

Orthopaedic trauma from road crashes: is enough being done?

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Abstract

A file review of patients presenting to the Emergency Department of St Vincent's Hospital with fractures sustained in a road crash was completed to describe patterns of orthopaedic injury, acute intervention and separation as well as the cost of care for adult road crash victims. One-hundred and eighty-seven patients were included. 65.8% were male; 48.1% were pedestrians. Differing patterns of injury corresponded to the role of the patient in the road crash (eg, pedestrian, driver of vehicle, etc). The mean length of stay was 8.8 days. 35.2% of patients were prescribed a different analgesic at discharge to that which they had received in the previous 24 hours. 35.8% had a documented discussion regarding insurance matters, usually with a social worker. 11.9% were discharged to inpatient rehabilitation. 56.2% had orthopaedic follow-up arranged at discharge, while 4.8% were discharged to an outpatient rehabilitation clinic. The mean overall cost was \$13336, with patients aged over 65 costing the most.

The quality of acute care for fractures sustained in road crashes could be improved with evidence-based analgesia management, increased screening for psychiatric sequelae, enhanced assistance with insurance matters and vocational issues, and closer follow-up. Further research into the impact of these factors on long-term recovery is warranted.

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What is known about the topic?

Road crashes, a common cause of traumatic injury, have long-term medical and psychosocial sequelae with slow recovery, yet there is little evidence regarding common or optimal acute inpatient management of road crash trauma.

What does this paper add?

Analgesia use differed between patients, as did the involvement of allied health teams. Not all patients received follow-up services and no patients were referred to a vocational rehabilitation service.

What are the implications for practitioners?

Patients may benefit from closer follow-up, evidence-based analgesia management and greater assistance with the social consequences of injury such as insurance matters, and impact on income and vocation. Practitioners need to pay more attention to the psychological sequelae of road crash trauma.

ROAD CRASHES REPRESENT a leading cause of traumatic injury worldwide^{1,2} and there is strong evidence that recovery of road crash victims is poor. In 2001, 495 300 Australians reported a long-term condition caused by a road crash.³ This represents 22% of long-term sequelae from injury.³ In this Australian Bureau of Statistics report, such sequelae included only physical impairments such as chronic pain, and joint disorders. However, the effects of road crashes extend beyond physical and functional disability, to include psychological disorders and a range of social problems.⁴⁻⁹

Read et al's 2004 study confirmed that 12 months after a road crash, 35% of patients reported continued difficulty walking and 26% reported continued pain that interfered with activities of daily living (ADLs).⁵ Furthermore, 57% "felt the financial impact of their injury was moderate to severe and caused hardships for themselves and their families". Only 56% of participants who were employed at the time of

I Variables collected

Demographics

Age
Sex
Accident type (eg, pedestrian, bicyclist etc)
Need for language interpreter
Occupation and employment status
Health insurance status
Diagnosis related group

Pattern of injury

Number of fractures
Site of each fracture

Acute care descriptors

Total length of stay
Intensive Care Unit length of stay
Emergency Department length of stay
Completion of tertiary survey
Problems identified by the tertiary survey
Evidence of psychological problems
Use of narcotic analgesics
Use of simple analgesics
Whether a different analgesic was prescribed at discharge than was used in the previous 24 hours
Involvement of social worker and the time to first documented meeting with patient
Involvement of physiotherapist and the time to first documented meeting with patient
Involvement of occupational therapist and the time to first documented meeting with patient
Involvement of psychiatry and/or drug and alcohol team, and the time to first documented meeting with patient
Involvement of rehabilitation specialist, and the time to first documented meeting with patient
Evidence that compulsory third party insurance matters were discussed with the patient

Separation descriptors

Discharge destination
Post-discharge support arranged
Incidence of follow-up appointments made
Incidence of referral to vocational rehabilitation service
Incidence of patient leaving against medical advice

the accident were working after 6 months.⁵ Similarly, Evans et al's follow up of young road crash victims found that in the 5 years following major trauma, 38% of those who were at school at the time of injury left school with no qualification, while 17% reported that their disability made it impossible to work.⁷

In Shults et al's 2004 US review of 442 individuals who had previously been injured in a road crash, 33% had difficulty with "instrumental ADLs" such as "preparing meals, shopping, managing money [and] using the telephone",¹⁰ and 49% reported difficulty with "functional activities" such as walking up 10 steps or reaching over their head.¹⁰

Of this high burden of disability, Shults et al reported that 73% of road crash-related physical disability is associated with orthopaedic impairment or intervertebral disc disorders.¹⁰

Read et al's study also cited post-traumatic depression in about 50% of patients 6 months after the injury, and such psychological morbidity was especially evident in those not working after 1 year.⁵ Similarly, Michaels et al's US cohort study of blunt force orthopaedic trauma patients found that patients commonly reported "compromised" relationships due to their physical and psychological injury.¹¹

Notwithstanding that substantial attention has been paid to the poor outcomes of road crash trauma overseas, only minimal research has been conducted in Australia. Furthermore, no Australian or international research appears to have attempted to describe in detail the medical, surgical and allied health response to these injuries in the acute care setting. There is a dearth of published Australian or international research directed towards the cost of orthopaedic trauma from road crashes, notwithstanding their high prevalence. In Australia, the Australian Institute of Health and Welfare reports only on the cost of "injuries" in general, which includes suicide and other forms of injury.¹²

On this background of international evidence of persisting morbidity from road crashes and a dearth of research into the quality and cost of acute management, the purpose of this study was

2 Road traffic crash categories

Category	N	% of population	Male	Female	Mean age in years (SD)
Driver	21	11.2%	61.9%	38.1%	50.5 (19.4)
Passenger	10	5.3%	50.0%	50.0%	43.3 (24.3)
Motorcyclist	43	23.0%	90.7%	9.3%	34.6 (10.7)
Bicyclist	13	7.0%	84.6%	15.4%	39.5 (13.9)
Pedestrian	90	48.1%	53.3%	46.7%	43.4 (18.0)
Other	10	5.3%	70.0%	30.0%	37.3 (20.3)
Total	187	100.0%	65.8%	34.2%	41.6 (17.5)

to describe the pattern of injury, acute management, mode of separation and overall cost of the acute phase of orthopaedic trauma from road crashes. It is hoped that this information might help to identify opportunities to further investigate means of improving outcomes and recovery in this population.

Methods

This study was conducted at St Vincent's Hospital in Darlinghurst, Sydney, Australia. St Vincent's is a large tertiary hospital which services the central business district of Sydney and the surrounding high-density residential and commercial districts.

The World Health Organization accepted definition of a "road traffic crash" was used for this study; "a collision or incident . . . occurring on a public road and involving a moving vehicle".¹³ Road crash victims were also subdivided into different road traffic crash (RTC) categories, namely "driver", "passenger", "motorcyclists", "bicyclists", "pedestrians", and "other". The "driver" and "passenger" categories refer to cars and trucks only, while the "other" category includes miscellaneous accidents such as motorised scooter accidents and an elderly patient who fell over within a bus.

After ethics approval from the St Vincent's Hospital ethics committee, consecutive patients presenting to the Emergency Department (ED) with fractures arising from a road crash between 1 April 2005 and 30 September 2006 (18 months) were identified through the Emergency Depart-

ment Information System (EDIS). Patients who were dead on arrival were not included. A retrospective file review was then completed of 187 files. Nine files were not available as they were being used elsewhere in the hospital.

As illustrated in Box 1, data were collected in four domains: basic demographic data, the pattern of fracture, the pattern of intervention and mode of separation. The rationale for including these variables is based on a priori clinical estimation. Detailed demography was sought to assess the impact of patient background on presentation and treatment (eg, health insurance status could appear to shorten length of stay by allowing the patient to move from the acute care hospital prematurely). Intervention variables focussed on length of stay in various parts of the hospital (ED, intensive care unit and wards), analgesia use, rehabilitation, allied health involvement, and tertiary survey completion. Tertiary surveys involve a systematic and holistic re-evaluation of a patient's injuries and complaints, after initial review and the initiation of management. Finally, data pertaining to the pattern of separation focussed on discharge destination, ongoing support and follow-up.

Data were collected from written files and the online database of radiology and reporting. Only data pertaining to the primary presentation were included, except with regard to the incidence of follow-up appointments. Children younger than 15 years were not included.

Data were entered into an SPSS database (SPSS Inc, Chicago, Ill, USA), and on completion of

3 Distribution of fractures overall and by road traffic crash categories and age groups*

Site of fracture	Overall	Drivers	Passengers	Motor-cyclists	Bicyclists	Pedestrians	Other	Age ≤65	Age >65
Cranium	5.2% (24)	0	13.3% (4)	0	0	6.8% (16)	17.4% (4)	5.2% (20)	5.1% (4)
Facial	10.1% (46)	1.6% (1)	10.0% (3)	6.5% (6)	25.0% (5)	13.2% (31)	0	11.0% (42)	5.1% (4)
Clavicle	3.9% (18)	3.2% (2)	0	7.5% (7)	5.0% (1)	3.0% (7)	4.3% (1)	4.4% (17)	1.3% (1)
Scapula	0.6% (3)	0	0	1.1% (1)	0	0.4% (1)	4.3% (1)	0.8% (3)	0
Sternum	1.9% (9)	12.9% (8)	3.3% (1)	0	0	0	0	1.0% (4)	6.3% (5)
Rib	15.6% (72)	22.6% (14)	33.3% (10)	18.3% (17)	20.0% (4)	9.8% (23)	17.4% (4)	13.8% (53)	24.1% (19)
Vertebra	11.0% (51)	27.4% (17)	13.3% (4)	6.5% (6)	25.0% (5)	7.7% (18)	4.3% (1)	3.1% (12)	19.0% (15)
Humerus	2.6% (12)	0	0	2.2% (2)	0	3.8% (9)	4.3% (1)	9.4% (36)	0
Radius	5.4% (25)	3.2% (2)	6.7% (2)	7.5% (7)	15.0% (3)	3.8% (9)	8.7% (2)	5.0% (19)	7.6% (6)
Ulna	1.9% (9)	3.2% (2)	6.7% (2)	1.1% (1)	0	0.9% (2)	8.7% (2)	1.8% (7)	2.5% (2)
Carpal	1.3% (6)	1.6% (1)	0	2.2% (2)	0	0.4% (1)	8.7% (2)	1.6% (6)	0
Metacarpal	1.9% (9)	0	3.3% (1)	7.5% (7)	0	0.4% (1)	0	2.3% (9)	0
Upper phalanges	2.6% (12)	0	10% (3)	4.3% (4)	0	2.1% (5)	0	1.8% (7)	6.3% (5)
Femur	2.6% (12)	1.6% (1)	0	3.2% (3)	5.0% (1)	2.6% (6)	4.3% (1)	2.3% (9)	3.8% (3)
Patella	1.3% (6)	3.2% (2)	0	3.2% (3)	0	0.4% (1)	0	1.3% (5)	1.3% (1)
Tibia	10.0% (46)	4.8% (3)	0	6.5% (6)	0	15.4% (36)	4.3% (1)	11.5% (44)	2.5% (2)
Fibula	10.2% (47)	0	0	9.7% (9)	0	15.0% (35)	13.0% (3)	11.5% (44)	3.8% (3)
Tarsals	1.7% (8)	3.2% (2)	0	5.4% (5)	0	0.4% (1)	0	2.1% (8)	0
Metatarsals	5.0% (23)	0	0	5.4% (5)	0	7.7% (18)	0	5.0% (19)	5.1% (4)
Lower phalanges	0.4% (2)	0	0	1.1% (1)	0	0.4% (1)	0	0.5% (2)	0
Pelvis	4.8% (22)	11.3% (7)	0	1.1% (1)	5.0% (1)	5.6% (13)	0	4.4% (17)	6.3% (5)
Total	100.0% (462)	100% (62)	100% (30)	100% (93)	100% (20)	100% (234)	100% (23)	100.0% (383)	100.0% (79)

* All figures are % (no.).

data collection, statistical analysis was performed. Considering the high volume of statistics we calculated, statistical significance was defined as $P \leq 0.01$ in order to ensure significance was calculated at a more exacting level than the accepted value of $P < 0.05$. We have decided to report the confidence intervals at 95% for ease of comparison to other published results in this field. After the audit, costing analysis was completed using St Vincent's Hospital cost of care data reports and NSW Department of Health methodology.¹⁴ Costs are allocated to each patient for a variety of inpatient services, resulting in an estimated cost of care for each patient.

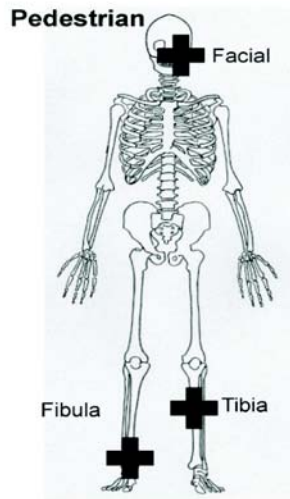
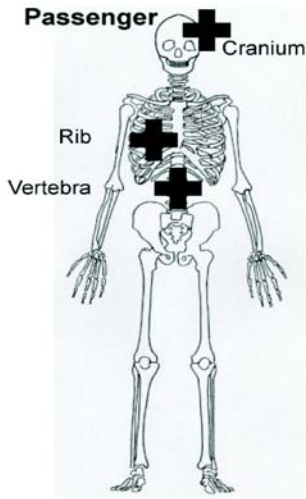
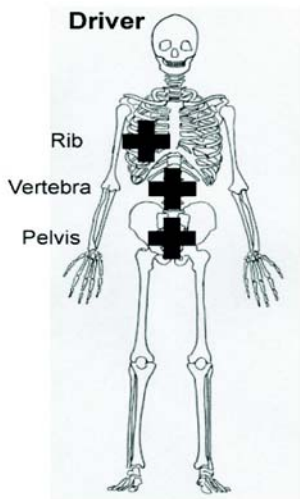
Results

Demographic data

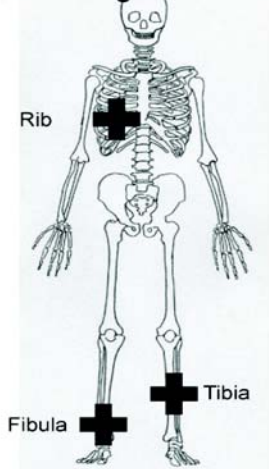
One hundred and eighty-seven patients were included in the study; 65.8% of patients (123) were male, 34.2% (64) female. The mean age was 41.6 years (SD, 17.5) and was lower among males, although there was no significant difference in age. Of all patients, 34.8% of patients (65) were recorded as having private health insurance and an interpreter was requested in 6.4% of cases (12).

The breakdown of RTC categories is seen in Box 2. Significant differences in mean age were

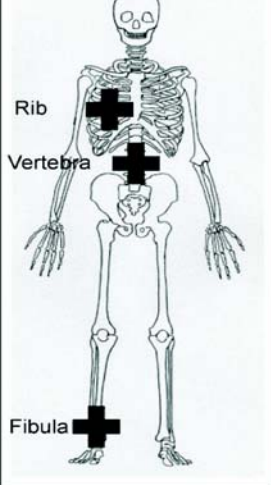
4 Most common fracture sites within road traffic crash categories and age groups



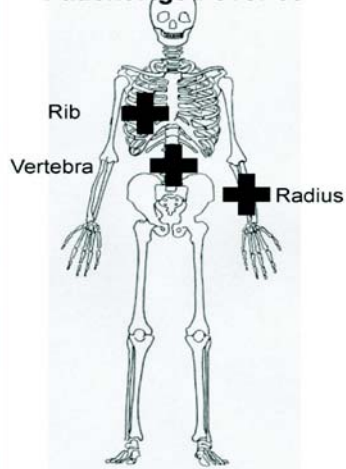
Patient Aged 65 or less



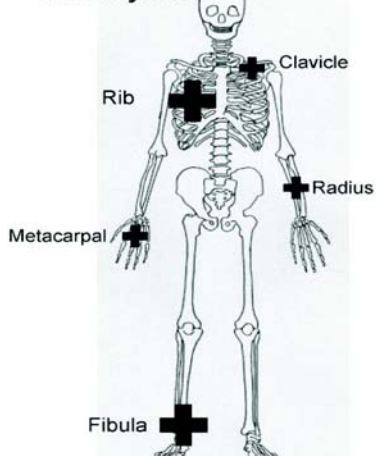
Road Crash Victim



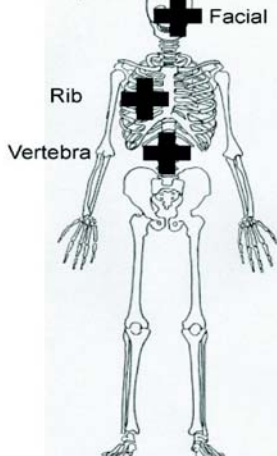
Patient Aged over 65



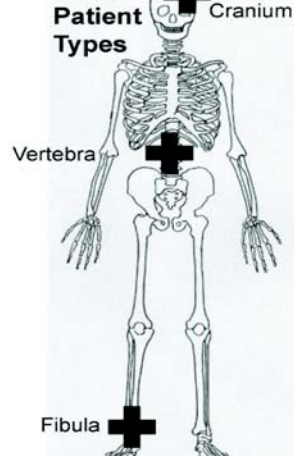
Motorcyclist



Bicyclist



Other Patient Types



seen between drivers (mean, 50.5; SD, 9.4) and motorcyclists (mean, 34.6; SD, 10.7; $P=0.001$; 95% CI, 6.9 to 24.9), and motorcyclists and pedestrians (mean, 43.4; SD, 18.1; $P=0.006$; 95% CI, 2.6 to 15.1).

Pattern of fracture

The mean number of fractures per patient was 2.5, with no statistically significant difference in number of fractures between sexes or between RTC categories. After grouping subjects into two age categories (≤ 65 , >65), a trend was noted between increasing age and increasing risk of fracture which did not meet our rigorous definition of statistical significance ($P=0.035$). The site of fracture for various groups of patients is shown in Box 3. Similarly, Box 4 illustrates the most common fracture sites for each accident type and age group.

Tertiary surveys were completed for 64.2% of patients. The mean hospital length of stay for patients who did not undergo a tertiary survey was 3.3 days (SD, 4.8) which was significantly less than the stay of those that did (mean, 11.8; SD, 15.9; $P<0.001$; 95% CI, 4.5 to 12.4). The incidence of tertiary surveys was highest within the driver and passenger groups (81% [17] and 90% [9], respectively), and lowest among bicyclists (32.8% [21]).

Of those patients that underwent a tertiary survey, 8.3% (10) of patients had a missed fracture suspected or diagnosed through the survey, and 10% of patients (12) had some other injury suspected or diagnosed through the survey process.

Length of stay

The mean hospital length of stay (LOS) was 8.8 days (SD, 13.7; median, 3; mode, 1). There were no significant differences between sexes. The mean length of stay for the driver category was 15.7 days (SD, 23.4), which was significantly longer than that for motorcyclists (mean, 5.7; SD, 9.2; $P=0.006$; 95% CI, 2.9 to 17.0) and bicyclists (mean, 3.0; SD, 3.5; $P=0.008$; 95% CI, 3.3 to 22.1). The mean LOS within the ED was 17.2 hours (SD, 16.2).^{*} There was no significant dif-

ference in ED stay between sexes or between RTC categories.

Twenty-five patients (13.4%) were admitted to the Intensive Care Unit (ICU). Their mean LOS within the ICU alone was 8.4 days (SD, 8.0), again with no significant differences in mean stay between sexes or RTC categories.

Patients aged over 65 had a significantly longer mean hospital LOS (mean, 15.8; SD, 23.1) than younger patients (mean, 7.8; SD, 11.6; $P=0.008$; 95% CI, 13.9 to 2.1), but there were no significant differences in ICU LOS or ED LOS. Correlation was seen between the number of fractures and overall length of stay ($R=0.551$; $R^2=0.304$).

Analgesia[†]

With regard to pain management, 60.2% (112) of patients were prescribed both simple and narcotic analgesics, 33.3% of patients (62) were prescribed narcotics only, and 2.7% (5) were prescribed simple analgesics only. 3.8% (7) appeared to be prescribed no analgesia whatsoever. Patients with combined analgesia had a mean of 3.1 fractures (SD, 2.7) which was significantly higher than for those with narcotic analgesia alone (mean, 1.5; SD, 1.1; $P<0.001$; 95% CI, 0.9 to 0.3) and had a significantly longer overall LOS (mean, 13.4; SD, 16.1) than those on narcotics alone (mean, 1.7; SD, 1.9; $P<0.001$; 95% CI, 7.7 to 15.6) and those without analgesia (mean, 1.0; SD, 0.0; $P=0.012$; 95% CI, 2.7 to 22.1).

Just over one third of patients (35.4%) were prescribed a different analgesic at discharge to that which they had received in the previous 24 hours.[‡] Those that had a different analgesic prescribed at discharge had a significantly shorter mean length of hospital stay (mean, 2.9; SD, 5.2) than those discharged on analgesia they had

^{*} 12 patients' LOS within the ED were not able to be calculated due to insufficient information within the files, and were thus not included in these calculations.

[†] One patient's drug charts were not available and this patient was thus not included in these calculations.

[‡] 9 files did not include discharge prescription information and were thus not included in these calculations.

received in the previous 24 hours (mean, 12.0; SD, 15.7; $P < 0.001$; 95% CI, -13.2 to -5.2).

In 7% of files (13) it was noted that analgesia was inadequate at some point during the patient's acute stay. Inadequate analgesia was not significantly associated with length of stay, number of fractures or age.

Acute management of non-orthopaedic sequelae

Just over 1 in 3 patients (35.8% [67]) had a documented discussion regarding insurance claims while in the hospital. Nearly all of these patients (97% [65]) were seen by a social worker.

Nearly half of the patients saw a social worker (49.2% [92]), and these patients were seen within a mean period of 2.7 days (SD, 2.9). Those who were not seen by a social worker had a mean hospital LOS of 2.2 days (SD, 2.2), which was significantly less than those who were (mean, 15.6; SD, 16.9; $P < 0.001$; 95% CI, 10.0 to 16.9).

Physiotherapists saw 60.4% of patients (113), and these patients were seen within a mean of 2.5 days (SD, 2.4). Those who were not seen by a physiotherapist had a significantly shorter LOS (mean, 1.4; SD, 0.8) than those who were (mean, 13.4; SD, 15.8; $P < 0.001$; 95% CI, 8.5 to 15.8).

Occupational therapists saw 42.2% of patients (79), and were seen after a mean of 6.8 days (SD, 7.9). Once again, those who were not seen by an OT had a significantly shorter LOS (mean, 3.8; SD, 10.5) than those who were (mean, 15.5; SD, 14.7; $P < 0.001$; 95% CI, 8.1 to 15.3).

Few patients (9.1% [17]) saw a psychologist, psychiatrist or drug and alcohol worker; they were seen within a mean of 10.6 days. Again, those who were not seen by a psychiatric or drug and alcohol worker had a significantly shorter LOS (mean, 7.0; SD, 10.5) than those who were (mean, 26.7; SD, 25.2; $P < 0.001$; 95% CI, 13.5 to 26.0). Of the 11.2% of patients (21) who had some sort of psychological disturbance recorded in their file (this includes patients with noted signs of general distress or anxiety), 61.9% (13) were seen by a psychologist, psychiatrist and/or drug and alcohol specialist.

A rehabilitation physician was consulted for 17.1% of patients (32), within a mean 9.9 days (SD, 8.3). Completing the pattern, those not seen by a rehabilitation physician had a significantly shorter stay (mean, 6.3; SD, 11.9) than those who were (mean, 21.0; SD, 15.5; $P < 0.001$; 95% CI, 9.9 to 19.5). 65.7% of patients (21) who were seen by a rehabilitation physician were discharged to a rehabilitation hospital.

There were no significant differences in mean times to seeing allied health practitioners between sexes. There was trend among RTC categories that motorcyclists took longer to see a social worker than did drivers and pedestrians, neither of which met our definition of statistical significance ($P = 0.043$ and $P = 0.025$, respectively).

No patient was referred to a vocational rehabilitation service from the acute care hospital.

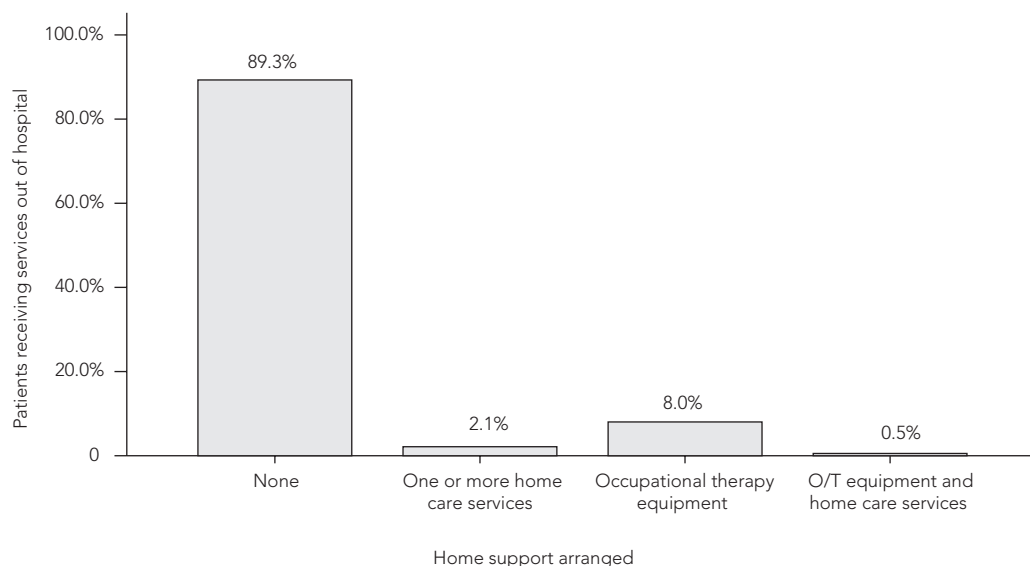
Mode of separation

The majority of patients (82.9% [153]) were discharged home; 11.8% (22) were discharged to a public or private rehabilitation hospital, and 4.3% (8) were discharged to another medical facility (eg, a private hospital). Those patients who were discharged to a rehabilitation hospital were significantly older (mean, 51.8; SD, 23.0) than those discharged to a non-medical destination (eg, home) (mean, 39.5; SD, 15.8; $P = 0.002$; 95% CI, 4.7 to 20.0).

Patients discharged to a rehabilitation hospital had a significantly higher mean number of fractures (mean, 4.9; SD, 3.7) than those discharged to a non-medical destination (mean, 2.1; SD, 1.8; $P < 0.001$; 95% CI, 1.8 to 3.8), and those discharged to another medical facility (mean, 3.1; SD, 2.2; $P = 0.049$; 95% CI, 0.0 to 3.5). Eight patients (4.3%) left the hospital against medical advice.

As illustrated in Box 5, few patients (10.6%, 20) had services arranged to support them following discharge. Of those who did, the most common service was the loan of occupational therapy (OT) equipment. Most patients (78.1%) had follow-up appointments arranged at discharge: 56.2% (105) had orthopaedic follow-up arranged; 25.7% (48) were referred to a physiotherapist; 31.6% (59)

5 Support service arranged upon discharge



were referred to a non-orthopaedic specialist or clinic, and 4.8% (9) were referred to an outpatient rehabilitation clinic.

Total cost

As hospital costing is calculated annually, the cost of care could only be calculated for patients who were admitted during the 2005/06 financial year. As such, only 107 patients (57.2% of the total cohort) were included in the costing analysis. As illustrated in Box 6, total costs were highest in vehicle occupants (drivers and passengers) and the elderly. Significant differences in mean total costs were seen between drivers and motorcyclists ($P=0.01$; 95% CI, 5556 to 40112). The mean cost of patients aged over 65 was significantly more than those aged 65 or less ($P=0.01$; 95% CI, -38181 to -4879).

Discussion

Although this study is limited by its reliance on the accuracy of patient files, by its retrospective design, and by other limitations described below, it provides detailed description of the patterns of injury of road crash victims and the way in which

patients are treated in the acute care hospital. It could also be interpreted as revealing a number of potential opportunities to improve the quality of care, the impact of which may warrant further research. This discussion comprises two parts: the first part reflects on the patterns of injury and orthopaedic management, while the second examines opportunities for improving non-orthopaedic management of road crash trauma.

Patterns of injury and orthopaedic management

The predominance of pedestrian victims in this study is reflective of the location of the hospital near the central business district of Sydney, where average road speeds are low and there is high pedestrian activity. With respect to the pattern of injury seen in motorcyclists, while the predominance of males among motorcycle victims has been reported elsewhere,¹⁵ the pattern of injury seen in this study differs markedly from that reported internationally.¹⁶ Whereas Markogianakis's large study of Greek road crashes found craniocerebral injuries to predominate among Greek motorcyclists, our study found the incidence of such injury to be relatively low.

6 Mean total cost between groups

Group	N	Mean total cost	SD
Overall	107	\$13 336	27066
Aged ≤ 65	96	\$11 123	17228
Aged >65	11	\$32 653	66995
Drivers	16	\$29 748	58486
Passengers	5	\$26 403	43097
Motorcyclists	22	\$6 914	6389
Bicyclists	9	\$7 919	15905
Pedestrians	51	\$10 876	13644
Other	4	\$10 233	3812

Indeed, across a range of measures the relative severity of injury of motorcyclists was strikingly low. They had relatively low rates of cranial and pelvic injuries, which have been associated with high morbidity and mortality in a range of studies;¹⁷⁻²⁰ they had a significantly shorter mean hospital length of stay than did other crash victims and the shortest mean ICU and ED stays; and they had a significantly cheaper mean cost than other groups. These results perhaps highlight the role of speed restrictions in built-up areas, the effectiveness of helmet laws in Australia, and the widespread use of protective equipment among Australian motorcyclists.

While the incidence of pelvic fractures was low among motorcyclists, it was high among drivers and was about 50% more common in patients aged over 65 years than in younger patients. This is concerning given that road crash pelvic injuries have a significant risk of high blood loss and mortality.^{19,20} Furthermore, the high prevalence of chest injury in the elderly is also concerning as it has been reported that such injuries are associated with increased morbidity,²¹ longer ICU stay,²¹ and high mortality.^{19,21}

These higher rates of chest injury seen in patients over 65 mirror the findings of Yee et al's study of road crash victims over 65.²¹ Yee et al associate this pattern of injury with the predominance of elderly patients within their "motor vehicle occupants" category.²¹ However, in our study, although the mean age of drivers was

significantly higher than other groups, patients over 65 accounted for only 26% of vehicle occupants, and as such, the same conclusion cannot be drawn. Instead, this preponderance of chest injuries among the elderly (particularly sternal injury which was close to 6 times more common in the elderly) could point to age as an independent risk factor for road crash injury.²² Alternatively, given that older patients are likely to have a higher number of comorbidities, these results could reflect the role of underlying comorbidities such as osteoporosis in road crash fractures. Other studies have associated such comorbidities with increased mortality.^{23,24}

Tertiary surveys have been shown to be an important method of screening for missed injuries in trauma patients.^{25,26} In this cohort, the incidence of tertiary survey was related to time in hospital. This is most probably related to the fact that many patients leave before an opportunity for a tertiary survey presents itself. The fact that around 18% of tertiary surveys revealed potential missed disease further demonstrates the value of these examinations.

The use of combined simple and opioid therapy is recommended by the National Health and Medical Research Council: Level 1 evidence suggests that paracetamol significantly enhances the efficacy of opioid analgesia.²⁷ Contrary to NHMRC recommendations, 35.8% of patients were not prescribed a combination of opioid and simple analgesics. Many of these, however, may have been discharged directly from the ED where there is a reluctance to give oral analgesia (including simple analgesics) in case the patient may require unpredictable and urgent operative intervention.

Of interest was the incidence (35.4%) of patients being prescribed a different analgesic at discharge to that which they had received in the previous 24 hours. Although this figure is probably mostly associated with the cessation of injectable opioids, many patients were clearly being discharged on analgesia whose effectiveness had not been monitored and which could be inadequate or lead to unnecessary side effects. It is possible that this practice is common in NSW

hospitals. This is significant, as a number of studies have reported poor pain management and chronic pain as being ongoing concerns following road crashes.^{4,5} Ideally, this practice could be a target for improvement so that analgesic changes are undertaken before discharge. Alternatively, if the practice continues close follow-up needs to be arranged to ensure that pain management is effective.

Rates of referral for orthopaedic follow-up appeared to be low (56.2%). However, given that most patients (78.1%) were referred to at least one specialist, in many cases referral for orthopaedic follow-up may not have been necessary. Other possible reasons for limited orthopaedic follow-up include geographical limitations and the inaccuracy of some files. Regardless, closer examination of the reasons behind such seemingly low rates of orthopaedic follow-up could reveal system errors whose correction may improve quality of care.

Management of non-orthopaedic sequelae and allied health involvement

Rates of referral to physiotherapy (25.7%) and outpatient rehabilitation (4.8%) also seemed low. Considering also the infrequent organising of post-discharge support (10.6%) it is probable that a burden is being placed on general practitioners who are likely to be responsible for pain management, fracture follow-up, osteoporosis management and rehabilitation towards return to work in many patients. As such, ensuring good communication between carers within the hospital and GPs is essential for adequate quality of care.

Only one patient (0.5%) was referred to outpatient psychiatric care. Indeed, the frequency with which patients were referred to psychological care within the hospital, notwithstanding documented concerns regarding patients' psychological health, was also low. This seems out of keeping with the high prevalence of psychological sequelae of road crashes reported elsewhere^{4,5} and evidence that recovery from such morbidity is improved with psychological intervention such as cognitive therapy²⁸ and cognitive behavioural therapy.²⁹

Moreover, the reported incidence of psychological sequelae in this study was 11.2%. This is markedly less than the incidence reported in a number of follow-up studies.^{4,5,30} While this may be indicative of the limitations of this study, it could also suggest that psychological sequelae are potentially not being diagnosed within the hospital, thus perhaps suggesting the need for better screening methods. Alternatively, this disparity could indicate that psychiatric morbidity tends to emerge some time after the initial traumatic injury, thus perhaps further demonstrating the need for comprehensive follow-up.

With regard to the involvement of allied health teams and rehabilitation specialists, the likelihood of seeing an allied health worker was strongly related to the amount of time spent within the hospital. Considering that only 47.6% of patients remained beyond 3 days and that the mean time to most allied health contact was between 2.4 and 10.6 days, it is clear that many patients are missing out on allied health assistance due to delays in initial contact.

Insurance matters, and matters of finance have been reported as causes of distress hampering the recovery of road crash victims.⁵ As such, it was of interest that 64.2% of patients did not have a documented discussion regarding insurance matters. This may again be related to the fact that only 47.6% of patients remained in hospital after 3 days and the mean time to social work contact was 2.71 days. Given that social workers' core responsibilities involve assistance with financial matters, social workers seem to be the appropriate member of the care team to continue assisting in this way (in our cohort, 97% of those that had assistance regarding insurance were seen by a social worker). More opportunities for social workers to assist in insurance matters could potentially improve the quality of care and reduce the burden of psychological distress.

It was significant that no patient was referred to a vocational rehabilitation service. When coupled with the fact that 71.7% of files recorded no occupation, these results suggest a lack of concern by acute hospital staff for the implications of injury on patients' employment. This is important

as problems with returning to employment are commonly reported among patients suffering from road crashes.^{5,7,31,32}

Indeed, in terms of vocational rehabilitation, it seems that the bulk of research on vocational rehabilitation and trauma is concerned with its role in traumatic brain injury and spinal cord injuries. As such it is possible that this study describes perhaps for the first time in Australia the lack of focus on return to work in an inpatient setting for orthopaedic trauma from road crashes.

Cost of care

The mean total cost of \$13 336 equates to a mean annual cost of about \$1.6 million for this inner city hospital. This represents a small proportion of the overall cost which is incurred as a result of road crashes considering the vast numbers of patients who suffer non-orthopaedic injuries as well as ongoing costs of care after discharge. Indeed, the Australian Institute of Health and Welfare reported that of the cost of "Injuries", the cost incurred within hospitals and aged care facilities accounted for only 70% of total health care budget allocated to the treatment of "Injuries".¹² Other significant costs were associated with pharmaceuticals and out-of-hospital medical services.¹² Further, one must also consider the indirect community costs associated with delayed return to work and disability payouts.

Using a broad Medline search we were unable to find any published Australian research into the cost of orthopaedic injuries from road crashes. It is likely however, that such data exist in private insurance company reports and perhaps government reporting. It is therefore in the patients' and the community's interest to have hospital stays used to the greatest effect in terms of acute management and the prevention of chronicity.

Conclusion

This study revealed a number of areas of acute management that could potentially be improved through the education of health care teams, changes to referral systems and the availability of information regarding insurance and return to

work. Similarly, improved provision of analgesia, early detection and management of psychological sequelae, and the identification of occupational issues could help to improve the quality of acute care for road crash victims. Referral systems may benefit from a review so that patients can have improved access to specialty clinics, vocational rehabilitation providers and outpatient pain management and rehabilitation clinics. Furthermore, given that this study has identified that most road crash victims with orthopaedic trauma do not receive adequate information regarding insurance and return to work matters in the inpatient setting, enhanced efforts to provide appropriate information may further assist patients in their recovery. It is with these findings as background, that the MAARRS (Motor Accident Acute Rehabilitation Response Study) group is currently running a continuous controlled trial of early intervention in the rehabilitation of road crash victims, with the intent that this trial too will help to better our understanding of the ideal acute and rehabilitative management of road crash trauma.

Competing interests

The authors declare that they have no competing interests. This study informed a later interventional study (MAARRS) that was funded by the Motor Accident Authority of NSW.

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