Amalgamation of Police and Hospital Trauma Data in the Australian Capital Territory 2002-2003

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ABSTRACT

AIM: Fatality measures of road trauma are insufficiently sensitive to guide policy in a small jurisdiction. This study describes the findings of road trauma data matching and amalgamation in the ACT for calendar years 2002 and 2003.

METHODS: Retrospective descriptive study of police and hospital data covering all road trauma in the ACT. Both automated name matching and manual searching were used to match police crash data with Emergency Department presentations to the only hospital with a major trauma service. Deaths and hospital presentations were classified by outcome and duration of hospital admission.

RESULTS: Of 23207 crashes on the Police database, 1079 were identified as leading to one or more deaths or hospital presentations. A further 986 incidents, at least 373 of them on public roads, were identified from hospital records, leading to a total of 2531 hospital episodes, including 24 deaths and 151 admissions of more than 7 days duration, and a total of 5540 hospital bed-days used.

CONCLUSIONS: There are significant limitations to road trauma data routinely collected by both by law enforcement and health personnel, reflecting operational constraints. This methodology provides significantly higher quality data than previous approaches and successfully quantifies the burden of road trauma.

INTRODUCTION

The annual death rate or "road toll" is one simple and widely reported measure of the consequences of road trauma, but in small jurisdictions this figure may fluctuate dramatically. Whilst the underlying causes of road trauma are well understood, the most appropriate and cost effective interventions are not always known. Trial of possible interventions is likely to occur first in relatively small populations, such as single States or Territories, where the death rate is an insensitive measure of outcome.

Data about road crashes is routinely collected by Police services, and data on hospital treatment by Health services. However, operational constraints markedly limit the accuracy of data that is not immediately relevant to the service, and privacy concerns limit the linkage between services. For example, in most Australian States, police attending a crash scene do not follow up patients taken to hospital unless a death or criminal charge is thought to be likely, and hospitals do not record structured details about the location or type of causative crashes, and only in Western Australia is the Health system able to easily track the care of a patient across multiple hospitals.

There have been studies linking health and police records in various jurisdictions [1-3], but much of the published Australian research has been limited to a particular type of crash [4] or particular type of road user [5]. The most successful long term linkage matches Western Australian public hospital admissions but not Emergency presentations, with Police data using an automated probabilistic match [6]. One of the further difficulties encountered in such research is accurate classification of events as road trauma. Many documents [7, 8] note that all Australian States and territories follow national "Guidelines for reporting and classifying road crashes" (or "road accidents" in earlier versions) but these guidelines have not been widely disseminated [Australian Transport Safety Bureau, personal communication], and are not provided for reference at Police Stations in the ACT .

This study aims to create a new and more accurate measure of the health consequences or "burden" of road trauma in the Australian Capital Territory (ACT), and to identify the nature and location of crashes contributing to these health consequences. In this region, all trauma cases requiring public hospital admission are treated at a single institution, The Canberra Hospital (TCH). Private hospital treatment of road trauma in the ACT is negligible, but TCH also treats much of the serious trauma occurring in surrounding areas of NSW, and a smaller number of ACT residents who were injured elsewhere. The Australian Federal Police (AFP) record details of all crashes attended by Police, and all crashes reported at Police stations (reporting is a requirement for most motor vehicle insurance claims).

METHODS

This was a retrospective descriptive data matching study of AFP and TCH data covering crashes occurring in calendar years 2002 and 2003. Identifying details were used in the matching process, but deleted before analysis, as approved by the ACT Health Research Ethics Committee.

The AFP data supplied consisted of four data tables: Crashes, People, Vehicles and (limited) free text. The Hospital data were Emergency Department (ED) and inpatient databases, which share patient identifiers, supplemented by reference to the hospital notes when necessary. Where appropriate, the information was compared to the publicly available Australian Transport Safety Bureau (ATSB) Fatal Road Crash Database, which is considered to represent the "official" road death toll.

An INCIDENT was defined as a crash that caused injury and occurred within the ACT as reported on the AFP database, or described in patient records. Because of the lack of clarity over road crash definitions, a liberal definition including any moving wheeled vehicle larger than a skateboard was used. Incidents were then classified as to the location and vehicle types. An EPISODE was defined as an incident-related patient encounter with the hospital system beginning within 7 calendar days, or a death prior to reaching hospital. Admission to a hospital bed immediately following Emergency Department care was counted a single episode. Lengths of admissions were counted until the first time the patient was physically discharged from hospital, ignoring any "statistical" discharges recorded in the interim. Episodes were classified by the outcome and number of bed-days used, by standard definitions [9].

A four phase matching process was undertaken: the initial match was automated, searching for concordance of the first four letters of first name and surname between AFP and ED databases, then manually establishing the accuracy of matches. The second phase was manual search of the Police data for incidents that matched remaining ED presentations with road trauma keywords recorded in their text fields. The third was manual search for incidents matching remaining admissions to hospital that had been classified by trained coders as "transport related". The fourth was a manual audit of the entire database to identify representations, deaths outside hospital, and multiple patients from the same incident. Matching was undertaken entirely by the two authors.

RESULTS

The AFP data included 23207 crash records, of which 198 (0.85%) described the same type of crash at the same location at the same time as another record, and a further 332(1.43%) described the same type of crash at the same location within 30 minutes of another record. One or more names were recorded on the "persons" database for 7042 of the crashes.

1479 hospital episodes and 10 non-hospital fatalities were matched to 1079 different police data incidents, 899 on the basis of patient name, the rest by concordance of other elements. A further 1046 hospital episodes could not be matched to a Police incident record, and these were believed to represent 986 separate incidents. 269 potential episodes examined were found not to represent road trauma, another 198 were from road trauma occurring outside the ACT, and 47 related to incidents more than 7 days before.

In total, 2065 incidents injured 2385 people (1.15 per crash), of whom 2303 recorded one episode, 75 had 2, and 7 had 3 or more as detailed in Tables 1 and 2. The episode count alone (mean 1.23 per crash, range 1-7) may be deceptive, since the most severely injured, who died at the scene or were immediately admitted to hospital for more than 7 days, could not experience more than one episode by definition. No person appeared in the final data in relation to more than one crash, although it was noted that some presented from both ACT and NSW crashes in the 2-year period.

Review of the hospital records suggested that two of the "struck pedestrian" deaths on the AFP and ATSB databases might be better classified differently: one as a suicide (and thus not strictly road trauma) and one as a fall from a moving vehicle. Three deaths were identified in both AFP and TCH data, but subsequently excluded from the ATSB Fatal road crash Database, apparently because medical conditions caused both the crash and the death. One road fatality was found to be missing from the AFP data: a perinatal death resulting directly from trauma to a pregnant vehicle occupant. In line with the inclusive approach of this study, all these deaths are included in the tabulated results.

The outcome of hospital episodes is shown in Table 3, the matching rate with AFP data in Table 4, the relative outcomes of crashes on the AFP data in Table 5, and the age distribution of individual patients in Figure 1. As shown in Figure 2, incidents that were outside the usual definition of road trauma because they were not known to occur on public roads accounted for 26.1% of all episodes, corresponding to 19.6% of all bed-days. Although this group had no fatalities, they included 53.4% of all single bed-day admissions.

DISCUSSION

This combined database provides a powerful tool for description of both individual consequences and the community burden of road trauma. It is already of sufficient magnitude to allow hypothesis testing, and when expanded it will allow detailed tracking of road trauma over time. For the first time in Australia these data allow study of road trauma using crashes (incidents), people, or hospital episodes as the fundamental unit of analysis.

There were significant limitations to the data sources. It is probable that around 2.5% of crashes on the AFP database represent duplicate records, resulting from the same crash being reported at different Police stations by different people. The AFP database infrequently included injury/identifying details if patients were not transported to hospital directly from the scene. Those definite car crashes that could not be matched reflected both frequent collisions without adequate distinguishing features (one wet morning in June 2003 had 21 crash reports in a 1-hour period, at least 9 of which represented different rear end collisions), and cases of genuine mis-reporting and non-reporting. Over a 90% match rate for car occupants as achieved is very good for data of this nature, much better than 67% reported in a similar study in Sussex [10] and the reporting rate of 65% (single vehicle) and 79% (multiple vehicle) for car drivers in New Zealand [11].

The much lower rate of matching for motorcycle injuries reflects both under-reporting of single vehicle crashes when there is little vehicular damage (and thus no insurance reason to report), and non-reporting of off-road crashes. Other studies have noted reporting of single motocycle crashes on the road in the range 41[11] to 69%[10]. Unless hospital data collection of "place of occurrence" improves, it will not be possible to identify how many of the apparently unreported 79% of motorcycle crashes in the ACT occur on the roads. The match rate for cyclists seems to be the lowest ever reported (compared to 22% for "serious" on road cycle crashes in New Zealand [12]). This certainly reflects the inclusive definition, capturing many backyard incidents, but probably also indicates a high use of off-road bicycle paths by the ACT cycling poulation.

The TCH data had no duplications (as befits a hospital records system, all unidentified patients eventually had their records merged correctly), but had inadequate crash descriptions in both computerised data and medical records. Staff generally recorded mechanism of injury well, but had no incentive to record location (even the State) in which the crash occurred, nor the vehicle types. It was also clear that despite the endeavours of hospital staff, some patients chose not to identify their injuries as due to vehicular trauma, and others were dishonest in nominating the driver of a vehicle. These factors, plus the availability of other sources of medical care, mean that the "Emergency Department Care only" group likely underestimates the actual incidence of minor injury. Because TCH is the only source of public inpatient care for trauma in the ACT, and separate staff code admissions, the admissions data is likely to be more complete than any previous Australian study.

These data describe a heavily urbanised population, where road speeds are relatively low, stop-start driving is common, roads are well built and maintained, and vehicle density is high. The contrast with the Northern Territory is dramatic: rollovers and pedestrian incidents constitute 1% and 0.9% of reported ACT crashes respectively, accounting for 5.9% and 6% of reported crashes leading to hospital episodes, wheras they account for 30% and 8% of all injury crashes in NT [4].

Choice of length of stay as a major outcome measure was arbitrary, but based on clinical knowledge: patients spending more than one week in hospital are likely to have significant residual impairment, and patients discharged after only one day most likely required only observation or a simple procedure. The divisions chosen appear to be robust and consistent, and the distribution by road user type and frequency of transfers to other hospitals supports the their use as an ordinal measure of severity. Total bed-day usage is a reasonable measure of the burden of care provided by the hospital system, but a less consistent metric over time, since it may easily be imbalanced by small numbers of very long stay patients.

About 1.5% of incidents on the final database appeared to be due to medical causes, but apart from the fatalities, this remains a matter of informal opinion. As illustrated by the difference between fatalities in this study and the ATSB "road toll", the line between road trauma and other trauma may be blurred even when coronial opinion is the final legal arbiter. Bicycle-related road trauma is grossly under-reported to the Police, even allowing for the high proportion of off-road incidents, but some incidents that are not strictly road trauma such as rally spectator injuries and private car park collisions are commonly reported to the AFP database. It is of some concern is that one unequivocal road trauma related death was apparently not reported to the Police nor the Coroner, but as noted above, more than 90% accuracy might be considered reasonable in this setting.

CONCLUSIONS

This amalgamated database provides an important tool in the description and measurement of the overall burden of road trauma in the ACT. It appears to be more robust and inclusive than previous similar previous Australian studies, although so far significantly smaller.

The process of collating the data has highlighted inadequacies in current Police and Hospital data collections, due to both operational constraints and data collection design. In particular the Police database does not identify duplicate records, does not contain adequate identifying data, and does not have a review process that imposes a uniform definition of road trauma. Hospital data collection does not mandate identification of crash location even at a State level, and has insufficient structure around cause of injury to clearly identify all cases.

Injured people themselves appear frequently to be less than forthcoming in both crash reports and medical history. Whether injured on- or off-road, those involved in single vehicle crashes with injury but without significant vehicular damage rarely report the case to the Police. This seems unlikely to change without significant legal imposition.

This database will form the basis of an expanded collection which will be a valuable research tool.

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TABLE 1: INCIDENTS, EPISODES, AND OUTCOMES BY TYPE OF CRASH

Crash Type	Incidents Admitted with Police Reports	Incidents Admitted without Police Reports	Total Incidents Admitted	Emerg Admitted per Person	Different Persons Admitted	Bed-Days with Police Reports	Bed-Days without Police Reports	Episodes Admitted	Episodes Bed-Days per Episode	Total Bed-Days	Fatalities >7 days only	Fatalities 2-7 days only	Fatalities 1 day	Admitted Dept Person	Admitted Total Admission	Admitted Total Admission
Motor Vehicle(s) on road	1053	334	1387	1722	1456	359	1815	24	123	156	105	1407	392	4421	2.56	11.2
Pushbike(s) only on road	6	43	49	49	7	48	55		2	8	4	41	14	52	1.06	3.71
Motor Vehicle(s) in Carpark	7	5	12	13	7	7	14		1	2		11	3	24	1.84	8.00
Motor Vehicle(s) in Driveway	4	11	15	15	4	11	15		6	2		7	8	222	14.8	27.7
Motor Vehicle(s) Off Road	8	149	157	158	10	153	163		12	46	19	86	77	359	2.27	4.66
Motor Vehicle(s) - Closed Roads		0	5	5	6	0	7	7		1			6	1	11	1.83
11.0																
Pushbike(s) on Path/cycleways	0	30	30	31	0	33	33			12	7	14	19	51	1.64	2.68
Pushbike(s) off road	0	104	104	103	0	105	105		4	25	16	60	45	157	1.52	3.48
Pushbike(s) race/competition	0	17	17	17	0	17	17		1	4	1	11	6	20	1.17	3.33
Pushbike(s) unknown location	1	288	289	287	1	306	307		2	43	82	180	127	244	0.85	1.92
TOTAL	1079	986	2065	2385	1485	1046	2531	24	152	298	234	1823	692	5561	2.33	8.03

TABLE 2: INCIDENTS, EPISODES, AND OUTCOMES BY ROAD USER

Road User Type	Incidents Admitted with Police Reports	Incidents Admitted without Police Reports	Incidents Emerg Admitted per Incidents	Total Admitted Persons with Police Reports	Total Admitted Persons with Police Reports	Different Bed-Days without Episodes	Episodes Bed-Days	Episodes Bed-Days	Total Episodes Bed-Days >7 days only	Total Episodes Bed-Days 2-7 days only	Total Bed-Days	Fatalities 1 day	Fatalities Dept	Admitted Total per Person	Admitted Total per Admission	
Driver	704	111	815	891	809	114	923	12	48	62	47	754	161	1612	1.80	10.0	
Front Pass		193	32	225	237	212	32	244	6	12	21	14	191	48	295	1.24	6.14
Rear Pass		102	24	126	154	136	25	161		5	4	9	143	18	148	0.96	8.22
Pass (unknown)	8	14	22	22	8	14	22			2	1	19	3	10	0.45	3.33	
MB Rider		132	248	380	369	140	254	394	1	41	75	33	244	149	1469	3.98	9.85
MB Pillion		4	6	10	10	4	6	10		2	2	1	5	5	27	2.70	5.40
PB Rider		50	493	543	540	57	520	577		19	106	113	339	238	865	1.60	3.63
Pedestrian		73	20	93	94	75	20	95	2	23	16	9	45	48	1049	11.1	21.8
Other	8	11	19	20	8	12	20	3	2	4	1	10	10	60	3.00	6.00	
Unknown		34	45	79	81	36	49	85			6	6	73	12	26	0.32	2.16
TOTAL		1079	986	2065	2385	1485	1046	2531	24	152	298	234	1823	692	5561	2.33	8.03

TABLE 3: HOSPITAL EPISODE OUTCOMES

	Died	Discharged		Transferred		Total	%Transferred
Fatal at Scene	11	--		--		11	--
Admitted >7 days	2	132		20		154	12.9
Admitted 2-7 days	2	285		13		300	4.33
Admitted 1 day 4		231	3		238	1.26	
ED only	5	1818		5		1828	0.27
TOTAL	24	2466		41		2531	1.61

The outcomes at discharge from all hospital episodes. "Transferred" means transferred to another acute hospital for ongoing care, commonly for care not available in the ACT (such as severe brain injury rehabilitation services), rarely for ongoing care in a private hospital. The increasing transfer rate across length of stay groups is evidence that the groups represent a valid indicator of severity.

TABLE 4: INCIDENTS WITH POLICE RECORDS IDENTIFIED BY VEHICLES INVOLVED

Vehicles involved	Police Crash Record Matched	No Police Crash Record Matched	Total	%Police Crash Record Matched
Multiple Vehicles	712	42	754	94.4
Single Car or Larger Vehicle	227	17	244	93.0
Vehicle-Pedestrian	71	23	94	75.5
Single Motorbike	59	217	276	21.4
Single Pushbike	7	469	476	1.5
Other	3	3	6	50.0
Unknown	0	215	215	0.0

The proportion of total incidents by whether a Police record was identified and by vehicles involved. Multiple vehicle crashes and car (or larger) crashes occur on road are evidently routinely reported, but pedestrian incidents may be unreported because they occur in driveways. A large proportion of motorbike injuries, even those occurring on roads, are not reported, and pushbike crashes are almost never reported no matter the loacation.

TABLE 5: POLICE EPISODES ONLY – MOST SEVERE CRASH OUTCOMES

Nature of Crash	Admitted Injury	Emerg	Number of crashes	% Injury	Fatality	Admitted %Major >7 days	Admitted 2-7 days	Admitted 1 day	Only	Crashes
REAR END COLLISION		8903	1	4	6	9	193	2.39	0.06	
RIGHT ANGLE COLLISION		2474	3	20	27	17	176	9.82	0.93	
WITH PARKED VEHICLE		2371			7	2	12	0.89	0.00	
ONE VEHICLE REVERSE		2066		1	1		1	0.15	0.05	
ACUTE - SAME DIRECTION		1907		6	6	2	28	2.20	0.31	
STRUCK OBJECT		1678	4	19	19	14	108	9.77	1.37	
RIGHT TURN INTO TRAFFIC		1061	2	8	9	3	84	9.99	0.94	
OTHER		1056	4	14	10	8	35	6.72	1.70	
STRUCK ANIMAL		484		1	2	1	10	2.89	0.21	
ACUTE - OPPOSITE DIR		400		2	1		15	4.50	0.50	
OVERTURNED		239	2	8	11	8	35	26.78	4.18	
STRUCK PEDESTRIAN		215	2	16	9	7	31	30.23	8.37	
HEAD ON COLLISION		181	2	9	6	1	16	18.78	6.08	
FALL - MOVING VEHICLE		71	1	1	3		12	23.94	2.82	
STRUCK VEHICLE		66					2	3.03	0.00	
NO OBJECT STRUCK	35		1			1	5.71	2.86		
Grand Total	23207	21	110	117	72	759	4.65	0.56		

Relative frequency and severity of the natures of crash recorded on the Police database. Crashes are categorised by the most severe outcome, and major injury is defined as fatality or admission for more than 7 days. Although limited by under-reporting, particularly of motorcycle crashes, this illustrates the commonest collision (rear-end) is amongst the least severe. It also illustrates one limitation of such crash descriptions alone – of the four rear end collisions causing long admissions, one was a pedal cyclist struck from behind by a car at highway speed and three were motorcyclists.

FIGURE 1: AGE DISTRIBUTION OF PATIENTS

Age distribution of the individual car drivers and pushbike riders in the final database by severity of injury. Note the peak in serious injuries amongst pushbike riders 35-49 years, and note that 20-24yo car drivers not only have a high incidence of crashes, but also have the highest proportion of serious injury of any group under 75.

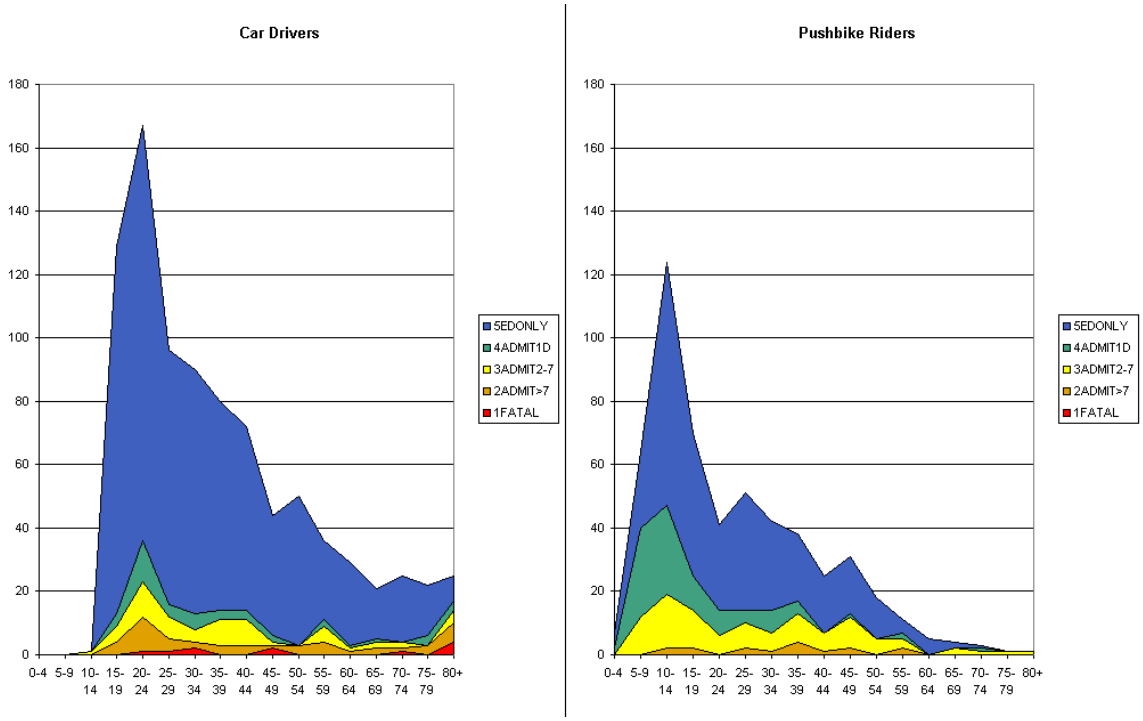

FIGURE 2: PATIENT EPISODES BY QUARTER

The number and severity of patient episodes by quarter of incident. The three graphs are to the same scale. Trauma on public roads has only a small seasonal component, being slightly greater in the first quarter, off-road trauma is slightly seasonal, and pushbike trauma is frequent but less severe, and markedly seasonal, reflecting the temperature of the Canberra winter.