.

Commentary

The percentage of injured patients taken into account by the associated trauma registries in Australasia is comparable to that in Canada in the same time period. The Canadian National Trauma Registry estimate that they capture approximately 90% of all cases ISS > 12 in Canada.

All patients who met their trauma registry’s criteria for inclusion in 2005 and who had an ISS > 15 were included in this report. All trauma registries that were functioning in Australia and New Zealand at the time of data collection are represented in this report. There were four state-based trauma registries and seven individual hospital-based trauma registries. It must be noted that only injury victims who presented live to a trauma registry hospital were included in the 2005 data set. Injury victims who died at the scene of the injury event, or who were dead on arrival at a trauma registry hospital, were excluded from this data set. The present report is not representative of all injury in Australia, with a focus on severe injury treated at trauma registry hospitals only.

State-based Registries

- New South Wales Institute of Trauma and Injury Management (ITIM)
- Queensland Trauma Registry (QTR)
- South Australian Trauma Registry
- Victorian State Trauma Registry (VSTORM)

Individual Hospital-based registries

- Auckland City Hospital (New Zealand)
- Fremantle Hospital (Western Australia)
- Middlemore Hospital (New Zealand)
- Princess Margaret Hospital (Western Australia)
- Royal Perth Hospital (Western Australia)
• Sir Charles Gairdner Hospital (Western Australia)
• Starship Children’s Hospital (New Zealand)

Data Collected

For the 2005 data collection period the following data points were supplied by participating registries (in order of display):
  • In-hospital mortality
  • Injury Severity Score
  • Sex
  • Age in years
  • Sex and Age in years
  • External cause of injury
  • Intent of injury
  • Day (of the week) of injury occurrence
  • Hospital arrival mode
  • Hospital admission type (referral or direct)
  • Length of stay in Intensive Care Unit
  • Surgical procedure
  • Hospital length of stay
Results

A total of 6939 trauma patients (ISS > 15) presented to participating Australian and New Zealand hospitals between January and December 2005. Eighty eight percent of patients (6077 of 6939 patients) survived to acute hospital discharge with the remainder having died prior to discharge.

Commentary

The percentage of injured patients in Australasia (ISS > 15) who survived to hospital discharge (88%) was consistent with findings by the Canadian National Trauma Registry and the German Trauma Register over the same time period (87% in both countries). The percent of patients surviving to hospital discharge in the United States of America (USA) was slightly lower at 84%. Comparisons with data recorded by other national trauma registries needs to be interpreted with care due to subtly different inclusion criteria, coding, and categorization methods. Variability in the health systems and patient management protocols across countries, also need to be considered.

The results were based on de-identified aggregate data provided by the participating registries. A number of caveats need to be considered when reviewing the data. The report does not capture all injuries with ISS > 15 in Australia and New Zealand. This is in part because, although all established trauma registries participated in the project, not all health jurisdictions within the two countries operate trauma registries. In addition to this, the report does not take account of injured persons who died prior to reaching a hospital.

It must also be noted that no individual patient level data were available for this report due to legislative restrictions. As a result of this no primary level data analysis was possible and this necessarily limited the potential to combine and compare variables once they were supplied by the registries. Data collection differences among registries, specifically the recording of either the number of injury events or the number of injury admissions, resulted in the variation in totals reported below. The main purpose for some registries making the distinction between the number of injury events and the number of injury admissions for relevant variables is to more accurately reflect that a particular trauma event can require admission to more than one hospital within that registry’s jurisdiction. For example, the results reported below show higher overall totals in the tables “Arrival mode and outcome”; “Outcome by admission type”; and “ICU admission by outcome” than in the tables “Total number of trauma events by sex and outcome”, and “Outcome by age range”, which represent single injury events (each patient only recorded once).

Injury Characteristics and Outcome

Injury Severity Score (ISS)

Individual cases of injury were coded at the local trauma registry level using the Abbreviated Injury Scale (AIS), which is a standardized system used for categorizing injury type and severity. From the AIS an overall Injury Severity Score was then calculated for each patient, giving an indication of the severity of the combination of
injuries sustained by the patient. An ISS was available for 6939 cases of injury, and each case/patient was assigned to one of three categories (“16 to 24”, “25 to 40”, or “41 to 75”) (Table 1). Over half of all cases had an ISS of “16 to 24” (3875), with the highest percentage deaths (in any category) occurring in the “41 to 75” category (43% of 551 cases) (Figure 1).

Table 1: Mortality by ISS category (n = 6939)

<table>
<thead>
<tr>
<th>ISS category</th>
<th>Total</th>
<th>Survived</th>
<th>Died (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 to 24</td>
<td>3875</td>
<td>3695</td>
<td>180 (4.6)</td>
</tr>
<tr>
<td>25 to 40</td>
<td>2513</td>
<td>2066</td>
<td>447 (17.8)</td>
</tr>
<tr>
<td>41 to 75</td>
<td>551</td>
<td>316</td>
<td>235 (42.6)</td>
</tr>
<tr>
<td>Total</td>
<td>6939</td>
<td>6077</td>
<td>862 (12.4)</td>
</tr>
</tbody>
</table>

Figure 1: The number and percentage of deaths per ISS category (n = 862)

Commentary

The pattern of ISS recorded in this data set were comparable with that recorded in the German, the USA, and Canadian national trauma registries over a similar time period. More than half of all patients (ISS > 15) in the USA had injuries which were recorded as being within the ISS category of “16 to 24”, and for both Canada and Germany, the mean ISS was 24. Comparisons with data recorded by other national trauma registries needs to be interpreted with care due to subtly different inclusion criteria, coding, and categorization methods. Variability in the health systems and patient management protocols across countries, also need to be considered.

Demographics

Males represented 72% (4995) of all injured patients. Females were, however, 31% more likely than males to die during hospital admission for the treatment of injury...
(RR = 1.31; 95% CI, 1.15 – 1.50). Of the 6939 cases recorded, the 15 to 24 year age group was more highly represented (21%) than any other single age group category and over half of all patients were between the age of 15 and 44 years at the time of their injury (Table 2). Survival rates were generally highest in the younger age groups and decreased steadily in the older age groups. The 85+ age group recorded the lowest survival rate of any single age group category (Figure 2). The data indicate a higher percentage of deaths in females in the older age groups (Table 3). Figure 3 shows a comparison of the number and percentage of deaths by age group and sex.

Table 2: Injury and mortality by age group (n = 6939)

<table>
<thead>
<tr>
<th>Age range</th>
<th>Total number (% of total)</th>
<th>Number of deaths (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 4</td>
<td>208 (2.1)</td>
<td>14 (6.7)</td>
</tr>
<tr>
<td>5 to 14</td>
<td>354 (5.1)</td>
<td>16 (4.5)</td>
</tr>
<tr>
<td>15 to 24</td>
<td>1448 (20.9)</td>
<td>113 (7.8)</td>
</tr>
<tr>
<td>25 to 34</td>
<td>1081 (15.6)</td>
<td>89 (8.2)</td>
</tr>
<tr>
<td>35 to 44</td>
<td>914 (13.2)</td>
<td>77 (8.4)</td>
</tr>
<tr>
<td>45 to 54</td>
<td>769 (11.1)</td>
<td>77 (10.0)</td>
</tr>
<tr>
<td>55 to 64</td>
<td>630 (9.1)</td>
<td>74 (11.7)</td>
</tr>
<tr>
<td>65 to 74</td>
<td>523 (7.5)</td>
<td>94 (18.0)</td>
</tr>
<tr>
<td>75 to 84</td>
<td>676 (9.7)</td>
<td>186 (27.5)</td>
</tr>
<tr>
<td>85+</td>
<td>336 (4.8)</td>
<td>122 (36.3)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6939</strong></td>
<td><strong>862 (12.4)</strong></td>
</tr>
</tbody>
</table>

Figure 2: Number and percentage of deaths per age group (n = 862)
Table 3: Injury and mortality by age group and sex (n = 6939)

<table>
<thead>
<tr>
<th>Age range</th>
<th>Total number (% of total)</th>
<th>Number of deaths (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>0 to 4</td>
<td>85 (4.5)</td>
<td>123 (2.4)</td>
</tr>
<tr>
<td>5 to 14</td>
<td>111 (5.9)</td>
<td>243 (4.8)</td>
</tr>
<tr>
<td>15 to 24</td>
<td>313 (6.9)</td>
<td>1135 (22.5)</td>
</tr>
<tr>
<td>25 to 34</td>
<td>199 (10.5)</td>
<td>882 (17.5)</td>
</tr>
<tr>
<td>35 to 44</td>
<td>180 (9.5)</td>
<td>734 (14.5)</td>
</tr>
<tr>
<td>45 to 54</td>
<td>201 (10.7)</td>
<td>568 (11.2)</td>
</tr>
<tr>
<td>55 to 64</td>
<td>133 (7.0)</td>
<td>497 (9.8)</td>
</tr>
<tr>
<td>65 to 74</td>
<td>165 (8.7)</td>
<td>358 (7.1)</td>
</tr>
<tr>
<td>75 to 84</td>
<td>305 (16.1)</td>
<td>371 (7.3)</td>
</tr>
<tr>
<td>85+</td>
<td>196 (10.4)</td>
<td>140 (2.8)</td>
</tr>
<tr>
<td>Total</td>
<td>1888 (27.2)</td>
<td>5051 (72.8)</td>
</tr>
</tbody>
</table>

Figure 3: Number and percentage deaths by age group and sex (Females n = 282; Males n = 580)

Commentary

The finding in the present data set that injured females were more likely than injured males to die during hospital admission should be interpreted with care, as the analysis did not control for age or injury severity. The data do indicate, however, that the older age groups in general had the lowest survival rates and that there was a higher number of females in the older age groups, and by extension a higher percentage of deaths in females in the older age groups (67% of all deaths in females were recorded in the age group 55 to 85+ compared with 49% of all deaths in males). This provides a possible explanation for the above finding.

External Cause of Injury

Specific external causes of injury were recorded for a total of 6939 patients (Table 4). Road traffic crashes accounted for almost half of all injuries (n = 3390) while falls accounted for 30% (n = 2075). Road traffic crashes and falls also accounted for the greatest number of deaths (n = 364 and n = 346 respectively) however when deaths are expressed as a percentage of total hospital admissions for that particular sub-category, patients injured by “Cutting, piercing object”, “Falls”, and “Burns” patients
were most likely to die (19%, 17%, and 16% respectively) following admission for their injury (Figure 4).

**Commentary**

The proportion of injuries attributed to falls and road traffic crashes in Australasia is consistent with findings by the Canadian National Trauma Registry for the same period. In comparison, the German Trauma Register recorded proportionally fewer falls and more road traffic crashes. Comparisons with data recorded by other national trauma registries needs to be interpreted with care due to subtly different inclusion criteria, coding, and categorization methods. Variability in the health systems and patient management protocols across countries, also need to be considered.

**Table 4: External cause of injury and mortality (n = 6939)**

<table>
<thead>
<tr>
<th>External cause</th>
<th>Total number (% of Total)</th>
<th>Survived</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animals</td>
<td>111 (1.6)</td>
<td>105</td>
<td>6</td>
</tr>
<tr>
<td>Burns</td>
<td>163 (2.3)</td>
<td>137</td>
<td>26</td>
</tr>
<tr>
<td>Collisions</td>
<td>653 (9.4)</td>
<td>608</td>
<td>45</td>
</tr>
<tr>
<td>Cutting, piercing object</td>
<td>184 (2.6)</td>
<td>149</td>
<td>35</td>
</tr>
<tr>
<td>Falls</td>
<td>2075 (29.9)</td>
<td>1729</td>
<td>346</td>
</tr>
<tr>
<td>Road traffic crashes</td>
<td>3390 (48.8)</td>
<td>3026</td>
<td>364</td>
</tr>
<tr>
<td>Other</td>
<td>363 (5.2)</td>
<td>323</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6939</strong></td>
<td><strong>6077</strong></td>
<td><strong>862</strong></td>
</tr>
</tbody>
</table>

**Figure 4: Number and percentage deaths per external cause category (n = 862)**

“Stab wound” accounted for the greatest number of injuries (n = 126) in the breakdown of the “Cutting, piercing object” category (n = 184) (Table 5 and Figure 5).
sub-category “Gun shot wound” (n = 51) accounted for the greatest percentage deaths of any sub category within the break down of “Cutting, piercing object” (n = 17; 33%) (Table 5).

Table 5: Outcome of external cause of injury “Cutting, piercing object” (n = 184)

<table>
<thead>
<tr>
<th>Cutting, piercing object sub-category</th>
<th>Total number</th>
<th>Survived</th>
<th>Died (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gun shot wound</td>
<td>51</td>
<td>34</td>
<td>17 (33.3)</td>
</tr>
<tr>
<td>Stab wound</td>
<td>126</td>
<td>109</td>
<td>17 (13.5)</td>
</tr>
<tr>
<td>Other penetrating</td>
<td>7</td>
<td>6</td>
<td>1 (14.3)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>184</strong></td>
<td><strong>149</strong></td>
<td><strong>35 (19.0)</strong></td>
</tr>
</tbody>
</table>

Figure 5: “Cutting, piercing object” by sub-category (n = 184)

When the external cause category “Collisions” was broken down (n = 653), the sub-category “With person-intentional (assault)” showed the greatest number of injuries overall (n = 409; 63%) (Table 6 and Figure 6). Of the three sub-categories that were specified (in other words, excluding “All other collision”), “With person-intentional (assault)” also accounted for the greatest percentage deaths of any other (specified) sub-category (8% of 409 cases died following admission for the treatment of this injury) (Table 6).

Table 6: Outcome of external cause of injury “Collisions” (n = 653)
### Table

<table>
<thead>
<tr>
<th>Collisions sub-category</th>
<th>Total number</th>
<th>Survived</th>
<th>Died (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With person intentional (assault)</td>
<td>409</td>
<td>377</td>
<td>32 (7.8)</td>
</tr>
<tr>
<td>With person-unintentional</td>
<td>27</td>
<td>25</td>
<td>2 (7.4)</td>
</tr>
<tr>
<td>With object</td>
<td>206</td>
<td>197</td>
<td>9 (4.4)</td>
</tr>
<tr>
<td>All other collision</td>
<td>11</td>
<td>9</td>
<td>2 (18.2)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>653</strong></td>
<td><strong>608</strong></td>
<td><strong>45 (6.9)</strong></td>
</tr>
</tbody>
</table>

### Figure 6: “Collision” by sub-category (n = 653)

“Motor vehicle drivers” (n = 1161) accounted for more road traffic crash (RTC) -related hospital admissions than “Motor bike drivers” (n = 698), “Motor vehicle passengers” (n = 646), and “Pedestrians” (n = 555) (Table 7). However, when deaths within each specified “Road traffic crash” sub-category (in other words, excluding the “Road traffic accident unknown” and “Other” sub-categories) are expressed as a percentage of the total hospital admissions for that particular sub-category, the results reveal that “Pedestrians” are most likely to die after hospital admission for their injuries (20%) followed by “Motor vehicle driver” (11%) and “Motor vehicle passenger” (10%) (Figure 7).
Table 7: Outcome of external cause of injury “Road traffic crashes” (n = 3390)

<table>
<thead>
<tr>
<th>Road traffic crash sub-category</th>
<th>Total number</th>
<th>Survived</th>
<th>Died (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicle driver</td>
<td>1161</td>
<td>1038</td>
<td>123 (10.6)</td>
</tr>
<tr>
<td>Motor vehicle passenger</td>
<td>646</td>
<td>581</td>
<td>65 (10.1)</td>
</tr>
<tr>
<td>Motor bike driver</td>
<td>698</td>
<td>655</td>
<td>43 (6.2)</td>
</tr>
<tr>
<td>Motor bike pillion passenger</td>
<td>46</td>
<td>43</td>
<td>3 (6.5)</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>238</td>
<td>226</td>
<td>12 (5.0)</td>
</tr>
<tr>
<td>Road traffic crash unknown</td>
<td>3</td>
<td>2</td>
<td>1 (33.3)</td>
</tr>
<tr>
<td>Other</td>
<td>43</td>
<td>37</td>
<td>6 (13.9)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3390</strong></td>
<td><strong>3026</strong></td>
<td><strong>364 (10.7)</strong></td>
</tr>
</tbody>
</table>

**Commentary**

In Australasia, RTC - car (“Motor vehicle drivers” and “Motor vehicle passenger” combined) accounted for a similar proportion of all RTC–related hospital admissions (53%) to that reported by the German Trauma Register over a similar time period (49%). \(^8\) By contrast, the Canadian National Trauma Registry over the same period of time recorded that RTC - car accounted for 70% of all RTC-related injuries \(^7\) and that there were almost half as many RTC - motorcycle (“Motor bike driver” and “Motor bike passenger” combined) injuries than were recorded by the other two national registries. \(^7,8\) It is possible that the smaller proportion of motorcycle injuries in Canada was due to the lower use of this form of transportation in the winter months. This may result in the higher use of motor vehicles for transportation, and in turn explain Canada’s relatively higher proportion of RTC - car injuries in the RTC sub-category. In Germany, where temperatures in the winter months may approximate those experienced in some areas in Canada, motorcycle use may be more likely because of the relative density of cities and smaller towns in that country, in comparison to Canada. This may account for the higher proportion of RTC - motorcycle injuries recorded in the German Trauma Register (22% of all RTC-related hospital admissions), in comparison to those recorded in Canada (11%). Comparisons with data recorded by other national trauma registries needs to be interpreted with care due to subtly different inclusion criteria, coding, and categorization methods. Variability in the health systems and patient management protocols across countries, also need to be considered.
Intent of Injury

Intent of injury was available for 4625 cases. Eighty seven percent of all injuries were recorded as “Accidental” (n = 4042) (Table 8). However, when deaths within each Intent category are expressed as a percentage of the total hospital admissions for that category, the results reveal that injuries which are “Self-inflicted” are more likely to result in death following hospital admission (Figure 8).

Table 8: Intent and outcome of injury (n = 4625)

<table>
<thead>
<tr>
<th>Intent category</th>
<th>Total number</th>
<th>Survived</th>
<th>Died (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident</td>
<td>4042</td>
<td>3560</td>
<td>482 (11.9)</td>
</tr>
<tr>
<td>Self-inflicted</td>
<td>116</td>
<td>86</td>
<td>30 (25.9)</td>
</tr>
<tr>
<td>Violence-related</td>
<td>406</td>
<td>375</td>
<td>31 (7.6)</td>
</tr>
<tr>
<td>All Other</td>
<td>61</td>
<td>51</td>
<td>10 (16.4)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4625</strong></td>
<td><strong>4072</strong></td>
<td><strong>553</strong> (12.0)</td>
</tr>
</tbody>
</table>

*Discrepancy with totals in Table 1 due to data collection differences between registries n = 2314

b Discrepancy with totals in Table 1 due to data collection differences between registries n = 2005

c Discrepancy with totals in Table 1 due to data collection differences between registries n = 309
Figure 8: Number and percentage deaths per intent category (n = 553)

**Commentary**

Unfortunately it was not possible to compare injury intent with data from the USA, or Germany, but data from Canada indicates the percent of injuries recorded as having being self-inflicted (2% in both Canada and Australasia) or the result of assault (9% in both Canada and Australasia), were equivalent.\(^7\) Comparisons with data recorded by other national trauma registries needs to be interpreted with care due to subtly different inclusion criteria, coding, and categorization methods. Variability in the health systems and patient management protocols across countries, also need to be considered.

**Day of Injury Occurrence**

Day of the week on which the injury occurred was available for all 6939 cases (Table 9). Analysis revealed that injuries were more likely to occur on certain days of the week, as opposed to having an even spread of injury occurrence over the entire week ($\chi^2 = 228.96, p < 0.001$). The most common day of injury was Saturday (n = 1304), with 36% (n = 2498) of all injuries occurring on the weekend (Figure 9). The likelihood of being injured on a weekend rather than a week day was statistically significant ($\chi^2 = 187.60, p < 0.001$).
Table 9: Occurrence and percentage of injuries over the week (n = 6939)

<table>
<thead>
<tr>
<th>Day of the week</th>
<th>Total number (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>822 (11.8)</td>
</tr>
<tr>
<td>Tuesday</td>
<td>824 (11.9)</td>
</tr>
<tr>
<td>Wednesday</td>
<td>841 (12.1)</td>
</tr>
<tr>
<td>Thursday</td>
<td>912 (13.1)</td>
</tr>
<tr>
<td>Friday</td>
<td>1042 (15.0)</td>
</tr>
<tr>
<td>Saturday</td>
<td>1304 (18.8)</td>
</tr>
<tr>
<td>Sunday</td>
<td>1194 (17.2)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6939</strong></td>
</tr>
</tbody>
</table>

Figure 9: Day of the week of injury occurrence (n = 6939)

Patient Management and Injury Outcome

**Arrival Mode**

For those cases that had data available on mode of arrival to hospital (n = 7060) the majority of injured patients were transported by “Road ambulance” (n = 4299, 61%), followed by “Helicopter” (n = 839, 12%), “Fixed wing aircraft” (n = 417, 6%), and “Private” means (n = 407, 6%) (Figure 10). Table 10 shows the outcomes of injury following admission to hospital, for each of the arrival mode categories.
Table 10: Arrival mode and outcome of injury (n = 7060)

<table>
<thead>
<tr>
<th>Arrival mode</th>
<th>Total number</th>
<th>Survived</th>
<th>Died (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helicopter</td>
<td>839</td>
<td>726</td>
<td>113 (13.5)</td>
</tr>
<tr>
<td>Fixed wing aircraft</td>
<td>417</td>
<td>382</td>
<td>35 (8.4)</td>
</tr>
<tr>
<td>Road ambulance</td>
<td>4299</td>
<td>3689</td>
<td>610 (14.2)</td>
</tr>
<tr>
<td>Private</td>
<td>407</td>
<td>400</td>
<td>7 (1.7)</td>
</tr>
<tr>
<td>Other/unknown/NA</td>
<td>1098</td>
<td>997</td>
<td>101 (9.2)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7060</strong></td>
<td><strong>6194</strong></td>
<td><strong>866</strong> (12.3)</td>
</tr>
</tbody>
</table>

* Discrepancy with totals in Table 1 due to data collection differences between registries n = 121

* Discrepancy with totals in Table 1 due to data collection differences between registries n = 117

* Discrepancy with totals in Table 1 due to data collection differences between registries n = 4

Figure 10: Mode of transportation to hospital (n = 7060)

**Admission Type**

Thirty five percent of cases of injury were recorded as having been transported to the definitive care hospital via a referring hospital. The “Direct from scene” category was intended to include all other cases of injury, in other words, those which were not admitted to the definitive care hospital via another (referring) hospital. This category included, for example, admission to a definitive care hospital via a general practitioner’s surgery; another specialist; or direct from the scene of injury occurrence (by ambulance or private means). Of those patients transported directly from the scene of the injury (not via a referring hospital) approximately 14% (n = 627) did not survive to hospital discharge and 10% (n = 239) of patients transferred from referral hospitals did not survive to discharge (Table 11). The likelihood of surviving to hospital discharge after being transferred from another hospital was statistically significantly higher than the likeliness of surviving to hospital discharge following admission directly from the scene of the injury ($\chi^2 = 23.51$, p < 0.001).
**Commentary**

Differences in injury severity may explain the finding that patients who were transferred from another hospital were more likely to survive to hospital discharge than patients who were admitted directly from the scene. The first group of patients - by virtue of them being sufficiently stable to withstand and survive hospital transfer - were likely to be less severely injured, on average, than the second group of patients.

### Table 11: Admission type and outcome of injury (n = 7060)

<table>
<thead>
<tr>
<th>Admission type</th>
<th>Total number</th>
<th>Survived</th>
<th>Died (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/F hospital</td>
<td>2468</td>
<td>2229</td>
<td>239 (9.7)</td>
</tr>
<tr>
<td>Direct from scene</td>
<td>4592</td>
<td>3965</td>
<td>627 (13.7)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7060</strong></td>
<td><strong>6194</strong></td>
<td><strong>866 (12.3)</strong></td>
</tr>
</tbody>
</table>

* Transfer from another

Additional notes:
- a Discrepancy with totals in Table 1 due to data collection differences between registries n = 121
- b Discrepancy with totals in Table 1 due to data collection differences between registries n = 117
- c Discrepancy with totals in Table 1 due to data collection differences between registries n = 4

### Intensive Care Unit Admission (ICU)

Over half (n = 3673) of all 7060 cases of injury were admitted to an ICU. Patients admitted to an ICU were less likely to survive to hospital discharge (Table 12) compared with those patients who did not require treatment in an ICU and this difference was statistically significant ($\chi^2 = 16.56, p < 0.001$). Table 13 shows length of stay in ICU by days, according to outcome.

### Table 12: Treatment in an Intensive Care Unit and mortality (n = 7060)

<table>
<thead>
<tr>
<th>Admission to ICU</th>
<th>Total number</th>
<th>Survived</th>
<th>Died (% died)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>3673</td>
<td>3155</td>
<td>505 (13.7)</td>
</tr>
<tr>
<td>No</td>
<td>3387</td>
<td>3039</td>
<td>361 (10.6)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7060</strong></td>
<td><strong>6194</strong></td>
<td><strong>866 (12.3)</strong></td>
</tr>
</tbody>
</table>

* Discrepancy with totals in Table 1 due to data collection differences between registries n = 121

### Table 13: Length of stay (LOS) in ICU (n = 3673)

<table>
<thead>
<tr>
<th>Mean LOS in ICU</th>
<th>Total</th>
<th>Survived</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>In days</td>
<td>7.16</td>
<td>7.49</td>
<td>5.13</td>
</tr>
</tbody>
</table>
**Commentary**

Patients recorded by the German Trauma Register who required ICU treatment stayed on average, four days longer ($m = 11$) than patients recorded in the present report ($m = 7$). Possible explanations for this difference are numerous but may include variations in ISS between German and Australasian patients who were admitted to ICU or differences in ICU protocol across the two countries. Similarly, different ICU protocols are likely to account for the vastly disparate findings between the USA and Australasia with regard to the percent of patients requiring treatment in an ICU. Eighty three percent of all USA registry patients (ISS > 16) received treatment in an ICU compared with 52% of all Australasian patients.

**Surgical Procedure**

A subset of participating trauma registries provided data on five common surgical procedures performed on patients following traumatic injuries. Accurate figures on surgical procedures were difficult to access due to the fact that registries have vastly differing methods of collecting this information. Some registries collect information on surgical procedure by body region, for example, while others collect information by surgical specialty. As such this data set contains a limited subset of data on surgical procedures from those registries able to interpret and provide data according to the five procedures specified in Figure 11.

![Surgical Procedure Pie Chart](image)

**Figure 11: Surgical procedure (n = 6614)**

**Overall Length of Hospital Stay and Outcome**

Those patients who were transferred from another hospital (to the trauma registry hospital which provided their definitive care) and who survived to hospital discharge had the greatest average length of hospital stay (mean of approximately 19 days) (Table 14). Patients who were admitted directly from the scene of an injury for
treatment (in other words, all patients who were not transferred to a definitive care hospital via another hospital) and who survived to hospital discharge had an average length of stay of approximately 16 days. Those patients who did not survive to hospital discharge died on average 6 days after admission for the treatment of their injury.

Commentary

These data indicate that there were more in-hospital deaths in patients who were admitted directly from the scene of an injury compared to those who were transferred from another hospital. The mean length of stay was markedly lower for patients who died compared to those who survived to hospital discharge. It follows that the shorter mean length of stay for those directly admitted from the scene of an injury may be accounted for by more deaths in this category.

The mean overall length of stay in the present report is consistent with findings by the Canadian National Trauma Registry who also recorded an average of 16 days for the same period. The German Trauma Register recorded a mean overall length of stay of 23 days over a similar period. Variations in ISS between German and Australasian patients or slight differences in hospital protocol and transfer practices across the two countries, may explain this disparity.

Table 14: Total length of hospital stay in days and outcome (n = 7060)

<table>
<thead>
<tr>
<th>Mean length of stay in days</th>
<th>Total</th>
<th>Survived</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>16.10</td>
<td>17.48</td>
<td>6.14</td>
</tr>
<tr>
<td>Direct from scene</td>
<td>14.80</td>
<td>16.36</td>
<td>5.06</td>
</tr>
<tr>
<td>T/F** hospital</td>
<td>18.30</td>
<td>19.26</td>
<td>9.38</td>
</tr>
</tbody>
</table>

*Mean was calculated taking into account number of cases within each category (Table 11) and within each registry
**Transfer from another

Comparison with 2004 data set

The National Trauma Registry Consortium (Australia and New Zealand) has collected data annually over four years. From 2002 (n = 5438) to 2003 (n = 5837) the annual number of cases increased by approximately seven percent. From 2003 to 2004 (n = 6387) there was an increase in injury cases of approximately nine percent, and 2005 data indicated an increase of eight percent since 2004 (n = 6939) (Figure 12).

Commentary

The increase in cases of injury (ISS > 15) reported to the NTRC by the participating trauma registries across Australia and New Zealand over the four year period may not necessarily signify an increase in injury of this severity. It is possible that the progressive increase in cases is due to improved data quality and clearer communication between the NTRC and the registries with regard to the data required for the annual aggregate reports.
Apart from annual increases in numbers of injury cases, the patterns and distributions of injury in terms of injury characteristics, patient management, and outcomes were generally similar across the four-year time period. Table 15 and Figure 13 show the notable variations in data over the recent two-year period (2004 – 2005).

**Table 15: Comparison of selection of data from 2004 and 2005 (n = 13326)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description of variation between 2004 (n = 6387) and 2005 (n = 6939)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall mortality</td>
<td>The likelihood of surviving following admission for treatment was similar in 2004 (87%) and 2005 (88%).</td>
</tr>
<tr>
<td>ISS and mortality</td>
<td>Over the 2004 and 2005 data collection period deaths recorded for each ISS category were comparable: ISS 16 to 24 - 4% in 2004 and 5% in 2005; ISS 25 to 40 - 20% in 2004 and 18% in 2005; ISS 41 to 75 - 40% in 2004 and 43 in 2005.</td>
</tr>
<tr>
<td>Sex and mortality</td>
<td>In 2005, as in 2004, females were statistically significantly less likely than males to survive following admission for injury.</td>
</tr>
<tr>
<td>External cause of injury and mortality</td>
<td>The likelihood of surviving following admission for all external cause categories was comparable for the 2004 and 2005 data collection periods. The percentage of injuries recorded within each category, were also comparable across the two years of data collection.</td>
</tr>
<tr>
<td>External cause of injury sub-category</td>
<td>In 2005, “Pedestrians” were less likely to survive following admission for their injuries than all other “Road Traffic Crash” sub-categories, while in 2004 the “Motor Bike Pillion” category of patients was recorded as being least likely to survive following admission for their injuries.</td>
</tr>
<tr>
<td>Intent of injury</td>
<td>In 2005, the likelihood of surviving a “Self-inflicted” injury was statistically significantly higher than in 2004 ($\chi^2 = 5.06$, p &lt; 0.05).</td>
</tr>
</tbody>
</table>
Figure 13: Comparison of 2004 and 2005 data by hospital length of stay category and admission type (n = 13592)
References


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Belinda Gabbe  NH&MRC Public Health Research Fellow, Department of Epidemiology and Preventive Medicine, Monash University  VSTORM Steering Committee
Bill Barger  Manager, Metropolitan Ambulance Service  VSTORM Steering Committee
Stephen Bernard  Deputy Director of ICU, Dandenong Hospital  VSTORM Steering Committee
Warwick Butt  Intensivist, Royal Children’s Hospital  VSTORM Steering Committee
Alex Currell  General Manager Strategic Planning, Metropolitan Ambulance Service  VSTORM Steering Committee
David Eddey  Director of Emergency Medicine, The Geelong Hospital  VSTORM Steering Committee
Andrew Hannaford  Trauma Information Systems  VSTORM Steering Committee
<table>
<thead>
<tr>
<th>Name</th>
<th>Position and Affiliation</th>
<th>Committee</th>
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<tbody>
<tr>
<td>Rodney Judson</td>
<td>Manager, VSTORM, Director of Trauma, Royal Melbourne Hospital</td>
<td>VSTORM Steering Committee</td>
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<tr>
<td>Thomas Kossman</td>
<td>Director, Department of Trauma Surgery, Director, National Trauma Research Institute (Alfred Campus)</td>
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<td>Sue McLellan</td>
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<td>Mimi Morgan</td>
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<td>Project Manager Strategic Planning, Metropolitan Ambulance Service</td>
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<td>Ann Sutherland</td>
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<td>Owen Williamson</td>
<td>Senior Lecturer, Department of Epidemiology and Preventive Medicine</td>
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<tr>
<td>Cameron Willis</td>
<td>PhD Scholar</td>
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<td>Louise Niggemeyer</td>
<td>Trauma Coordinator, The Alfred Hospital</td>
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<td>Steven White</td>
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<td>Lynda Treloar</td>
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<td>Neely Pratten</td>
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<td>Robyn Potter</td>
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<td>Bree McGillivray</td>
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<td>Sue Stevens</td>
<td>Data Collector, Frankston Hospital/Rosebud Hospital</td>
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<td>Megan Clooney</td>
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<td>Kerrie Russell</td>
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<tr>
<td>Tania Parr</td>
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<tr>
<td>Amanda Hulley</td>
<td>Data Collector, Monash Medical Centre/Casey Hospital</td>
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<td>Maree Woodhouse</td>
<td>Data Collector, Sandringham Hospital</td>
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<tr>
<td>Barbara Fox</td>
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</table>
Amanda Garrett  Data Collector  Maroondah Hospital
Rebecca Sedgman  Data Collector  Box Hill Hospital
Marja Wondergem  Data Collector  Box Hill Hospital
Jay Weeraratne  Data Collector  Knox Hospital
Jana Bos  Data Collector  The Angliss Hospital

**RACS Administration**
Mary Solomon  Administrative Officer, Qld Trauma  RACS
Lyn Journeaux  Executive Officer, RACS Trauma Committee (national)  RACS