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DEVELOPMENT OF DATA COLLECTION METHODOLOGY: CRASHES RESULTING IN HOSPITALISATION AND CASUALTY CRASHES NOT RESULTING IN HOSPITALISATION

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Abstract:

This report examines current casualty crash data collections and makes recommendations for improved data collection methodologies for crashes resulting in hospitalisation and casualty crashes not resulting in hospitalisation. Recommendations include the increased utilisation of health sector data as well as augmentation of police reported crash data.

Major recommendations include linkage of road crash databases with hospital morbidity files to improve data quality; use of hospital morbidity files to more accurately monitor serious injury rates; the application of AIS scoring to validate the severity of injury required for hospital admission; use of emergency department data to identify non-admitted crash victims for the purpose of enumeration; linkage of injury surveillance data with road crash databases to better describe crash types resulting in less severe injuries and to determine the extent of under-reporting in police reports; general practitioner sampling to estimate the proportion of G.P. attendances which result from road crashes.

Key Words:
road crash, surveillance, injury, hospitalised, emergency department, general practice, data collection, methodology

DEVELOPMENT OF DATA COLLECTION METHODOLOGY:

CRASHES RESULTING IN HOSPITALISATION

AND

CASUALTY CRASHES NOT RESULTING IN HOSPITALISATION

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May 1993

EXECUTIVE SUMMARY

There is widespread concern that current systems for collection of data concerning casualty crashes may be inadequate. That concern has motivated the Federal Office of Road Safety to commission this study and has provided the impetus for a number of other related studies. In the past much attention has been centred on fatal crashes and focused little on casualty crashes and even less on property damage only (PDO) crashes.

The specific objectives of this study are:

1. To explore the feasibility and utility of:

    - maintaining the status quo
    - augmenting/expanding and making uniform the existing database by including supplementary data from a range of possible sources
    - weighting the existing collection in areas where it can be shown to be under-representing road traffic crashes not resulting in hospitalisation
    - using a hospital based system possibly based on ISIS and CAS2 to create a new specific purpose data collection for casualty crashes
    - surveys of the general public
    - General Practitioner sampling to augment other systems
    - combinations of the above

2. To address the strengths and weaknesses of such systems for the purposes of both macro and micro level uses of the data.

3. To establish methods of validation and quality control for any proposed systems

4. To consider the ethical and privacy implications, particularly constraints on any proposed systems, and possible solutions

5. To provide an outline of the techniques and processes which would be required to develop such systems

6. To examine in general terms the relative costs of proposed systems

This study was originally structured as two projects relating respectively to casualty crashes resulting in hospitalisation and those not resulting in hospitalisation. They are reported together because of the large amount of common ground between the two projects. Options for improving data collection methodologies, beyond those in the project specifications, were also explored in consultation with FORS.

This report has identified a number of sources of data for casualty crashes, some in the road crash data area and others in the health data area. Differences between health and road data should be recognized. Health data are person based while Police road crash data are generally crash based. Health data provide good information on the nature and severity of injuries by road user type and broad categories of mechanism of injury. However, they provide no information on uninjured persons in the crash and there is an inability to link injured persons from the same crash, while road data provide little personal information on injured persons other than the driver (in some jurisdictions) such as postcode of residence. Little pre-crash information and no precise crash location are provided in health data. Police road data appear to be seriously under-reported in most jurisdictions, and the severity of injury appears to be poorly estimated.

It was not possible to identify a single alternative to the status quo for either part of the project which would meet all of the requirements of improved data collections. The choice of recommendations for implementation by FORS will be dependent on their specific quantitative or qualitative data needs.

The major issues addressed by these projects are improvements to the quantitative (counting) and qualitative (research) aspects of casualty crash data. Improvements to road crash statistical collections would be expected to lead to more accurate costing of crashes and may cause a change in direction of prevention programs if the size of the problem is found to vary from that previously understood.

General issues/conclusions related to data collection methodologies

1. Better utilisation of collected data

While most of the report focuses on the collection of data, it should be noted that the contribution that the data can make to prevention of crashes and resultant injuries is also determined by the use that is made of the data once it is collected. How much use is made of data depends on its availability (feedback), quality, ease of use and access to resources to examine the data and implement changes.

It should be noted that, for the purposes of intervention, a casualty crash data collection can be most effectively used if the appropriate exposure information is available.

2. Who pays and who benefits?

While it is relatively easy to identify and suggest improvements, there needs to be some consideration of why the improvements have not already been implemented. Often it is the case that the benefits and costs of improvements to these systems accrue to different agencies or different parts of the agency.

3. Interpretation of past research findings

Much road safety research has been based on the use of Police-reported crash data. This report has shown that these data have the following major problems: under-reporting and inaccuracy in coding of crash severity and lack of information on the nature of injury. The magnitude of these problems varies among jurisdictions and among crash types. Under-reporting is greater for crashes involving children and nonmotor vehicles.

4. Augmenting or improving the existing Police road crash databases

The two major problems which were identified were those of under-reporting and inaccuracies in coding (particularly of accident severity).

Requiring that Police accident report forms be filed as a condition of claiming third party injury insurance would increase reporting rates for crashes involving motor vehicles at least.

Standardisation of road injury data among jurisdictions has potential benefits but the likelihood of this occurring is remote (except for a small number of data items only). Thus while this would be a very helpful outcome, it is considered to be unlikely to occur and thus is not discussed in any detail in this report.

There would be some advantages if details of property damage only (PDO) crashes were made available for inclusion in the road crash data system. General information on PDO crashes is important for overall costing of traffic crashes, and in devising appropriate road and traffic engineering treatments. Moreover, Sanderson & Hoque (1987) estimated that costs associated with PDO accidents represent some 50% of the cost of all road crashes.

Recommendations for improved data collection methodologies for crashes resulting in hospitalisation

1. Linkage of road crash database and hospital morbidity file to improve data quality.

2. Use of hospital morbidity file to more accurately monitor serious injury rates from road crashes.

3. Abbreviated Injury Scale (AIS) scoring to validate the severity of injury required for patients to be admitted to hospital and the variability in this criterion across hospitals.

4. Augmentation of crash and hospital admissions databases.

5. Further research into the poor reporting rate of blood alcohol levels of road crash casualties attending hospital.

6. Inclusion of crashes reported to property damage insurance companies.

Recommendations for improved data collection methodologies for crashes not resulting in hospitalisation

1. Use of hospital Emergency Department data to identify non-admitted road crash victims for the purpose of enumeration.

2. General Practitioner sampling to estimate the proportion of primary (and repeat) GP attendances which result from road crashes and then scaling up using Medicare information on total numbers of GP attendances, or using emergency department presentations and hospital admissions for scaling purposes.

3. Use of Injury Surveillance System data to follow up injured persons not admitted to hospital.

4. Use of Injury Surveillance data to link with road crash databases to better describe crash types resulting in less severe injuries and to determine the extent of under-reporting of injuries of this severity in Police reports.

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PART 1:
ISSUES COMMON TO BOTH PROJECTS

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

It has been well documented that injury is the leading cause of death and disability in children and young adults and the leading cause of potential quality years of life lost (Graitcer,1987; Mackenzie,1989; Armstrong,1990). In Australia, road crashes contribute largely to this picture and create an enormous impact on public health. They are costly in terms of human resources and are a burden on the economy, being one of the leading causes of utilisation of acute hospital inpatient services.

In the past much attention has been centred on fatal crashes and focused little on casualty crashes and even less on property damage only (PDO) crashes. At present, we know little about the epidemiology of injuries and the determinants of injury outcomes and information is needed as the base to plan and evaluate injury control (MacKenzie,1989). If a more comprehensive national database with good quality data were constructed for crashes resulting in hospitalization and crashes not resulting in hospitalization we could gain a wider perspective on road crash circumstances and consequences.

Road crash data systems aim to gather comprehensive information about the location, road users and vehicles involved in crashes. Such information is necessary to ascertain the types of factors contributing to crashes and to identify possible countermeasures. In seeking to answer these questions using the road crash databases maintained by the road authorities, it is often apparent that crash location variables provide the richest and most accurate information and that available information about vehicles is less helpful. However, the latter can be augmented by linking with registration databases. Information about the road users is often sparse (Sweatman, Ogden, Haworth, Pearson and Vulcan, 1990). This applies particularly to non-admitted casualties, where non-inclusion of cases is the fundamental concern.

Relevant information on events, injuries and outcomes of road crashes is needed for the development of effective strategies to reduce the number and severity of injuries due to road crashes. It is the aim of this study to further develop a data collection methodology to indicate directions for future research and policy for interventions. The report will discuss the existing data sources, their uses and limitations and explore the feasibility and utility of linking a variety of data sources to develop an alternative collection methodology based on existing data sources. It will also explore the feasibility of other alternatives.

There is widespread concern that current systems for collection of data concerning casualty crashes may be inadequate. That concern has motivated the Federal Office of Road Safety to commission this study and has provided the impetus for a number of other related studies. Generally separate studies have been conducted by researchers and administrators in the road safety and health fields. Road safety studies have included an ongoing examination of Police road crash data by Andreassen and his colleagues (Andreassen, 1991; Andreassen and Evangelou, 1990), an examination of road crash data systems in Victoria (Drummond and Vulcan, 1989) and a number of less formal investigations as part of changes to road crash data systems. In the health field, there has been a number of investigations of the best way to computerise injury and other information, including ongoing development of a National Minimum Data Set. Recently, the National Injury Surveillance Unit issued a report proposing a Road Injury Program (O'Connor, 1992).

1.2 OBJECTIVES OF THE STUDY

The study aims to examine a wide range of methodologies for the collection of casualty road crash data and:

a) determine whether a feasible and cost-effective alternative to the status quo is likely to be available

b) if so, to describe the alternative collection methodology in sufficient detail to enable a pilot collection to be conducted.

It is acknowledged that an improved data collection system would have the following characteristics:

- Reliability and national consistency of the data
- Capacity to provide an unbiased estimate of national figures
- A comprehensive range of useful information available on each crash
- Timely
- Affordable
- Repeatability where sampling methods are used

Other more detailed requirements for an improved data collection system depend on the purposes for which it will be used. The simplest of the possible uses of an improved road crash injury database is to monitor crash frequencies. Outcome data are more difficult to obtain but are necessary to quantify the cost of serious crashes for countermeasure development and dealing with the public.

1.3 SPECIFIC OBJECTIVES

1. To explore the feasibility and utility of:

   - maintaining the status quo
   - augmenting/expanding and making uniform the existing database by including supplementary data from a range of possible sources
   - weighting the existing collection in areas where it can be shown to be under-representing road traffic crashes not resulting in hospitalisation
   - using a hospital based system possibly based on ISIS and CAS2 to create a new specific purpose data collection for casualty crashes
   - surveys of the general public
   - General Practitioner sampling to augment other systems
   - combinations of the above

2. To address the strengths and weaknesses of such systems for the purposes of both macro and micro level uses of the data.

3. To establish methods of validation and quality control for any proposed systems

4. To consider the ethical and privacy implications, particularly constraints on any proposed systems, and possible solutions

5. To provide an outline of the techniques and processes which would be required to develop such systems

6. To examine in general terms the relative costs of proposed systems

1.4. METHOD

1.4.1. Consultants approach

Work on the study commenced with a think tank meeting of MUARC staff, external consultants and FORS. At this meeting, additional knowledge of standard and possible supplementary data sources was pooled, and the issues identified in the objectives were explored and possible solutions proposed. The think tank determined relevant possibilities for improved data systems and rank ordered the preferred options.

A major output of the think tank was a set of "hypotheses for development of data collection methodologies". From this, a set of specific questions to be addressed in meetings with road safety and health authorities was developed (Appendix A).

Discussions were conducted with officials responsible for road crash data collection and health department officials in each State and Territory, covering the specific questions and other additional matters which were considered important.

As the study progressed, it developed more of the characteristics of an action research project. Input was made to the selection of items for a national uniform data set for Emergency Department data collections and members of the research team were called upon for advice in re-design of Police crash reporting systems. In addition, the possibility of establishing intersectoral links was increased by meetings held by the team.

Appendix B presents a list of organisations consulted regarding this project.

In addition a literature review was undertaken in relation to the various issues raised by the projects, such as data linkage, legal, ethical, and privacy issues, and costing systems. In depth discussions with road and health authority personnel often lead to new insights into the issues being studied and to further interviews with additional individuals. In the pursuit of information on hospital costing systems, it became apparent that attendance at the National Casemix Conference would be the most efficient method of obtaining detailed information. Attendance at the Conference, in turn, led to the identification of a widely applied system of data collection in general practice in the United Kingdom.

Finally, specific quality of data issues were explored directly by analyses of relevant data sets.

1.4.2 Overview of the report

Many of the general issues related to the development of data collection methodologies are the same for crashes resulting in hospitalisation and crashes not resulting in hospitalisation. For this reason, it was decided to structure the report into four parts:

- Part 1: Issues common to both projects
- Part 2: Development of data collection methodology: Crashes resulting in hospitalisation
- Part 3: Development of data collection methodology: Casualty crashes not resulting in hospitalisation
- Part 4: Conclusions and recommendations

Detailed contents pages, together with cross-referencing throughout the report, provides guidance to the comprehensive background material on which the recommendations are based. The status quo, against which the recommendations should be compared, is discussed in Chapter 2 and Chapter 8.

While most of the report focuses on the collection of data, it should be noted that the contribution that the data can make to prevention of crashes and resultant injuries is also determined by the use that is made of the data once it is collected. How much use is made of data depends on its availability (feedback), ease of use and access to resources to examine the data and implement changes.

In a number of jurisdictions Police commented that they collect data but there is little feedback to them. In NSW, Police commented about the lack of feedback from the Roads and Traffic Authority, hospitals or the Blood Analysis Section. This currently prevents linking crash statistics to location and timing of enforcement campaigns. In other states, the situation seems somewhat better (e.g. South Australia).

Police in several states commented on the data flow being largely upward through the hierarchy and the lack of feedback of statistical information to officers. In South Australia the Traffic Intelligence Section attempts to remedy this by issuing a regular newsletter.

CHAPTER 2. AN OVERVIEW OF CURRENT DATA COLLECTIONS

2.1. INTRODUCTION.

In recognition of the impact of road trauma there are established road crash information services in use at the present time, however these data sources seem not to meet the full needs of statistical information and prevention nor do they use the full potential of available data. In his project to determine the cost of various crash types based on data from a number of States, Andreassen (1991) found that there is still a lack of compatibility in what information is collected, how it is collected and how it is processed. There are, at present in Australia a number of data collection systems such as Police Accident Reports, Hospital Morbidity files, a National Injury Surveillance System, Ambulance Service Reports and others. Each collection is primarily for its organization's own purposes yet gives information on a variety of road crash and injury characteristics which is relevant to road safety research.

2.2. POLICE CRASH REPORTING SYSTEMS.

The Police reporting system provides detailed information of the crash site, circumstances of the crash, vehicles and persons involved, and persons killed or injured. These data are used for statistical and enforcement purposes and contain rich information collected at the crash site, however they give little information on casualty outcomes or demographic information beyond that of the driver as they are crash-based rather than injured person-based.

In each jurisdiction there is a legal requirement for crashes beyond defined severity thresholds to be reported to Police. Generally these crashes then become the subject of an accident report form. Copies of accident report forms from each of the jurisdictions are presented in Appendix C.

The data contained in the accident report form are used for Police prosecution and manpower purposes and in most jurisdictions a crash database is compiled from the forms by the Department of Transport or its equivalent. Current exceptions are the Northern Territory and Western Australia where the crash database is the responsibility of the Police Department, although the former is in a transitional phase prior to transfer to the Department of Transport.

Issues of compatibility of crash databases between jurisdictions have been discussed by a number of authors, including Andreassen (Andreassen, 1991; Andreassen and Evangelou, 1990) and Haworth, Vulcan and Wai (1991).

Police accident reports can result from Police attending a crash or be filled out at the Police station with details given by one of the crash participants. It is likely that the

former reports should be more detailed and accurate than the latter. Some Police accident report forms record whether Police attended the crash or the scene of the crash (e.g. NSW, Queensland, South Australia and Tasmania) but this variable is not always computerised (NSW, Queensland, South Australia). In South Australia, Western Australia and the ACT accident report information can be supplied by the motorist rather than Police.

2.2.1. Reporting criteria

The legal requirements for reporting a crash to the Police vary among jurisdictions in Australia. Some examples of reporting criteria and definitions are presented in Appendix D. The reporting criteria in each jurisdiction have three aspects: where, what involved and the outcome.

Where. In general, there is a requirement that the crash occurred on a road. Most jurisdictions use a variant of the Australian Bureau of Statistics criterion for accident location which is "The accident occurred on any road, street, thoroughfare, footpath, raialway level crossing, or any place open to the public" (ABS, 1988).

While this definition would seem to include accidents occurring in car parks and their access roads, most states do not include these locations. In the Queensland Department of Transport coding manual, for example, a road is commonly defined to include "the entire way devoted to public travel where that way is in a surveyed road reserve". It includes the carriageway, footpath, cycle path, median strip etc. but excludes (for example) off-road parking area, private property and roads closed to the public. In Victoria at least it was noted that an entrance to a car park is considered as a driveway, rather than an intersection. This may lead to anomalies if traffic control devices (sometimes electronic signals) are present. What are in reality intersection crashes are then coded as mid-block crashes.

What involved. In some states reporting is only legally required if a motor vehicle is involved. Thus it is likely that nonmotor vehicle crashes are more under-reported in these states. In other states (e.g. New South Wales, Queensland and Tasmania) crashes which involve a road vehicle (whether motorised or not) are required to be reported.

Outcome. In each state the requirement for reporting road crashes is dependent on the outcome of the crash. The outcome is generally expressed in relation to a threshold level of personal injury and/or property damage (see Section 2.2.6).

The characteristics of where, what involved and outcome sometimes interact in the reporting criteria. In Queensland, for example, crashes of motor vehicles with a particular outcome are "reportable road crashes" wherever they occur but crashes of nonmotor road vehicles are "reportable road crashes" only if they occur on a road.

The above discussion relates to what is required by law. Not all reportable road crashes are actually reported. The degree of under-reporting and factors which affect under-reporting are discussed in detail in Section 2.5.

Another discrepancy exists between the set of reported road crashes and the contents of road crash databases. Some databases contain crashes which do not fit their criteria for inclusion which are tagged as such. These may result from a crash which was considered to be intentional (such as suicide) or one in which the crash was considered to have resulted from a medical disorder (e.g. heart attack) or a crash which occurred off-road.

For example, the Western Australian accident data system contains a data item entitled accident scope. It is used to distinguish a normal road trafic accident from other types of accidents entered onto the database. It is coded in the following manner:

A Out of scope trafic accident e.g. suicide, driver collapse
T Out of scope - traffic e.g. pedestrian fell in street
R Out of scope - off-road location e.g. on private property
Blank Normal accident

Some crashes reported to the Police are not entered into accident databases. In NSW, for example, minor accidents can be reported to the Police on a P5 Self Reporting Collision Form which may be completed by each of the drivers involved. These accidents are not coded onto the accident database maintained by the Road Safety Bureau of the Roads and Traffic Authority.

2.2.2. Checks in data entry

In each jurisdiction there are inbuilt checks in the entry of data from accident report forms. Checks are made of impossible ranges or combinations of values and unlikely ranges or combinations. In NSW, for example, a warning appears when typing in "sex=female" for a driver of a truck.

In several jurisdictions the comment was made that there were not enough inbuilt checks in the entry of data from accident report forms but that decisions based on economics had been made, thus compromising quality control.
In addition to inbuilt checks, some jurisdictions undertake random quality control by recoding. Some jurisdictions undertake crosschecks with licensing and registration at the time of data entry (e.g. South Australia) but others do not (e.g. NSW).

2.2.3. Changes in Police reporting systems

In a number of jurisdictions, changes are being made that should result in Police entering data on-line at Police stations and further enhancement of the data being performed by road authorities. In NSW, the Roads and Traffic Authority (RTA) is developing a new data collection system which is expected to be fully implemented in 1993. It will feature on-line data entry at Police stations and enhancement by the RTA. The system will include licensing and registration as well as crash data.

There is a move towards introduction of a new crash reporting form (P5) which will be largely a self-reporting system. Information on this form will be largely confined to time, date and place. It is planned that crash reporting will be incorporated by the Police into a new computer system which will be called COPS (Computer Operations Police Service).

The Queensland Department of Transport (DOT) and the Queensland Police have recently made changes to the crash reporting system. There is a new Police accident report form (see Appendix C) which was due to be introduced from 1 October 1991. Police will enter data at stations and the resultant file be enhanced by DOT. The Police will use their file for court purposes and it will be downloaded to DOT on a weekly basis. The road crash database was managed by Australian Bureau of Statistics until July 1991, now this is responsibility of DOT. It is hoped that the new system will be considerably more timely, having a time frame of about two months for the entire system, with preliminary data being available before that time (the previous system had approximately six months lag).

The DOT is introducing a new ORACLE database system which will eventually contain driver licensing and registration data as well as the crash database. It will not be able to match repeated involvement of the same drivers in crashes, however.

In South Australia, discussions are underway between the Office of Road Safety and the SA Police regarding which data items should be retained on a new reporting form.

It is hoped that online data entry will allow easier querying of information on the accident report forms. It is anticipated that online querying of staff at Police stations may be possible. In addition, online data entry should improve the timeliness of data for Police-reported crashes.

In changes designed to allow online data entry by Police, methods for digitising the accident sketch have caused problems. While road authorities wish to retain the information on the sketch for accident classification, delays in solving the problems of digitising the sketch have meant that, in Queensland for instance, the Department of Transport has to be sent the back page of the Traffic Incident Report (accident report form) for coding. In NSW the new accident report form will have a tear-off section containing the narrative, diagram and details of location. This information will be used by the Roads and Traffic Authority for enhancement by the Geographic Information System and for coding of Definitions for Classification of Accidents (DCAs).

The Northern Territory Department of Transport will shortly assume responsibility for the Police reported road crash database from the Police. A review of data collected and computerised is likely to occur at that stage.

Compatibility across time

The occurrence of changes in road crash databases raises the possibility of problems in the compatibility of data across time. In Queensland, data back to 1986 have been loaded onto the new system in an attempt to avoid this problem.

Incompatibilities may arise without changes in the database, however. In Victoria, a change in the wording of the injury severity item by Police resulted in an overestimation of hospital admissions. Attempts have been made to recode injury severity to avoid this problem but a completely satisfactory solution has not been reached.

2.2.4. Data items poorly reported

A number of overseas studies of the accuracy of Police road crash data have been conducted. Shinar et al (1983) compared Police records with those of an in-depth crash investigation team. They found that Police data were most reliable for location, day of week and number of drivers, passengers and vehicles involved. Police data were least reliable for vertical road character, accident severity and road surface. Errors were also observed in coding driver age and vehicle model.

Discussions with database managers in the road authorities identified a number of data items which they consider are too often inaccurately recorded or missing on Police report forms. A number of possible reasons were cited for poor reporting of these items:

- the information may not be directly available to the Police (particularly if Police do not attend scene at time of crash). For example, seat belt wearing can only be checked directly if the occupant has not been able to move from the seating position

- the design of the accident report form is misleading or does not contain adequate or appropriate categories

- there is inadequate follow-up for information that is not available at the time of the crash (e.g. hospital admission, drivers licence number if not carried by driver)

- mistakes are made in transcribing information (e.g. registration number, licence number).

Data items which database managers in one or more jurisdictions noted as having problems with recording were:

- Injury severity
- Blood alcohol concentration
- Vehicle type (buses, trucks)
- Location (midblock country)
- Drivers licence number
- Drivers licence status
- Drivers licence type
- Vehicle registration number
- Year of manufacture
- Loading/ capacity
- UN Hazchem number

- Traffic control
- Age (infants less than 1 year)
- Definition for Classifying Accident (or Road User Movement Code)
- Seatbelt wearing
- Traffic signal operation and number
- Contributory circumstances

Location of midblock country crashes, traffic control and year of manufacture were mentioned as problem data items by road authorities in three jurisdictions. Because of their importance, accident severity and blood alcohol concentration data are described in more detail in a later section.

2.2.5 Data items not considered worth collecting

It has been noted that there is currently less information on the Police accident report form than in the past. Information that has been dropped includes items relating to defects, speed and damage estimates (Victoria). In a number of jurisdictions, Police would prefer to minimise the number of data items that must be collected by their officers. This has encouraged discussions of what data items are worth collecting and whether they should be collected by officers or incorporated later by merging with other databases.

Many jurisdictions favour retaining road geometry information on the form because of poor linking at this stage with road geometry databases. Officials differ as to whether it will eventually be possible to get all this information from the database, rather than asking Police to record it.

Discussions with Police and database managers identified the following data items which at least some representatives considered might be able to be dropped from the accident report form:

- wet vs. dry road
- sex
- view
- adjacent land use
- other traffic controls
- experience of the controller

In some jurisdictions it was considered that coding of rain made coding of wet vs. dry road superfluous. In Tasmania, the road must be coded as wet if rain is coded.

In addition, in many jurisdictions there are data items which are collected by Police but are not incorporated into the road crash database. In Queensland, all items are computerised onto the Police database but some of these items are not kept on the DOT database.

The data items collected but not computerised in at least one jurisdiction are:

- Witnesses

- Police administrative details
- Police attend scene
- Driver address
- Driver occupation
- Name of owner of vehicle
- Names, addresses, uninjured
- Vehicle damage
- Property damage
- Phone numbers
- Responsible party
- Estimated speed
- Colour of vehicle
- Model of vehicle
- Make of vehicle
- Nature of injury
- Hospital taken to
- Accident description
- Accident sketch
- Notebook number and page

The data items most commonly collected in the Police accident report form but not computerised are names and addresses (whether of witnesses, drivers, owners, injured or uninjured persons) and the accident sketch.

2.2.6. Coding of injury and accident severity

The road crash data systems in each jurisdiction code both injury severity and accident severity. The injury severity variable describes the extent of injury to each person and is coded for each person in the crash. For each crash, the most severe injury severity among the persons in the crash is selected and coded as the accident severity variable. If one person was admitted to hospital and two persons were treated but not admitted in a crash, then the accident severity of that crash would be coded as "hospital admission".

The uses of injury severity and accident severity data differ. The injury severity variable is used to count the *number of casualties* admitted to hospital but the accident severity variable is used to count the *number of crashes* resulting in admission to hospital. Accident severity is commonly used as a criterion for selecting crashes for inclusion in particular road safety studies. This approach is generally taken in recognition that the completeness and quality of data coding are better for more severe crashes. Thus it is important to examine how accident severity is coded and how accurately it is coded.

To understand the limitations of the current coding of injury and accident severity, it is important to remember that the data goes through two stages in most jurisdictions, first it is coded by the police on the accident report form and then this form is recoded to some extent by the road authority managing the database. The categories used for coding injury severity sometimes differ between the accident report form and the

database. Importantly, the accident severity variable does not always have the same categories as the injury severity variable.

Injury severity is recorded on the Police accident report form in each jurisdiction but accident severity generally is not. It is commonly derived and coded later by the road authority managing the database.

The database in each jurisdiction has a variable for accident severity but the categories used for coding accident severity vary. The categories used for coding the accident severity variable do not allow crashes resulting in hospitalisation to be directly identified using this variable in South Australia, Western Australia and the ACT. However, they can be identified by further manipulation of the injury severity variable. In the past, the variable "Injury" has been missing for a significant number of crashes in the Northern Territory, making identification of crashes resulting in hospitalisation difficult.

Crashes not resulting in hospitalisation (defined in this study as treatment in a hospital Emergency Department or by a general practitioner) can be identified from the accident severity variable in NSW, Queensland and Tasmania. In most other jurisdictions these numbers could be derived from the injury severity variable.

The accuracy of Police coding of injury severity differs among jurisdictions. In NSW, matching of data from the road crash database and hospital records found that injury severity was accurately coded where cases could be matched (Helby and Thomson, 1991). A comparison of numbers of hospital admissions according to the Police and the hospital morbidity file in Victoria (presented elsewhere in this report) suggests that Police in Victoria overestimate injury severity. In Tasmania the Police will often ask the ambulance officer for his or her assessment of severity of injury. Officers will usually attend the hospital if in the metropolitan area and may speak with a doctor. This practice of validation varies from State to State. Police do not follow up hospitals in Queensland, for example.

2.2.7 Blood alcohol concentration data

All States and Territories have a legal requirement for compulsory blood or breath alcohol concentration (BAC) testing of persons killed or injured in road crashes. BAC data are generally far from complete in the road crash data systems, however. There are a number of reasons for the large amount of missing data which include:

- a number of exemptions to the requirement apply (e.g. in the case of persons below a certain age)
- samples are not always taken
- samples are sometimes spoilt or lost
- failures in linkage of hospital and Police BAC files

Generally, data quality is better for more seriously injured persons and little data are available for passengers. The percentage of BAC data which is missing differs among jurisdictions, however, being least in NSW and South Australia and greatest in Queensland (Rechnitzer and Haworth, in preparation).

Blood alcohol data are collected for a range of reasons, not just after crashes. These include random breath testing operations and by Police mobile patrols, either as a result of a random check or because of poor driving attracting Police attention. Vaughan (year unknown) stated that drivers breath tested following involvement in a collision comprised only 16% of all breath test data held by the Traffic Alcohol Section of the Victoria Police.

Accessibility of blood alcohol data has been limited in some jurisdictions. The degree to which it is collected as well as computerised differs among jurisdictions. In Victoria, for example, the Traffic Alcohol Section of the Victoria Police has the responsibility for breath testing and compulsory blood testing. Records at this section were computerised from July, 1987 and all breath tests and blood samples are now recorded on computer. Unfortunately the blood testing records cannot be classified by class or age of road user (Vaughan, year unknown).

2.2.8 Further scope for improvement

The progressive incorporation of new technology into the reporting system together with the selective inclusion of a few key variables which better allow comparisons or linkage with other data systems should be considered.

Clip board computers

Although this equipment is expensive (estimated US$5,000 each, at least during its early stages of development), direct data entry at the crash scene will have a number of benefits. A single step process for data recording and entry would provide cost savings. In addition, it is likely that data would be more complete and more accurate when entered immediately into a menu driven program. Trials of clip-board computers for road crash data are currently being undertaken in the United States, and should be monitored for cost/benefits. One obvious benefit is the reduction in time spent on the duplication of handling of data by police and support staff.

Demographic information for all occupants

The inclusion in police reports of two additional simple data items on vehicle occupants would greatly enhance the potential for linking police reported data with that of the health care system, or simply for comparisons between the systems. Date of birth is recorded for the driver in all jurisdictions, as is their post-code of residence, or information leading to the post-code. These items should also be recorded for all other occupants (particularly casualties). Although the costs for such inclusions would be minimal, these items may be seen by police and road authorities as of little direct value.

2.2.9 Time lags

Road crash data systems generally have very short time lags for fatal crashes and much longer time lags for casualty crashes. An overall time lag of six months is not

uncommon among jurisdictions. An analysis of time lags in the Victorian system (Drummond and Vulcan, 1989) showed that the number of reported injuries in a given month grew by about 10 percent in the metropolitan area and 6 percent in country districts in the five month period commencing some 30 days after the end of the month.

The changes in Police reporting systems described in Section 2.2.3 are expected to improve the timeliness of data collection in at least some jurisdictions. Other methods of improving timeliness which were suggested by Drummond and Vulcan (1989) include:

- improved design of accident report forms
- reinforcing requirements about reporting injury accidents by the end of the shift
- reinforcing prompt data entry of all injury accident reports
- a scaling up of accident numbers to an estimated total which includes expected late entries to the system. Monitoring of actual late entries could be used to check the weights used in the scaling process.

2.3. INSURANCE COMPANIES

Third party injury insurance is compulsory in each State and Territory. Motor vehicle insurance is not compulsory, however. State comparisons of these forms of insurance have been published by the Australian Automobile Association (Australian Automobile Association, 1991).

2.3.1 Third party injury insurance

Compulsory State-run third party motor vehicle injury insurance schemes currently exist in Victoria, South Australia, Western Australia, Tasmania and Northern Territory. The Transport Accident Commission administers third party injury insurance in Victoria. In South Australia the State Government Insurance Commission is the only provider but legislation allows all approved insurers to apply for a licence. The Motor Vehicle Insurance Trust existed in Western Australia until 1 January 1987 when it amalgamated with the State Government Insurance Office to form the Motor Vehicle Personal Injury Division of the State Government Insurance Commission. In Tasmania the Motor Accidents Insurance Board is responsible for third party injury insurance.

A compulsory State-run third party insurance scheme (called TRANSCOVER) operated in NSW in the past. In NSW, the Motor Accidents Authority (MAA) now supervises and controls the third party personal injury scheme implemented by the Motor Accidents Act 1988. The main functions of the Authority are to monitor the third party insurance scheme, to monitor and license insurers, to fund initiatives designed to prevent and minimise road accidents, and to advise the Government on the operation of the scheme.

NRMA Insurance Limited is the sole insurer authorised to conduct third party insurance in the ACT.

Data collected by third-party injury insurance schemes

The usefulness of the data collected by third-party injury insurance schemes is influenced by its scope and availability.

Data scope. The scope of the data can be assessed according to the proportion of injury crashes which are contained in the database and the range of data items collected.

Third party injury insurance, whether run by the State or privately, commonly does not cover injury resulting from a transport accident during the course of work. Thus one would not expect the insurance databases to include most truck crashes in which the driver only was injured. These crashes will not be found in the third party injury insurance database but should be recorded in a workers' compensation database. It is likely that workers' compensation databases contain some detailed information about pre-crash events, trip purpose and vehicle type which are not coded elsewhere.

Where there is a compulsory State-run third party injury insurance scheme, it can be assumed that most of the injury crashes in that jurisdiction will be included (where treatment costs exceed the threshold for benefits). Crashes which were not reported to Police will not be included, because this is a requirement of lodging a claim. While this requirement acts as an incentive to report crashes, there may be a small number of crashes, particularly single vehicle crashes for which the driver is responsible and only the driver is injured, for which no claim is lodged.

Private companies, on the other hand, have data only for their policy holders. Thus the data scope is limited by their share of the market. In addition, policies of some private companies may not be "no fault" and so coverage of crashes for which the insured is culpable and no-one else is injured may be poor. It is unclear whether injury crashes reported to a particular company can be held to be representative of injury crashes.

While the scope of crashes in State-run third party injury insurance databases is greater than that of privately-run schemes, it still differs from the scope of the road authority database. The insurance database contains crashes which involved a vehicle registered in that state (regardless of where the crash occurred) whereas the road authority database contains only crashes which occurred in that state (regardless of the state of registration of the vehicle). Thus crashes involving interstate vehicles will differ in where they are recorded in the two systems.

In general, third party injury insurance databases contain much richer short and long term outcome data than do road crash databases. Much of the data is in terms of costs of treatment and so it has potential for providing information about the costs and consequences of various kinds of injuries.

Data availability. A State-run scheme has the advantage for data analysis of containing a large number of records in the same format. Combining data from a

number of private insurers would require much effort to produce a standardised format, even if permission to access these records could be gained.

In NSW, there has been an attempt to maintain data in a standardised format despite privatisation of the third party system. The Motor Accidents Authority maintains a central Claims Register and Statistical Database which contains information on claims incurred since the scheme commenced on 1 July 1989. Data are supplied to the database by each of the private insurers (there is some concern about data quality). The database is primarily designed to allow insurers to investigate the occurrence of fraud and to enable this, some data from previous schemes has been incorporated.

The data consist of records which detail:

- the time and location of the accident
- vehicles involved in the accident
- people involved, including:
  - * drivers of vehicles in the accident
  - * owners of vehicles in the accident
  - * passengers in vehicles
  - * claimants (injured parties)
  - * witnesses
  - * pedestrians if involved in some way.

In addition to combining data from different insurance companies, it would be advantageous to match this data with Police reported data. The ability to combine information from third party injury insurance and road crash databases depends on whether the insurance scheme or company requires that a Police report be filed (this is so in NSW and Victoria, for example) and whether the accident number is recorded on the insurance database. Many third party injury insurance databases do not include accident number because the Police accident report form is not pre-numbered and it is not numbered until the form reaches the road authority. However, in some jurisdictions the Police are changing to pre-numbered forms.

Insurance data have some similarity with hospital data in that they are claim-based (like casualty-based), rather than crash-based. If multiple claims arose from a single crash (particularly on separate policies), counting of crashes might not be possible.

Current usefulness of insurance data and future possibilities

Crash details from third-party injury insurance data would be useful if they were more complete than Police-reported data or if the quality of data was better. Because many insurance companies and schemes require Police accident report forms to be lodged, it is unlikely that the insurance databases would include a large number of crashes not reported to Police. On the other hand, many injury crashes which are reported to Police may not be the subject of an insurance claim (if the cost threshold is not reached or the sole driver is at fault and not injured).

In some aspects, the quality of insurance data may be superior to that from Police reports. These aspects include details of injuries sustained and short- and long-term treatment required. For those cases for which a claim is lodged, whether or not the person was admitted to hospital should be well-recorded.

Thus, currently there is little scope for a widespread use of insurance data to count crashes but it may be useful for investigating patterns of injury and long-term consequences of more severe crashes.

An ideal method to improve data collection for casualty crashes involving motor vehicles would be the establishment of a national third-party compulsory injury insurance scheme. Such a scheme would require Police accident reports with each claim and would record the accident report numbers to facilitate matching of data. This would greatly enhance methodology for data collection. A comprehensive range of useful information on each crash would be available and national road crash data could then be consistent. Unfortunately, the future of even State-run third party insurance schemes is currently uncertain. In a number of jurisdictions a change of government could lead to privatisation of the scheme, as occurred in New South Wales.

2.3.2 Motor vehicle insurance

Motor vehicle insurance is offered by a range of Government- and privately-owned insurance companies. There are multiple providers in each jurisdiction.

The overlap between crashes reported to motor vehicle insurers and those in the road crash databases is likely to be less than was the case for third party injury insurance. First, not all claims are crash-related. Many relate to theft or damage, broken windscreens or fire. Secondly, not all crashes result in claims because the imposition of excesses and no claim bonuses makes claiming uneconomic in many cases. The result of this may be to limit claims to the more severe crashes and further biases may occur. Because larger excesses apply to younger drivers, claims submitted by these drivers (or owners of vehicles driven by these persons) may relate to more severe crashes than claims of older drivers.

In general, private insurance companies collect data for profitability reasons which is rarely in a form directly useful for injury prevention. RACV Limited conducted a study (Sanderson and Hoque, 1987) which showed the need for considerable recoding of their data if it were to be useful for road safety purposes. Recent experiences with another major insurer have confirmed this finding. The RACV study concluded that a number of changes to their data recording would be needed to allow useful analysis of crashes. These included:

- improved location information, particularly for mid-block crashes
- more detailed sketch and narrative, showing vehicle movements
- additional information on injuries incurred by occupants of insured vehicle
- introduction of information on part of vehicle damaged
- introduction of items such as day of the week, road conditions and light condition
- cost of damage to all vehicles involved (not just the insured vehicle)

In addition, the Insurance Council of Australia appears to have a much lower level of interest in prevention than its counterpart in the United States, which has established the Insurance Institute for Highway Safety.

The bulk of crashes reported to motor vehicle insurers do not involve injury. However, information about property damage crashes is generally patchy in the road crash data systems. Such information is important for the overall costing of traffic crashes and devising appropriate road and traffic engineering treatments.

In summary, third party injury insurance data have the possibility of improving the detail of injury and outcome information about road crashes whereas motor vehicle insurance data may help to improve counting of overall (not just injury) crashes. Workers compensation schemes should not be overlooked as a source of data for work-related road crashes.

2.4. OVERVIEW OF HEALTH DATA

The National Committee on Health and Vital Statistics held a forum in February 1991 attended by health service researchers, epidemiologists, statisticians, consumer and community groups, health professionals and others to consider the state of Australia's health information systems and provide advice on the development of national health statistics.

If national statistical systems are to realise their full research, management and evaluative potential, they need to be standardised in ways which will permit regional, state and international comparisons. Currently, the development of adequate national databases is often limited by issues of ownership, confidentiality, incompatibility and inability to pass data from its site of collection to the point of national aggregation. As a consequence many data collections cannot be utilised on a national level.

It has been proposed that the National Health Information Agreement would provide for the establishment of a long term strategy on the improvement of national health data collection, and its linkage to health policy development. Standardisation across States and Territories and improved access to Registrars' data are essential prerequisites to improving the system. In addition, the ability to link data through individual identifiers across various databases is needed in a number of areas. The forum has identified some of the issues to make better use of existing data. Some of the key issues are to make better use of existing data, to ensure that existing data sources are linkable and that linked data sets be made available for epidemiological and health services analysis and research.

While computerised data are kept for all cases of hospital admission, emergency department databases are generally non-existent, and where available tend to be separate systems from admission databases.

It should be emphasised that hospital admission and presentation databases are person based, whereas road crash data are crash based.

2.4.1. Hospital Morbidity File.

The Hospital Morbidity File is a comprehensive collection of all public hospital admissions which records a "mechanism of injury" code (International Classification of Diseases 9th Revision, 1978) for each injured patient admitted to hospital. In addition, the hospital admission system contains further information such as length of stay and destination on discharge, detailed diagnosis information and limited information on injury outcome. The potential for Abbreviated Injury Scale (AIS) coding exists, with increasing potential for reliable electronic conversion from diagnosis codes (ICD-N codes).

Within Hospital Morbidity File data, it is possible to identify and exclude from datasets: deaths, re-admissions and transfers.

Little crash data beyond road user type, and general information such as collision or non-collision data are available in health sector databases. In the case of hospital admission data, location of crash, occupant seating positions, and details of uninjured persons are lacking.

On the other hand, the detailed diagnosis information provided is of particular interest. For prevention strategies in the future, it may be of considerable importance to identify the body system or body part which was injured, or whether the injuries were multiple. This sort of information can lead to hypothesis generation for further studies if not to direct policy decisions. Diagnosis data could also provide the basis for Abbreviated Injury Scale coding (AIS coding) which quantifies injury severity for comparative purposes (eg outcome or cost) using an internationally agreed scoring system (American Association for Automotive Medicine, 1990). A small number of Australian major trauma hospitals are already undertaking routine AIS scoring for selected admitted patients (Westmead, NSW; Alfred, Victoria), and this practice is widespread in the United States.

2.4.2. Injury surveillance

Surveillance is "the ongoing systematic collection, analysis and interpretation of health data needed to plan, implement, and evaluate public health programs" (Graitcer, 1987: 191). Injury surveillance systems are an essential part of injury research and need further development to become an integral part of road safety. In the last ten years efforts have been made to develop surveillance mechanisms that provide meaningful and useful information on which to develop policy decisions, preventive and control measures for injuries and program evaluation. Injury surveillance systems often combine data obtained from several data sources to compensate for inadequacies in individual sources and to improve the system's overall uses.

In 1986 the National Injury Surveillance & Prevention Project (NISPP) commenced as a 3 year pilot study funded by the Commonwealth Health Department (referred to later in this document as National Injury Surveillance Unit [NISU]). A small number of participating hospitals within Adelaide and Brisbane were used as the original data

collection sample and more recently the project was extended to Western Australia, Victoria, New South Wales, ACT and Tasmania. Now, in each state a small number of metropolitan hospitals, sometimes supplemented by rural and special purpose collections, are used as the data collection regions (Ozanne-Smith et al., 1991). The fundamental aim of the current National Injury Surveillance Unit is to identify local injury patterns within each state, however it does not provide comprehensive injury surveillance of whole states. It should be noted that the data are generally self reported by the injured person, with the treating doctor providing diagnosis and treatment details.

In Victoria an important step towards improvements in the collection, availability and computerisation of injury data was the commencement of the Victorian Injury Surveillance System (VISS) in January 1988. VISS is one of the most developed state injury surveillance systems. Such a system is necessary to provide quantitative estimates of injury morbidity and mortality, detect clusters of injury events, and identify factors in injury occurrence. Detailed injury data are collected from five hospitals around the Melbourne metropolitan area and two hospitals in the Latrobe Valley, encoded and stored in a computerised database (ISIS). This database has been used to identify a range of factors that assist in understanding how injuries might be prevented, and to give clues about problem areas which require further, more detailed investigation as well as monitoring the effectiveness of specific interventions (Ozanne-Smith, 1992).

In terms of casualty crashes the Injury Surveillance System provides useful information including some pre-crash information and circumstances of injury in the presenting patients at Emergency Departments at participating hospitals. This system enables the circumstances of each injury to be identified, thus the events and behaviour preceding the injury can be identified as well as the actual mechanism of injury. It also provides a high level of detail regarding various types of injuries and allows for specific identification of hazards (such as finger jams in vehicle doors). However, it falls short of describing the details of the crash site or nature of the crash beyond road user type, vehicle type, seating position, restraint use, and, in some cases, make and model of vehicle.

The following material provides an example of the detail of information the VISS database can produce. It focuses on injured children presenting to VISS hospitals during 1989 - 1991 (aged 0 - 14 years inclusive). Information is available on the proportion of injury cases that are admitted to hospital following presentation at the Emergency Department. Hospital admission cases are thus regarded as an index of injury severity in that they comprise the more serious injury cases.

Of the 42,994 children presenting to VISS hospitals during 1989-1991, 11% were due to road trauma. Of these road trauma casualties, 24% required admission to hospital for further treatment. The largest injury category overall was falls (35%). This ratio of presentations to admissions can be determined for all age groups by road user type using ISIS data.

Table 1 refers to the types of road users between the ages of 0 - 14 years (inclusive) injured in a transportation related accident who presented to VISS hospitals during 1989-1991. Some of these injuries may have occurred off-road. As can be seen,

more male children presented and were admitted to hospital than females. Of importance is the finding that male bicyclists comprised the most frequent type of male road user to present to hospital with an injury (56%) Females also tended to be injured as bicyclists making up 40% of female road user injury cases. Note, that the bicyclist was the most frequent road user injured overall and made up 51% of all road injury presentations. This was followed by vehicle occupants who made up a further 27% of injury presentations. Of interest is the finding that although pedestrians made up only a small number of transport related injury presentations (16% of all transport related injuries), 25% of hospital admissions were pedestrians. This can be further expressed by the finding that 37% of the 777 children injured as pedestrians during 1989-1991 incurred injuries severe enough to warrant hospital admission.

When VISS data are restricted to motor vehicle accidents and road traffic accidents, the number of injury cases during 1989-1991 drops to 3072. Figure 1 shows these data as a function of sex, age and type of road accident (i.e., road trauma involving a motor vehicle and road trauma not involving a motor vehicle). As can be seen, there is an overall trend for more males to present to hospital with injuries than females. Furthermore, the frequency tends to increase with age, whereby a gradual increase is shown in the 'involving motor vehicle' group, and a sharp step-like increase in the 'not involving motor vehicle' group. There is a less marked increase with age for females with injuries not involving a motor vehicle than for those involving a motor vehicle. Hence, the general disparity between males and females tends to be more apparent in the 'not involving motor vehicle' group (i.e., the difference between males and females in each group is greater for the 'not involving motor vehicle' group).

Table 1. Types of road users injured in a transportation related accident who presented to a VISS hospital during 1989-1991 as a function of sex and disposal from hospital (n = 4758).

Type of road user injured	Hospital Presentation (includes admissions)			Hospital Admission and deaths		
	Male	Female	Total	Male	Female	Total
Pedestrian	467	310	777	183	106	289
Bicyclist (incl passenger)	1722	683	2405	365	121	486
Motorcyclist (incl passenger)	178	23	201	41	4	45
Vehicle Occupant	635	644	1279	160	143	303
Other	61	35	96	17	5	22
TOTAL	3063	1695	**4758**	766	379	**1145**

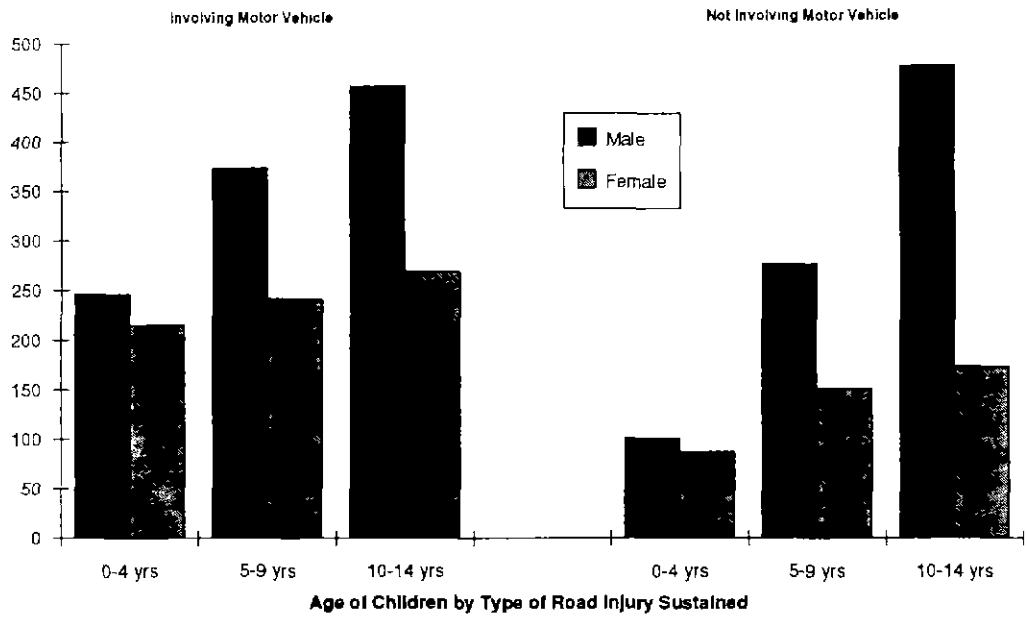

Figure 1. Number of children between the ages of 0-14 years (inclusive) who presented to a VISS hospital (including hospital admissions) during 1989-1991 as a function of age, sex and type of road injury sustained (N=3068).

2.4.3. Ambulance

Ambulance reports are completed for crashes attended by the Ambulance service. These include information on the origin, destination, time taken and medical care provided on-site and en-route, medical information relating to the injured person and they provide a link between police and hospital data sets.

Often an ambulance will arrive before a Police vehicle and may be involved in removing the injured person from the vehicle. Thus ambulance officers have the potential to collect more accurate information on restraint use than do Police officers. Encouraging Police officers to ask ambulance officers about seat belt wearing status of injured persons could improve accuracy of seat belt wearing data.

Researchers in Western Australia incorporated ambulance data in their data linkage. Linkage to health data is of interest to examine effects of time to receipt of medical care but the utility of other aspects of ambulance data remains to be investigated.

2.4.4. Other

Other sources of data regarding road crashes include records of vehicles towed away which are maintained by the Tow Truck Allocation Scheme (at least in Victoria) and a number of registers of serious injury. These registers collect detailed information on particular types of injury (e.g. multiple trauma, spinal cord injuries or head injuries), some of which result from road crashes. Currently these registers provide detailed information but lack coverage of the population.

2.5. DEGREE OF UNDER-REPORTING

One fundamental issue concerning traffic safety and analysis is the degree of under-reporting. As noted by Harris (1990), "we road safety researchers do not know the size of our own field of study". He goes on to conclude that researchers do not know the true population of road traffic accidents.

In another overseas study, James (1991) reviewed a number of studies of under-reporting of road crashes. In general, these studies have compared crashes reported to Police and persons injured in road crashes that have been identified from hospital records. She concluded that not all crashes which are legally required to be reported to Police are indeed reported. Reasons for this included:

- ignorance of the legal obligation to report
- perception that the crash was too trivial
- the victim did not become aware of their injuries at the scene of the crash.

James summarised the factors affecting Police reporting and accuracy of Police data as follows:

- children's accidents were less often reported
- children were likely to be involved in pedestrian and bicycle crashes which are often under-reported
- under-reporting greater for bicyclists and motorcyclists and pedestrians than vehicle occupants
- levels of reporting were higher if a motor vehicle was involved in the crash
- under-reporting greater at lower severity levels
- some minor injury cases may get into Police database but not be treated at hospital and so not be in hospital database.

Although motor vehicles are used as the instrument in many cases of suicide attempt - by means of carbon monoxide poisoning - such deaths and injuries are uniformly excluded from motor vehicle casualty data. In Victoria, for the year 1989/90, there were 83 deaths from car exhaust gassing (Henderson, 1992).

2.5.1 Children and motorcyclists

The hospital admission system has the advantage of achieving more comprehensive ascertainment than the police reporting system, at least in some areas. This has been demonstrated by a MUARC study of child and adolescent injuries which identifies marked under-reporting of injuries to motorcyclists in this age group (Ozanne-Smith et al, 1991). The findings of this study are detailed below. A low police report rate of 37% for single vehicle injuries to motorcyclists across all age groups has previously been identified in the United Kingdom (Turnbridge et al, 1988) and similar under-reporting to the police of non-fatal motorcycle related injuries has been reported in the United States (Baker et al, 1984). Many other reports of under-reporting of road crash injuries are identified from the relevant literature by Fildes (1986).

Agran and Dunkle (1985) pointed out that under-reporting of injury is greater for noncrash (noncollision) accidents than crashes. Noncrash events are defined as traffic accidents in which injury occurs as the result of the vehicle (sudden stop, turns, swerves etc.) or passenger (loss of balance, opening doors, falling out etc.) manoeuvres in the absence of impact with another object or vehicle. Thus they include both the ICD-9-CM definition of "Noncollision motor vehicle traffic accidents" (E817 and E818) and similar events that occur when the vehicle is not on a public road.

An earlier study compared numbers of children injured according to a hospital emergency room monitoring system and according to Police accident report forms (Agran and Dunkle, 1980, 1981). The hospital data showed that 15% of motor vehicle injuries to children were incurred in noncrash events but in only 20% of these cases had a Police accident report been filed. In contrast, Police accident reports had been filed in 90% of crash cases.

In their later study, 19 noncrash events resulting in injury to children under the age of 14 occurred in the county during the 15 month period of the study, according to Police data. In contrast, monitoring of nine major hospitals in the county identified 53 noncrash cases. Only seven cases were identified through both methods.

How did the Police-reported and non-reported cases differ? Eight of the cases not reported to the Police did not occur on a public road (19%). The cause of the accident differed somewhat: 47% of the Police-reported accidents occurred when the motor vehicle was making a turn, in contrast to 28% of the non-reported cases and 46% of the non-reported cases occurred when the vehicle was stopping, compared to 26% of the Police-reported cases. Children in the non Police-reported cases were generally younger. Police-reported cases more often involved children riding in non-passenger locations (luggage areas, backs of trucks etc.) than non-reported cases. This may partly explain the most striking difference between the two samples which was the much higher rate of ejection (compared with interior impact) in Police-reported cases.

Overall, injury severity levels were similar for Police-reported and non-reported cases. Both samples included MAIS scores of up to three. Thus it is not the case that injuries not reported to Police were necessarily less severe.

2.5.2 Injury severity

Under-reporting is usually most marked at low injury severity levels. Harris (1990) found that injuries reported by police were very incomplete (only 24% of the survey total of 210,00 injuries were reported). Similarly, Greenblatt et al. (cited in Harris, 1990) used a similar method of comparison as Harris and found that police recorded 79% of all inpatients as sustaining an injury, but only 26% of all outpatients and only 11% of those not needing hospital treatment in the US as sustaining a slight injury. From this, Greenblatt et al. concluded that police coverage of injury cases declines rapidly with decreasing injury severity. Tunbridge and Everest (1988) found similar trends in the UK.

In a local study, Searles' (1980) comparison of official statistics and a random sample of 'comprehensive' insurance claims revealed that officially coded crashes form a small, non-uniform sample of the crash population. Searles selected a sample of "comprehensive" insurance claims at varying rates from seven National Roads & Motorists' Association (NRMA) in the Sydney area, compared details of reported and unreported crashes and estimated the population of coded, reported and unreported crashes, total vehicle repair and personal injury costs. Through these comparisons Searles also noted that the total vehicle repair costs for crashes which are notified to insurance companies and do not appear in the official statistics is almost double the repair cost of the officially coded crashes.

Police Reports in most states are only completed when the Police have attended an accident site. It is not surprising then that there are large numbers of crashes, especially property damage only (PDO) crashes, that are not included in official statistics. It has been estimated that over 75% of crashes which occur in Sydney and which are reported to insurance companies are not reported to the Police (Searles, 1980).

In each jurisdiction, under-reporting is least for fatal crashes, and increases with decreasing accident severity. For example, VicRoads officials estimated that the

Victorian road crash database covers most fatal crashes, 60 to 70% of serious injury crashes and 30 to 40% of crashes not resulting in hospitalisation. Some fatal crashes may be missed if persons who were identified by the Police as injured, later die in hospital, without follow-up by Police. In Victoria at least, there is apparently no mechanism for the Coroner to inform the road authority of persons who have died as a result of road crashes.

The above discussion compares Police reported crashes to hospital admission data. Where appropriate collection systems are in place in hospital Emergency Departments, it is likely that even greater levels of Police under-reporting could be documented.

2.5.3 Consequences of under-reporting

Hakkert and Hauer (1988) identified two generic questions about road safety which are commonly addressed by use of Police accident reports:

- What is the magnitude of road safety for some specific 'entity' during a certain period of time.

- What is the change in relative magnitude of the safety of an entity from one period of time to another or the relative difference in the safety of several entities. (pp.5-6)

They underline that the only data which are available to estimate the magnitude of road safety are the reported numbers of crashes which are a function of both the reporting rate and the real number of crashes. They develop models based on cases where the reporting rate is known with certainty and cases where it can only be estimated. If the reporting rate is known accurately, then the accuracy of the estimate of magnitude of road safety increases with an increased number of reported crashes (or more years of data) and an increased proportion of crashes reported. If the reporting rate is not known with certainty, no matter how much data are collected, the uncertainty surrounding the reporting rate limits how accurately the magnitude of road safety can be estimated.

They note that it is probably unrealistic to assume that the reporting rate remains constant over time, and so merely collecting data over a longer time period may not solve the problem of low reporting rates.

CHAPTER 3: PROPOSALS FOR IMPROVED DATA COLLECTION METHODOLOGIES

The alternatives for improving data collection methodologies were listed earlier as follows:

- maintaining the status quo
- augmenting/expanding and making uniform the existing database by including supplementary data from a range of possible sources
- weighting the existing collection in areas where it can be shown to be under-representing road traffic crashes not resulting in hospitalisation
- using a hospital based system possibly based on ISIS and CAS2 to create a new specific purpose data collection for casualty crashes
- surveys of the general public
- General Practitioner sampling to augment other systems
- combinations of the above

The previous chapter has shown that the current data collection methodologies for casualty crashes resulting or not resulting in hospitalisation have inadequacies, both in data quality and coverage.

But it has also been shown that there are a range of data sources, each of which has its own advantages and disadvantages. Combining information from these sources has the potential to create a better quality database without the considerable cost of a new data collection.

3.1. DATA LINKAGE

It is possible to utilise the existing data bases and link the range of samples of information available on each to formulate an improved data system on a national level. Linked injury surveillance systems often combine data obtained from several data sources to compensate for inadequacies and omissions in individual sources. For example, the Victorian Injury Surveillance System (VISS) reports full ascertainment of injuries which result in admission or death in the emergency department however excludes injury severity scale scoring, length of hospital stay and outcome measures such as disability on discharge and re-admissions. Hospital morbidity files provide medical records including injury severity, discharge details and outcome measures. By linking these two data sources a much wider scope for analyses and preventive measures is made available. There is great potential for improving the timeliness,

quality and level of integration of data available to administrators, practitioners and researchers through linking data sources.

3.1.1. Characteristics of linked data systems

Before any guidelines are set for the development of a data-linkage methodology the attributes, advantages and limitations of linked injury-surveillance systems should be addressed. Graitcer (1987) reported on the rationale and uses of injury surveillance systems and suggested there are 5 major steps that must be taken to develop such a system. These are:

1. Identification of existing and potentially useful data sources for injuries:
2. Preparation of a surveillance plan that will include the collection, analysis and dissemination of these data;
3. Identification of priority injuries that are amenable to prevention and control interventions;
4. Continued surveillance on these priority areas to measure the effectiveness of injury interventions; and
5. Dissemination of the information gathered in the surveillance system and on the effectiveness of injury interventions.

The major advantage of a linked database is the ability to overcome the limitations of research studies using crash data restricted to one source. Through using more than one data source in a surveillance system, sensitivity (the ability to correctly identify all of the true cases of injury in the surveyed population), specificity (the measure of how non-cases are misclassified as cases) and representativeness (including a good sample that is representative of the whole population being surveyed) can be increased. For example, Smith (1990) in his report on the Road Injury Database developed in Western Australia found that from the Police Accident report form one only knows whether a person was killed, injured and admitted to hospital, or injured but not admitted to hospital. There are no details of the types of injuries received. The hospital morbidity records however, have comprehensive data on the nature of the injury, but there are no details of the accident, nor the circumstances of the accident beyond the mechanism of injury (including road user type). By linking these two files the important limitations of only using one of the sources can be overcome.

Linked road crash data bases are an important asset to research efforts because they provide the best available data on many aspects of crashes. By utilising linked data, studies have been made on motorcycle conspicuity and travel exposure (Cercarelli et. al. 1991), bicycle accidents and injuries (Stutts, Whitley & Sheldon, 1990), types of injuries received by persons following specific types of accidents (Gordon et. al, 1986). Cost of hospital treatment can be studied from different types of crashes, and vehicle design characteristics can be related to specific types of injuries (Fildes, 1991).

The relatively timely dissemination of data is another major attribute of linked surveillance systems. Traditional research often reveals details of injury many years after the events occurred, thus a fundamental rationale for injury surveillance is to overcome these barriers to injury prevention. Determinants ot timeliness includes

both the lag time between an injury incident, the reporting of this incident and the frequency with which the surveillance data are analysed (Graitcer, 1987). It is noted that if the official sample of the crash population is too small significant time periods may elapse before authorities become aware of hazardous sites (Searles, 1980). Early recognition of hazardous locations, crash trends and the early application of corrective measures may assist in reducing crash losses. One way of achieving this result is through a comprehensive surveillance collection.

3.1.2. Previous studies utilising linked data systems

Many epidemiological studies have used record linkage techniques to create databases which detect associations between variables and outcomes of interest. Epidemiological studies have been greatly facilitated in Canada by the development of a "Generalised Iterative Record Linkage System" (GIRLS) (Smith & Silins, 1981). This system has made large-scale studies both feasible and economic and has been successfully adapted to road safety research (Roadwatch,1989) in Australia. It makes possible much larger applications than ever conceived to be possible by manual procedures and it is consistent in its decision-making in its use of complex matching rules (Smith & Silins, 1981). To determine if records from a pair of sources, which do not have unique identifiers, should be matched or 'linked' GIRLS uses a probabilistic process.

By matching cases from two major data sources describing fatal traffic crashes in the United States (The Fatal Accident Reporting System [FARS] and The National Centre for Health Statistics [NCHS]), Fife (1989) successfully linked 85% of all FARS fatalities to the corresponding report of a traffic death from the NCHS file. The resulting file represented an enriched FARS file in which demographic and injury data not previously available were appended to the usual FARS data for each matched fatality. Fife concluded that linked data is useful for examining many aspects of motor vehicle crashes including the types of injury involved in different types of crashes, the relationship between motorcycle helmet laws and head injury deaths of motorcyclists, and the relationship between crash characteristics and demographic characteristics.

Smith & Middaugh (year unknown) evaluated the usefulness of existing data sources for surveillance and recommended the establishment of a statewide injury surveillance system in Alaska. By using as an example injuries associated with three-wheeled all-terrain vehicles they linked death certificates and medical examiner data and concluded that linked data provides an excellent mechanism for defining injury trends, monitoring injury fatalities and monitoring injury-specific intervention strategies.

There have been a number of attempts to link data for road crashes in Australia. In perhaps the earliest study, Gordon, Charlton, Ravazdy, Lam, Langley, Williams, Young, Hardes and Gibberd (1986) measured the feasibility of linking various data sources such as Police Accident reports, Ambulance Reports, Hospital medical records. Through these linkages the study brought together detailed information concerning the circumstances of the road crash with detailed information on the resultant injuries and the medical care given to the road crash casualties for all

casualty accidents in the Hunter Region. By achieving a computerised linking of records in the NSW traffic crash file and the NSW hospital morbidity collection Gordon and his colleagues concluded that analyses may be made on the major medical outcome variables (diagnoses, procedures performed, length of stay etc,) in terms of the traffic crash variables (such as speed zone, vehicle type and make, rural/urban crash etc.).

The most sophisticated road crash data linkage in Australia was the creation of the Road Injury Database (Ferrante, Rosman and Knuiman, 1991) undertaken by the Road Accident Prevention Research Unit (Roadwatch) and the Health Department in Western Australia. They linked casualty data from the Western Australian Police casualty crash records, the Hospital Morbidity File, St John Ambulance and death records for the 15 months from October 1987 to December 1988. Name, age, sex and date of crash were used to link information from the various sources. Names were removed from the database after linking. The stages involved in linking are detailed by Ferrante et al. (1991). The matching rates for the various stages in the procedure are described in Table 2. From the Table it can be seen that:

- 35% of hospital records linked to 29% of ambulance records
- 58.7% of hospital records linked to 14.3% of Police records
- 49.9% of ambulance records linked to 15.6% of Police records

Table 2. Some details of construction of the Road Injury Database. Table adapted from Ferrante, Rosman and Knulman (1991)

Database	**Number of records**
Hospital admissions	5035
Police crash database	18557
Ambulance	5825
Linkage attempted	**Number of records linked**
Hospital-ambulance	Hosp. 1760, Ambulance 1701
Hospital-Police	Hosp. 2957, Police 2648
Ambulance-Police	Ambulance 2911, Police 2903

Ferrante et al. note that it is not surprising that the match rates of hospital, ambulance and death records to Police records were very low. Most of the persons in the Police data would have been insufficiently injured to require hospitalisation or an ambulance trip.

Linkage rates were examined also as a function of road user type (see Table 2). The lowest linkage rates were associated with noncollision pedal cycle crashes (6%) and motorcycle noncollision crashes (29%).

Table 3. Linkage rate of hospital records by road user type (from Ferrante et al., 1991).

Road user type	Linked to Police	Total cases	% linked
Driver	720	900	80
Passenger	589	936	63
Motorcyclist	348	703	49
Pillion passenger	41	74	55
Pedal cyclist-vehicle	151	201	75
Pedal cyclist alone	40	642	6
Pedestrian (traffic)	316	457	69
Pedestrian (nontraffic)	2	14	14
Other (specified)	5	14	36
Other (unspecified)	789	1756	45
Total	2999	5694	53

The matched file has been used for studies of under-reporting of crashes (Giles and Rosman, 1990), crashes involving pedestrians (Giles, Arnold, Cercarelli and Rosman, 1991), the role of frontal conspicuity in crashes involving motorcycles or cars (Cercarelli, Arnold, Smith, Thornett and Rosman, 1991), bicycle crashes and hospitalisation costs (Giles, 1990).

As an example of the usefulness of the linked database, Giles (1990) reported a study of its use to gain a better estimate of the cost of hospital inpatient treatment resulting from road crashes. Most road crash cost studies conclude that their values are underestimates for several reasons

1. under-reporting of crashes to the Police
2. some hospital treatment unable to be identified as resulting from a road crash (due to mistakes in coding of external cause of injury)
3. average hospital costs are likely to lead to overestimation of inpatient costs for minor injuries and underestimation for severe injuries
4. incorrect classification of accident severity levels (hospital admissions being recorded by Police as having a lower level of severity).

The linked data file contained length of stay for hospital admissions. Multiplication by average hospital inpatient cost per day allowed calculation of inpatient costs per patient or per type of crash. The total cost of road crashes derived from use of the linked file was $11.6 million compared with the estimate of between $7.6 and $9.3 million derived from Steadman and Bryan's (1988) analysis of crash costs.

Using the linked data file it was demonstrated that pedestrians and those persons involved in head-on, sideswipe and indirect right-angled crashes have higher than average lengths of hospitalisation.

A preliminary study of linkage of crash data collected by the Roads and Traffic Authority of NSW and hospital and ambulance data relating to crashes in the western suburbs of Sydney was reported by Helby and Thomson (1991). The report examined the geographic areas and cases in each database, compared age, sex and time of crash profiles in each database and made an assessment of missing data. They concluded that matching should involve a number of stages, starting with the

complete range of matching variables and a narrow definition of time of crash. Once these matches were removed, further stages would be undertaken with looser matching criteria until a criterion level of false positives was achieved.

The RTA and NSW Health Department are currently co-operating in developing further linkages. This project is being funded by the Federal Office of Road Safety.

VIC ROADS attempted to link BAC data from hospitals (or Coroners) with Police accident data in 1978-79. They used a phonetic code for names and achieved about a 50% match rate.

MUARC has worked extensively with the Victorian Transport Accident Commission database, including the merging of this database with the Vic Roads database of Police accident reports. This has produced a data set which has good road user, vehicle and injury information for road crashes, with relevant environmental and crash data on a case by case basis. Injury information is limited compared with that available on the Hospital Admission File.

Table 4 compares injury details recorded by the Police and the Transport Accident Commission in Victoria for the years 1983 to 1988. The data are for drivers only, for crashes in which at least one occupant made a TAC claim which was matched with the Police report. For these reasons, the degree of agreement in injury severity coding is likely to be greater in this data set than for crash data as a whole.

Even with these constraints, the accuracy of coding of injury severity was far from perfect. According to the Police, 2511 drivers were admitted to hospital, compared with 1726 drivers coded as being admitted to hospital by the TAC. 1191/2511 drivers coded as hospital admissions by the Police were not admitted to hospital according to the TAC. It should be noted that Victoria is atypical in this regard, generally under-reporting by Police results in higher numbers in hospital than Police data.

Table 4. Comparison of injury details recorded by the Police and TAC for drivers of late model cars and station wagons involved in Police reported crashes, and at least one occupant made a TAC claim which was matched with the Police report (bold figures indicate where the two data systems are consistent). Table taken from Cameron, 1991.

	TAC General Assessment of Injury					
Police Assessment of Injury	Killed	Hospital stay more than 6 days	Hospital stay up to 6 days	Not Admitted to Hospital	No TAC Claim by Driver	Total
Killed or died within 30 days	**210**	2		2	10	224
Hospital admission	3	**597**	**585**	1191	135	2511
Medical treatment		133	259	**2424**	253	3069
Injured, no medical treatment	1	12	26	**532**	141	712
Not injured	3	30	80	1683	1369	3165
Not known	1	1	1	56	12	71
Total	218	775	951	5888	1920	9752

3.1.3. Limitations of linked data

Despite the many advantages of record linkage systems there are five major difficulties or limitations to be overcome to achieve effective record linkage. The first limitation is that of inadequate or incomparable identifying items to discriminate between persons to whom the record refers. The identifying information usually comprises one or more of the following items: surname, given name(s) or initial(s), birthdate and/or an identification number (Fett, 1984). Verification of information depends largely upon the presence of complimentary information in two or more of the data sources, however, much of the information is unique to one data source. Due to this, there are few opportunities to resolve inconsistencies. Previous studies show inconsistencies and restrictions between data sources. Gordon et. al. (1986) indicates a major problem in Australian data files due to the lack of unique identifiers and confidentiality requirements. Names and addresses are suppressed in the preparation of statistical data files to preserve privacy and confidentiality. Without these unique identifiers it is necessary to use less precise variables for linking such as age and sex which may lead to two practical problems. First, the identifying items, singly or in combination, are not unique to a particular individual, and second, identifying items may be missing or miscoded on certain records.

The second limitation arises because of human error when recording information. In the case of Police accident reports, while it is expected that police officers will record information reasonably accurately, if information was not obtained at the accident scene there may be no way of obtaining it. Similarly, Giles et. al. (1991) found inconsistencies in the classification of accident severity levels on the Police reports. With other data sources potential sources of error occur in the recording of information. Recording errors include clerical errors in recording information, coding errors and data entry errors.

A third difficulty arises because most data bases include information that has been collected for other purposes (for example, the Police record accident events for legal purposes, law enforcement and other administrative and statistical needs). Consequently, the data may fail to include critical facts, may be imprecise, and information is often not timely, which limits their value for injury surveillance.

Differences in classification of injury severity between road crash and hospital data systems are likely to cause some difficulties in linkage. In an overseas example, Agran & Dunkle (1985) found two entirely different injury grading systems between police accident reports and emergency room cases in California. Medical assessments of injuries through AIS scoring were completed on hospital records whereas the police accident report provides assessment in terms of 1) the presence or absence of injury, 2) complaint of pain, which is a result of injury and 3) fatality, which is an outcome rather than an injury. The AIS coding scheme thus is not applicable due to the lack of specific information provided on the police report. Neither is the body part injured recorded, thus limiting the usefulness of the injury data for prevention purposes.

A fourth difficulty may arise because of incomplete files on the traffic crash written by police or the hospital morbidity data base may be incomplete. The main reasons

for these errors are firstly, the police investigation of a crash may not have been completed by the end of the recording period. Although in most cases accident report forms are completed either at the scene of the crash or soon after, there are occasions where the attending police officer completes forms at a later date which could be anything up to a month after the crash. This may give rise to potential errors or incomplete records. In addition, since the morbidity file is completed on the discharge of the patient from hospital, some overlap into the next period is likely among patients in any given period. Also, in any system work overloads or other problems may delay the submission of returns until after the cut-off date set by the processing unit.

A final difficulty is due to the magnitude of national data and inconsistencies found between States and Territories and their various coding and recording systems. Road safety research cannot begin any improvement in data collection methodology without having national accident data available which is both sensible and reliable. Greater clarity in format and wording of report forms and a uniformity of interpretation is needed from each State and Territory (Andreassen and Evangelou, 1990).

MUARC recently completed an analysis of Australian data on truck accidents and an assessment of data sources as part of the Australian Truck Safety Study (Haworth, Vulcan & Wai, 1991). The study identified a number of incompatibilities in truck crash information available in the State and Territory accident databases, these include variations in definitions of trucks, definitions of single vehicle crashes, categories of crash severity and the road type variables coded.

Furthermore, in their report on the quality of accident data, Andreassan and Evangelou (1990) found grave incompatibilities between States and Territories in reporting and recording procedures. They concluded that even core data items such as road user variables, vehicle variables, environment and other variables which were endorsed by the Australian Transport Advisory Council in 1977 are still not being recorded in a consistent and uniform manner between States and Territories. In addition, they identified a number of other items such as towed/not towed, highway/other road, origin of license, and year of manufacture which were not recorded on the Police report form of each and every State and Territory.

Moreover, information recorded has the potential to be misleading due to design of report forms and jargon used. For example, the use of the term 'unit' is different between States and may be interpreted wrongly. The ACT does not use it, NSW has moved away from its previous use, NT does not use the term either. Queensland uses the term and has a specific list of 'type of units involved' where South Australia records details for 'Unit 1 and 2' yet does not define unit type. Unit type therefore includes vehicles, pedestrians, trees, fences and poles. Tasmania uses 'unit' but restricts the usage to pedestrians or vehicles. Victoria (1988 Form) does not use the term nor does Western Australia.

Unquestionably, the major advantage of compiling a linked database is that limitations of doing research studies with crash data restricted to one source are overcome. A linked database plays a significant role in understanding and investigating traffic safety and analysis and provides an excellent mechanism for

monitoring traffic-related injuries. A linked mass database may effectively aid a variety of studies concerning traffic safety, injury prevention and control and ultimately the reduction of road crashes. Studies concerning issues such as the severity of injury in road crashes, crash profiles for different age and sex groups, bicycle crashes and associated injuries, long term outcomes of road crashes and others may be conducted using a linked database.

3.1.4. On-going linking

It should be noted that some linking of data from Police accident report forms is currently undertaken by road authorities. Linkages with registration and licence databases are undertaken in those jurisdictions where this is possible. Linking of Police data and hospital records of BAC data are undertaken. Mismatches between hospital and Police BAC data regularly occur. Cases exist of hospital BAC being available but no corresponding Police report form and vice versa. Some of the mismatch results from testing of passengers, rather than drivers.

3.1.5. Attitudes to data linking

Transport officials in many jurisdictions perceived the main barrier to linkage to be objections by hospitals, rather than their own organisations. It was noted, however, that linkage would require the permission of the Police. In NSW the existence of the Privacy Committee means that that body would also need to be consulted.

The health sector in most states and territories expressed reservations about the concept of linkage, particularly in regard to confidentiality issues, and the responsibility for preventing further linking. Only the Northern Territory Health Department indicated that there may be insurmountable barriers to this specific case of linkage.

In a FORS survey assessing attitudes to road safety which was conducted in July 1991, a question was asked which is relevant to public opinion about data linking. The survey asked:

> *It has been suggested that all information on crashes resulting in hospitalisation should be put together in one location to assist road safety research. Would you agree or disagree with this proposal?*

Of 1039 persons interviewed, 91.0% agreed, 5.9% disagreed and 3.0% responded "don't know/can't say".

These responses suggest that the community has less concerns about linkage or similar methods of analysis than the authorities.

3.2. ETHICS

Recent advances in computerisation and linkage of medical and other records for epidemiologic research means the accumulation, analysis and storage of an unlimited quantity of personal records and medical record information thereby seriously compounding existing controversies surrounding patient confidentiality and privacy. Without any doubt one of the most important issues in creating a linked database is the protection of privacy and the maintenance of confidentiality of identifiable information as it flows through the system.

When attempting to generate new knowledge through research it is frequently necessary to be able to use information about a particular individual from one source of information and relate it to information obtained about the same individual from another source. This can only be done if it is possible to identify particular individuals within each of the data sources. For record linkage to be feasible each primary record to be linked must be able to be related unambiguously to a particular individual. Most primary records are identified by details such as name, date of birth, sex, etc. These details must be replaced by a unique but anonymous identifying number once initial linking has been established, only then will privacy and confidentiality be maintained.

While linkage has many positive values associated it is not acceptable or warranted if personal privacy and individual liberties are violated. Adequate measures to control medical privacy must be established. The National Health and Medical Research Council (NHMRC) recognises that both the privacy of individuals and the advancement of medical knowledge are of fundamental importance to the well-being of individuals and society. Eleven guidelines in Section 95 of the Privacy Act, 1988 have been provided to ensure that the privacy of the individual is not interfered with when a researcher seeks the release of personal information held by a Commonwealth agency, or when a Commonwealth agency conducts medical research, and to ensure that the conduct of medical research is not inhibited by the privacy legislation. However, the 1988 Privacy Act operated in such a way that through the restrictions and responsibilities placed upon researchers and Institutional Ethics Committees research was inhibited (Bentley-Cooper, 1991).

The NHMRC recognised that at times there will be conflict between public interest in privacy and the public advancement of medical knowledge and that the Information Privacy Principles might inhibit the conduct of medical research. In 1990 the guidelines of the Privacy Act 1988 were revised and have undergone a number of changes including provision allowing agencies to release personal information in certain circumstances which can include medical research. These guidelines are designed to achieve the purpose of protecting privacy in the conduct of medical research in three ways: first, they prohibit all medical research which might involve an unlawful interference with privacy from proceeding unless otherwise stated by an Institutional Ethics Committee; second, they state the principles and matters that are to be considered and the reasons used in reaching that decision; and third, they determine who is to make that decision and set out the procedures that are to be followed in reaching that decision and in monitoring the conduct of research.

Despite these guidelines, the tremendous growth of data systems, the development of huge data banks and the advancements in record linkage still pose an enormous threat

to the privacy of medical information. When analysing privacy rights in health care, specifically with respect to medical records three major issues are raised (Hiller & Beyda, 1981). These are 1) sources of a right to privacy, 2) the accessibility and disclosure of medical records, and 3) the assurance of adequate safeguards.

3.2.1 Sources of a Right to Privacy

Based on the principle of respect for another person, individuals have a right to have the confidentiality of their medical records preserved. In addition, the concept of autonomy dictates that one has a choice to control uses of information generated regarding one's mind and body.

3.2.2 Accessibility and Disclosure of Medical Records

To allow use of medical records for any function without placing strict controls on the users and the potential uses of the information risks infringements on the rights of patients. Necessary access to records for purposes other than medical purposes is increasingly being given to non-health professionals such as computer analysts, office personnel and researchers. These people may be neither sensitive to patient concerns over confidentiality and privacy nor bound by strong professional codes of ethics regarding the use of such information. Data, when released to non medical professionals, should have no traceable identifiers & should be in aggregate form. Small cells should be protected from dissemination by editing systems.

3.2.3 Assurance of Safeguards

The sensitivity of health and medical information requires the establishment of policies and procedures that will limit access to users, recording personnel, coders, etc. When information is given that identifies individuals, proper standards require that the confidentiality of that information is protected, that records are held securely and that access to identifying information is always restricted to those who need to have it for the purposes of the study.

Privacy issues must be addressed through ethical public policies that reflect a balance between the need for information flow and the right of privacy. Injury information, properly managed in a data system can enhance efforts to improve road safety and can contribute to many other facets of research. However, there must be a clear delineation of policies and practices governing the situations under which information is disclosed to other parties, acquisition, analysis, storage, exchange and transmission of this data.

Among other considerations, clear understanding must be established regarding the ownership and control of linked data.

3.3. LEGAL ISSUES

There is considerable overlap between ethical and legal issues. This relates particularly to the requirement that data are de-identified and cannot be used for the purposes of litigation. To prevent the possibility for litigation, it may be necessary to assign the whole linkage process special statutory status which excludes it from being available for legal processes. Such powers are available, for example under the Victorian Health Act.

3.4. WEIGHTING THE EXISTING COLLECTION

Weighting the existing collection to correct for underreporting and use of General Practitioner sampling to augment other systems are improvements to data collection methodologies which are most relevant to crashes not resulting in hospitalisation. For this reason, they are discussed in detail in Part 3.

Weighting the existing collection is a possible way to improve the data collection in areas where it can be shown that the Police crash reporting system is underrepresenting the number of that type of road traffic crash. Thus, weighting has particular application to improving data collections for crashes involving motorcyclist, bicyclist and pedestrians.

Weighting can be simply described as finding the ratio of frequencies of particular types of crashes from two databases and using this ratio to adjust the frequencies in one of the databases. The ratios are termed weights. Sophisticated mathematical treatments of weighting and associated issues have been published.

Weighting results in more accurate counts of the number of crashes of particular types but does little to improve the quality of the data. The contrast should be made with linking of databases which improves quality without necessarily improving the accuracy of counts.

In using weighting, it is assumed that the police reported crash database would form the data to be weighted and the issue is that of which other data source should be used to derive the weights. Possible data sources for crashes resulting in hospitalisation include hospital morbidity files and special purpose data collections whereas injury surveillance systems, Emergency Department data systems, General Practitioner sampling, surveys and special purpose data collections need to be considered for crashes not resulting in hospitalisation.

The choice of the data source for weighting affects whether the weighted data are crash-, vehicle- or person-based and its level of specificity. For example, hospital morbidity data are person-based and so the resultant weighted Police crash data would be person-based. Weights derived from hospital morbidity data could be specific with respect to road user type and age but not with respect to, say, number of vehicles involved.

Another issue to be addressed in deciding whether to use weighting to improve data collection is that of the generalisability of weights. If a specific purpose collection is conducted in a restricted geographical area, it is necessary to ascertain whether these weights will apply in other areas within the same State or Territory. And given the differences in Police crash reporting between States and Territories, it is likely that weights derived in one jurisdiction would not be appropriate elsewhere. The generalisability of weights across time is another issue. If weights are derived from data for a particular time period, to what degree can those weights be applied to earlier and later data?

The accuracy of weighted data will be less if there is bias as well as under-reporting in the Police reported crash database. If, for example, the under-reporting of motorcycle crashes to Police is greater for unlicensed motorcyclists, then a weighting factor for motorcycle crashes as a whole derived from hospital morbidity data would not correct for the underlying bias.

It would be difficult to justify the creation of a new specific purpose hospital based system for casualty crashes, in view of the costs involved and the limited usefulness of such a specialised system to the health sector, particularly since developments are proceeding in more generalised emergency department data collections.

3.5. SURVEYS OF THE GENERAL PUBLIC

Potential exists for the inclusion of Census questions relating to injuries resulting from road crashes. The NSW Roads and Traffic Authority was unsuccessful in having supplementary questions about traffic crash involvement incorporated in the ABS Household Survey in NSW in 1992. However, there is potential for such Supplementary Surveys in the future, possibly co-ordinated between states.

Postal surveys of motorcyclists and car drivers (names selected randomly from licence database) were conducted by the British Department of Transport (James, 1991). Data collected included personal details, crash information and whether the crash was reported to the Police. Overall, 17% of motorcycle crashes (8% of noninjury and 24% of injury crashes) and 33% (26% of non-injury, 86% slight injury, 93% fatal) of car crashes were reported to the Police.

For motorcycle crashes, reporting rates increased with severity of injury to the rider and were higher for multiple than single vehicle crashes (32% vs 6%). Reporting rates were higher when someone else was injured and increased with vehicle damage. Damage to other vehicles was the most significant factor affecting reporting. If damage to other vehicles was slight, severity of injury to the motorcyclist then affected reporting. For car and van crashes, reporting rates increased with injury severity and, for non-injury crashes, severity of damage to vehicles involved.

In Australia, five separate surveys have been conducted by Reark Research for the Federal Office of Road Safety between October 1986 and May 1990. These projects surveyed respondents aged 15 years and over in all states of Australia on community attitudes toward road safety and their major objective was to monitor key community

attitudes regarding the importance of road safety issues. These studies were successful in monitoring changes in attitudes over the 4 year period. Although these surveys do not touch on issues of crash casualties they do indicate that the methodology was successful and may be adapted to other future research such as this data collection methodology.

The 1989/90 National Health Survey, constructed by the Australian Bureau of Statistics was severely limited in its usefulness for road safety purposes. Published data from the Survey classify injuries by location and do not distinguish between road user type. Thus most motor vehicle accidents are included in the general location category of "on path, road or highway".

Potential roles of surveys of the general public in improving data collection methodologies include determination of the extent of under-reporting. Survey information could not be used for detailed follow-up and linkage unless confidentiality issues could be overcome.

It is probable that more specifically targeted surveys could be more useful. Surveys could be targeted to vehicle owners by including the survey with registration renewal papers.

Injury should be categorised by severity (killed; hospital admission; other medical treatment; injured, not treated) and road user type to allow a reference base for other data collections. It is likely that a very large sample would be needed to provide national data able to be sufficiently disaggregated. Thus the cost of a national survey could be considerable.

3.6. RECOMMENDATION

Because of the potential for breaches of confidentiality as outlined above, it is recommended that a set of guidelines, or even a contract, be developed for uses and constraints of linked data. For example, any additional linkages should have all identifiers removed. An experience described for the US, where registrations data was added to hospital and police reported data re-introduced licence plate details and allowed individuals to be identified in California. This is reported to have resulted in abandonment of linked road crash data systems in that state.

PART 2:
DEVELOPMENT OF DATA COLLECTION METHODOLOGY: CRASHES RESULTING IN HOSPITALISATION

This part of the report focuses on those aspects of data collection methodology unique to crashes resulting in hospitalisation. The majority of Part 2 is devoted to detailed examination of the types of inpatient data collected by hospitals and a comparison with Police road crash data.

CHAPTER 4. INTRODUCTION

4.1. SPECIFIC OBJECTIVES

The specific objectives of this study are:

1. To explore the feasibility and utility of:
    - maintaining the status quo
    - augmenting/expanding and making uniform the existing database by including supplementary data from a range of possible sources
    - weighting the existing collection in areas where it can be shown to be under-representing road traffic crashes not resulting in hospitalisation
    - using a hospital based system possibly based on ISIS and CAS2 to create a new specific purpose data collection for casualty crashes
    - surveys of the general public
    - General Practitioner sampling to augment other systems
    - combinations of the above
2. To address the strengths and weaknesses of such systems for the purposes of both macro and micro level uses of the data.
3. To establish methods of validation and quality control for any proposed systems
4. To consider the ethical and privacy implications, particularly constraints on any proposed systems, and possible solutions

5. To provide an outline of the techniques and processes which would be required to develop such systems

6. To examine in general terms the relative costs of proposed systems

4.2. CURRENT STATUS (POLICE REPORTING SYSTEM)

Crashes resulting in hospitalisation are required to be reported to Police in each jurisdiction. As noted in Part 1, crashes resulting in hospitalisation cannot be identified from the injury severity variable in South Australia, Western Australia and the ACT. In the Northern Territory, degree of injury is missing for a significant number of crashes, making identification of crashes resulting in hospitalisation difficult.

In addition, the accuracy of Police coding of injury severity differs among jurisdictions. Injury severity is quite accurately coded in New South Wales (Helby and Thomson, 1991) and Tasmania but later analyses in this report show that Police in Victoria tend to overestimate injury severity (there is a tendency to code persons who attend hospital as admitted).

The problem of under-reporting of casualty crashes was also identified in Part 1. It was shown that under-reporting varies as a function of injury severity, leading one to expect that the degree of under-reporting of crashes resulting in hospitalisation would be less than that of crashes not resulting in hospitalisation.

4.3. IN DEPTH EXAMINATION OF HOSPITAL DATA FOR ADMISSIONS

In each jurisdiction a hospital morbidity file is compiled which is a central database of hospital admissions containing considerable inpatient details. As an example of the information available from this source, the list of variables contained in the New South Wales hospital morbidity file is attached as Appendix E.

Hospital morbidity files vary according to whether they include patients' names, when centralized and whether both public and private hospitals are included or only public hospitals. The Queensland and New South Wales hospital morbidity files, for example, contain information about patients in both public and private hospitals but do not include their names. Names do exist on a precursor file for public hospital patients, however.

The timeliness of hospital morbidity data is currently a problem in some States and Territories. Lags are commonly of the order of about one year but vary depending on staffing restrictions in hospitals. These delays are unlikely to persist as hospital funding becomes contingent on casemix information (a component of the Hospital Morbidity File from 1993).

4.3.1. AIS-ICD9 conversion programs.

The Hospital Morbidity File is useful in many respects in the improvement of casualty crash data collection methodologies. Its application of ICD9 diagnosis or N- codes provides a discharge diagnosis but this is not quantified to readily indicate the severity of injury. However, AIS scoring provides traffic crash investigators with a uniform system for rating the severity of injuries. It should also be noted that the AIS system applies to anatomical injuries and does not necessarily take into account physiological effects. The Trauma Score and its various revisions are used as quantifiable measures of physiological status to provide, together with AIS, a more comprehensive definition of injury severity. As well as blood loss and head injury severity, the Trauma Score also provides a measure for the effects of, for example, strangulation/suffocation, drowning, and hypothermia.

The AIS is widely recognised internationally, is applied to many traffic and non-traffic related trauma and is increasingly being used for research purposes. It is also used to evaluate the adequacy of emergency medical services and systems in responding to acute care needs.

The AIS was first developed in 1971 and provides a numerical scale ranging from 1 (minor injury) to 6 (maximum injury - virtually unsurvivable) for injury severity scoring. Scores are assigned by medical experts and are implicitly based on four criteria - 1) threat to life, 2) permanent impairment, 3) treatment period and 4) energy dissipation. The type and extent of injury may be summarised by calculating the maximum AIS scores within body regions. AIS scores may be further utilised for rating overall case severity that takes into account the combined effect of injuries to the multiple body system by applying the Injury Severity Score (ISS). This is an AIS-based measure and is defined as the sum of squares of the highest AIS for each of the three most severely injured body regions.

To enhance the potential for new applications of the AIS, the Johns Hopkins Health Services Research & Development Center (HSR&D) and The Maryland Institute for Emergency Medical Services Systems (MIEMSS) have developed a computerised conversion table that maps IDC9-CM codes into AIS-1985, severity scores. In the formulation of the ICD to AIS conversion a modified Delphi approach was used whereby criteria and assumptions necessary for assigning 1985 AIS severity scores to specific diagnoses were determined. Following agreement on assumptions AIS scores were assigned to all ICD-9CM rubrics between 800.00 and 959.00 by members of the AAAM Scaling Committee. AIS scores derived using the conversion table were validated by comparison with medical records and it was found that the majority of ICD-9CM rubrics were successfully converted to appropriate AIS scores. Only 3.2% of the rubrics were assigned an AIS 9 or unknown severity code due to either a lack of sufficient detail in the ICD description or because injuries of very different levels of severity are incorporated within one ICD rubric (eg when state of unconsciousness is unspecified).

While there are limitations to the conversion system such as conservative assumptions and errors in abstracting and ICD coding leading to lower average values of AIS it

has been found to be valuable for providing reasonably precise information on injury severity. Currently MUARC is undertaking a feasibility study of occupant protection countermeasures which includes the assessment of injury reductions and estimating the effectiveness of each safety system. In this study, Hospital Morbidity File ICD9-CM codes have been successfully converted to AIS scores using the conversion table thereby determining injury severity for hospital admissions.

The potential for wide application of the ICD-9CM to AIS conversion table is vast. By using hospital discharge data the conversion systems can facilitate new research into epidemiologic factors affecting the incidence of road trauma. As discussed in Section 4.11 of this report the conversion would allow the validation of injury severity required for hospital admission and the variability in this criterion across hospitals including urban/rural distribution. It is important in monitoring the severity of road crash injury to compare like with like. Variability in hospital admission criteria may also have implications for health care planning.

The quantification of injury severity by body part injured could also provide the basis for comparing costs and outcomes by crash type.

It should be noted that methodological problems may arise from the use of single AIS scores for research purposes when, in fact, the crash victim may have multiple injuries. In order to account for the combined affect of multiple injuries when quantifying injury severity, the Injury Severity Score (ISS) has been derived. It represents the sum of the squares of the highest AIS scores for up to three defined body regions. However, only one AIS score can be attributed to each body region, even if say three AIS scores of 5 occur to the head, and no other injuries are documented.

4.3.2 Identification of road crash casualties using external cause of injury codes

As outlined in Part One of this report, each State or Territory Health Department compiles a Hospital Morbidity File which is a comprehensive collection of hospital admissions. Because of the role that it plays in the provision of funding to hospitals, the Hospital Morbidity File is generally considered to count all hospital admissions (no under-reporting).

A "mechanism of injury" code (International Classification of Diseases 9th Revision, 1978) is recorded for each injured patient admitted to hospital. The range of external cause of injury codes (E-codes) which pertains to motor vehicle accidents is E810-E825. This is further subdivided into motor vehicle traffic accidents (E810-E819) and motor vehicle nontraffic accidents (E820-E825). This subdivision corresponds to on-road (E810-E819) and off-road (E820-E825) motor vehicle accidents. Motor vehicle nontraffic accidents include accidents involving motor vehicles being used in recreational or sporting activities off the highway and collision and noncollision motor vehicle accidents occurring entirely off the highway. The categories which make up motor vehicle traffic accidents are listed in Table 5.

Table 5. ICD-9-CM external cause of injury codes for motor vehicle traffic accidents.

Code	Event
810	Motor vehicle traffic accident involving collision with train *(excludes motor vehicle collision with object set in motion by train or train hit by object set in motion by motor vehicle)*
811	Motor vehicle traffic accident involving re-entrant collision with another motor vehicle *(includes collision between motor vehicle which accidentally leaves the roadway then re-enters the same roadway, or the opposite roadway on a dividied highway, and another motor vehicle)*
812	Other motor vehicle traffic accident involving collision with motor vehicle *(includes collision with another motor vehicle parked, stopped, stalled, disabled or abandoned on the highway)*
813	Motor vehicle traffic accident involving collision with other vehicle *(includes collision between motor vehicle and other road nonmotor transport vehicle, such as ridden animal, animal-drawn vehicle, pedal cycle, street car)*
814	Motor vehicle traffic accident involving collision with pedestrian *(includes collision between motor vehicle and pedestrian, pedestrian dragged, hit or run over by motor vehicle)*
815	Other motor vehicle traffic accident involving collision on the highway *(includes collision between motor vehicle and abutment, animal, fallen stone or landslide, roadside furniture, median, object set in motion by train or road vehicle, other fixed or moving object)*
816	Motor vehicle traffic accident due to loss of control, without collision on the highway *(includes motor vehicle failing to take curve, going out of control due to blowout, mechanical failure, driver asleep or inattentive, excessive speed and colliding with object off the highway, overturning or stopping abruptly)*
817	Noncollision motor vehicle traffic accident while boarding or alighting *(includes fall down stairs of bus, fall from car, injured by moving part of vehicle, trapped by door of bus while boarding or alighting)*
818	Other noncollision motor vehicle traffic accident *(includes following events while motor vehicle is in motion: accidental poisoning by exhaust gas, breakage of part of vehicle, explosion, fire, injury from moving part or falling or thrown object. Also collision of pedestrian or nonmotor road vehicle with object set in motion by motor vehicle or motor vehicle hit by object set in motion by railway train or any road vehicle)*
819	Motor vehicle traffic accident of unspecified nature *(includes motor vehicle traffic accident or traffic accident not coded elsewhere)*

In addition, there are codes for "other road vehicle accidents", road accidents which do not involve a motor vehicle. These include accidents of pedal cycles (E826), animal drawn vehicles (E827), animal being ridden (E828) and "other road vehicle accidents" (E829). The last category includes crashes involving streetcars, skateboards and other nonmotorised road vehicles. It is unclear whether these codes apply only to accidents occurring on public roads.

Table 6. ICD-9-CM external cause of injury codes for other road vehicle accidents.

Code	Event
826	Pedal cycle accident *(includes collision between pedal cycle and any nonmotorised road vehicle, pedestrian, or other object, breakage of any part of pedal cycle, entrapment in wheel of pedal cycle, fall from or overturning pedal cycle. Excludes collision between pedal cycle and motor vehicle)*
827	Animal-drawn vehicle accident *(includes collision between animal-drawn vehicle and any motorised road vehicle, pedestrian or other object, breakage of any part of vehicle, fall from, knocked down by, overturning of, run over by or thrown from animal-drawn vehicle. Excludes collision of animal-drawn vehicle with motor vehicle or pedestrian)*
828	Accident involving animal being ridden *(includes collision between animal being ridden and nonmotor road vehicle, pedestrian or other object, fall from, knocked down by, thrown from, trampled by animal being ridden or ridden animal stumbled and fell. Excludes collision of animal being ridden with animal-drawn vehicle or pedal cycle)*
829	Other road vehicle accidents *(includes accident while boarding or alighting from, blow from object in, breakage of any part of, caught in door of, derailment of, fall in, on or from, fire in streetcar or nonmotor road vehicle not classifiable to E826-828, collision between such vehicle and animal not ridden, another such vehicle, pedestrian, other object, other nonmotor road vehicle or streetcar accident. Excludes collision with animal being ridden, animal-drawn vehicle, pedal cycle)*

Separate codes are used for the late effects of motor vehicle accidents (929.0) and other transport accidents (929.1).

The E-code has a fourth digit which provides information about the type of road user that was injured. The fourth digits for motor vehicle traffic accidents are listed in Table 7 and those for other road traffic accidents in Table 8. It can be seen that these subdivisions correspond quite well to the categories of road user type in many road crash databases, enabling comparison.

Table 7. Fourth-digit subdivisions of ICD-9-CM external cause of injury codes for motor vehicle traffic accidents.

Code	Explanation
.0	Driver of motor vehicle other than motorcycle
.1	Passenger in motor vehicle other than motorcycle
.2	Motorcyclist
.3	Passenger on motorcycle
.4	Occupant of streetcar
.5	Rider of animal; occupant of animal-drawn vehicle
.6	Pedal cyclist
.7	Pedestrian
.8	Other specified person
.9	Unspecified person

Table 8. Fourth-digit subdivisions of ICD-9-CM external cause of injury codes for other road traffic accidents.

Code	Explanation
.0	Pedestrian
.1	Pedal cyclist
.2	Rider of animal
.3	Occupant of animal-drawn vehicle
.4	Occupant of streetcar
.8	Other specified person
.9	Unspecified person

The usefulness of E-codes in providing more than basic counts of road crash admissions is dependent on how well type of road user information (the fourth digit) is coded. An examination of the proportion of cases for which type of road user was coded as "other specified" or "unspecified" was undertaken for 1989 Victorian hospital admissions data. As Table 9 shows, type of road user was not known for about a third of crashes coded as "Motor vehicle traffic accident of unspecified nature" (E819). In addition, type of road user was unknown for many cases of "Noncollision motor vehicle accident while boarding or alighting" and "Other noncollision motor vehicle traffic accidents". For other E-codes for motor vehicle traffic accidents, road user type was missing for less than 5% of cases. In general, type of road user was not available for many nonmotor vehicle traffic accidents (E826-E829).

Table 9. Coding of type of road user as "other specified" or "unspecified" in 1989 Victorian Hospital Morbidity File.

E-code	Road user - Other specified		Road user - Unspecified	
	Number	Proportion	Number	Proportion
810 - collision with train	0	.00	0	.00
811 - re-entrant collision	0	.00	1	.05
812 - collision with motor vehicle	2	.00	49	.02
813 - collision with other vehicle	3	.00	10	.02
814 - collision with pedestrian	6	.01	7	.01
815 - other collision on highway	3	.01	12	.03
816 - loss of control without collision	3	.00	37	.03
817 - boarding or alighting	8	.13	11	.18
818 - other noncollision	18	.06	21	.06
819 - unspecified nature	9	.01	396	.32
826 - pedal cycle	9	.01	73	.07
827 - animal-drawn vehicle	0	.00	5	.19
828 - animal being ridden	4	.01	85	.13
829 - other road vehicle	46	.47	11	.11

Table 10 shows that the problem of missing data for type of road user is not confined to Victorian hospital admissions data. Indeed, Queensland data shows generally higher proportions of type of road user coded as "other specified person" or "unspecified person". The proportions of road users unidentified by type exceed 0.50 for "Motor vehicle traffic accident of unspecified nature" and "Noncollision motor vehicle accident while boarding or alighting".

4.3.3 Comparison of numbers of casualties in Hospital Morbidity Files and Police crash databases

In order to assess the relative completeness of coverage of hospital admissions resulting from road crashes, the numbers of admissions according to the hospital morbidity files and Police-reported crash data bases were compared.

Table 10. Coding of type of road user as "other specified" or "unspecified" in 1989 Queensland Hospital Morbidity File.

E-code	Road user - Other specified		Road user - Unspecified	
	Number	Proportion	Number	Proportion
810 - collision with train	1	.07	5	.33
811 - re-entrant collision	0	.00	0	.00

812 - collision with motor vehicle	7	.01	67	.09
813 - collision with other vehicle	0	.00	26	.05
814 - collision with pedestrian	5	.01	32	.05
815 - other collision on highway	1	.00	38	.16
816 - loss of control without collision	1	.00	140	.21
817 - boarding or alighting	2	.04	26	.50
818 - other noncollision	8	.02	113	.33
819 - unspecified nature	0	.00	2569	.65

In drawing comparisons between numbers of casualties or in attempting to link the Police road crash and hospital morbidity files, it is necessary to establish which external cause of injury codes should be included. Two approaches are possible in selecting E-codes for inclusion. The first approach is a conceptual one and open to debate. It deals with defining the universe of events and injuries of interest. A wide interpretation of this universe might include all events and injuries arising from road transportation, whether occurring on a public road or not, whether involving a motor vehicle or not. This interpretation would include, for example, an injury resulting from a collision between two bicycles on a cycle path. The outcome of such an interpretation would be a wide selection of E-codes, perhaps E810-E829, and the demonstration that Police data is missing for many of these injuries.

A second approach, which will be taken here, is to define the universe of events and injuries of interest in the way that Police data collections do and assess how complete is their coverage. Generally, Police data collections confine themselves to crashes which occurred on a public road. According to that criterion, Police data should include "motor vehicle traffic accidents" (810-819) but not "motor vehicle nontraffic accidents" (820-825). It is somewhat unclear whether "nonmotor vehicle traffic accidents" should be included (i.e. whether all of these occurred on a public road).

The total numbers of hospital admissions resulting from road crashes in 1989 according to the Victorian Hospital Morbidity File and VIC ROADS crash database were similar (E-codes from the ranges 810 to 819, 826 to 829). However Table 11 shows a large overrepresentation of drivers and passengers in the VIC ROADS crash database but underestimates of other types of road user.

Table 11. Comparison of numbers of hospital admissions as a result of road crashes in 1989 according to the Victorian Hospital Morbidity File (HMF) and VIC ROADS crash database. (E-codes 810-819, 826-829)

Road user type	HMF	VIC ROADS
Driver	2422	4075
Passenger (includes pillion passenger)	1841	2615
Motorcyclist	1010	877
Bicyclist	1311	583
Pedestrian	1052	1152
Animal rider or occupant of animal drawn vehicle	586	
Occupant of streetcar	20	
Other specified	111	54
Unspecified	718	
Total	9071	9356

A recent report (O'Connor, 1992) suggests that the overestimation by Police of the number of persons admitted to hospital may be largely a Victorian phenomenon (see Table 12). A NSW study of the feasibility of data linkage found little evidence of such an overestimation in that state (Helby & Thomson, 1991).

Table 12. Hospital admissions versus Police reported admissions by State, 1989 (From O'Connor, 1992).

State/Territory	Hospital admissions	Police reported admissions	Ratio
ACT	483	255	1.9:1
South Australia	5053	2713	1.9:1
Northern Territory	na	564	na
New South Wales	17965*	8790	2.0:1
Queensland	9759	4383	2.3:1
Victoria	9163	10132	0.9:1
Western Australia	4476	3253	1.4:1
Tasmania	937	787	1.2:1
Australia	**48284****	**30877**	**1.56:1**

* Based on 1989-90 financial year.
** Estimate of total hospital admissions was based on the admission rate applied to the total population of Australia.
Hospital admissions data include readmissions from the same accident, probably representing about 4-8% of admissions.

Table 13 shows a breakdown by age of the numbers of hospital admissions resulting from road crashes according to the Victorian Hospital Morbidity File (HMF) and the

VIC ROADS crash database. VIC ROADS data over-estimate the number of hospital admissions at each range. The degree of over-estimation is least for persons in the age range 0-4 (12%) and greatest for the age range 17-25 (37%). Motorcyclists aged 5-16 years are the only group for which the HMF shows more cases than the VIC ROADS database (74 vs. 24). The underreporting of crashes involving underage motorcyclists was noted in an earlier section of this report.

Table 13. Distribution by age of numbers of hospital admissions as a result of road crashes according to the Victorian Hospital Morbidity File (HMF) and VIC ROADS crash database. (E-codes 810-819, 826-829)

Road user type	0-4 yrs		5-16 yrs		17-25 yrs		26+ yrs		not stated
	HMF	VIC ROADS	HMF	VIC ROADS	HMF	VIC ROADS	HMF	VIC ROADS	VIC ROADS
Driver	0	3	18	25	845	1517	1559	2508	1
Passenger	83	86	349	409	643	869	766	907	344
Motorcyclist	0	0	74	24	535	488	401	357	8
Bicyclist	68	5	772	256	208	137	263	151	34
Pedestrian	52	54	273	277	182	192	545	537	92
Animal rider or occupant of animal drawn vehicle	4		239		145		198		
Occupant of streetcar	0		1		1		18		
Other	22	0	137	3	255	13	415	18	20
Total	**229**	**148**	**1863**	**994**	**2814**	**3216**	**4165**	**4478**	**520**

Marked under-reporting to/by police appears to be a significant barrier to good quality road crash serious injury data.

Comparison of numbers of hospital admissions resulting from road crashes in Queensland is more difficult. Police crash data do not code admission to hospital as an injury severity level, but rather "requiring medical attention". The medical attention may be provided at hospital (with or without admission) or by a general practitioner. Thus one expects that many injured persons "requiring medical attention" would not qualify for recording on the Hospital Morbidity File.

It is unlikely that events corresponding to E817 Noncollision motor vehicle traffic accident while boarding or alighting or E818 Other noncollision motor vehicle traffic accident would be found in the Police reported crash database.

4.4 USE OF HOSPITAL MORBIDITY FILE DATA FOR MONITORING CRASHES RESULTING IN HOSPITALISATION

Analysis of hospital admissions data alone (without attempting to match with Police data) would provide information about:

1. total number of persons injured

2. patterns of injuries
3. demographics of persons injured
4. some location information
5. length of stay in hospital
6. assigned cost (not necessarily approximating true cost)

but little crash or pre-crash information. Importantly, it would not allow persons from the same crash to be grouped together. Thus, there is no simple method to determine the number of crashes resulting in hospitalisation from the Hospital Morbidity Files.

4.5 LIKELY OUTCOME OF LINKAGE OF POLICE AND HOSPITAL MORBIDITY FILES

Linkage of Police crash databases and Hospital Morbidity Files provides potentially the best method of improving information about crashes resulting in hospitalisation. The advantages of this method are:

- no new data collection would be required, thus avoiding hugely increased costs
- both systems operate in every jurisdiction
- both systems aim to be comprehensive
- the linked database would allow identification of persons from the same crash

While a system based on this method has the potential to provide national data, it would be necessary to conduct a separate linkage in each jurisdiction. This is largely because of the differences between the Police databases. The degree of uniformity of Hospital Morbidity Files is much greater. Furthermore, Hospital Morbidity Files are internationally compatible.

Another reason for separate linkages is shown by the different ratios of numbers of persons in the Hospital Morbidity File and the Police databases in the various states (Table 12). O'Connor (1992) showed that there were about twice as many hospital admissions according to Health data than Police data in NSW, Queensland, South Australia and the ACT, about 1.3 times as many in Tasmania and Western Australia and about the same number in Victoria. Other analyses in this report have shown that these ratios reflect a combination of under-reporting of crashes to Police and inaccuracy of coding of injury severity in the Police crash databases. It is the latter factor which seems to be responsible for the difference between the ratio found in Victoria and in other jurisdictions.

The inaccuracy of coding of injury severity suggests that linkage of all casualty cases in the Police file with the Hospital Morbidity File should be attempted, not just those cases coded by Police as hospital admissions. While this would increase the resources required for data linkage, it would increase matching rates.

The likely outcome of data linkage would differ among road user types. Table 11 shows that the degree of under-reporting to Police of persons admitted to hospital as a result of a road crash is least for vehicle occupants and greatest for nonvehicle

occupants (particularly when the latter are involved in a crash that does not involve a motor vehicle). The degree of under-reporting puts a ceiling on the maximum matching rate. Thus linkage would result in much better matching for vehicle occupants than for other injured road users. This pattern of matching rates was also found in the Western Australian Road Injury Database (Ferrante et al., 1991, see Table 2 of Part 1 of this report).

The high matching rate for vehicle occupants should allow a linked database to be used for studies of secondary injury prevention (i.e. vehicle occupant protection). These studies could include examination of injury patterns by crash configuration. In addition, checks on data quality could be conducted for those variables which appear in both data files (e.g. age, sex, injury severity).

On the other hand, under-reporting to Police should result in a low matching rate for non-occupants (particularly those in nonmotor vehicle crashes). The matched cases will not be representative of the population of injured non-occupants because of the over-representation of persons injured in motor vehicle crashes. The benefits of data linkage for this group are then:

1. identification of the proportion of total persons injured that fall into the Police data set and biases therein. This can aid in the interpretation of earlier studies based on Police crash data.

2. the ability to examine in detail injury characteristics and relationship to crash characteristics for those subsets of crashes (probably involving motor vehicles) for which match rates are appropriately high.

While every effort should be made to maximise matching rates, the characteristics of non-linked data are important. An assessment needs to be made as to the extent that non-linking results from imprecision in the recorded data, under-reporting of crashes and other factors. The information about non-linked data has a number of potential uses:

- identifying and quantifying under-reporting of road crashes
- identifying crash types for which hospital morbidity data provides better frequency information than the road crash database
- interpreting the results of previous studies which have relied on road crash data alone
- making recommendations for improvements to data collection systems.

4.6 POTENTIAL FOR WEIGHTING

Weighting the existing collection is a possible way to improve the data collection in areas where it can be shown that the Police crash reporting system is under-representing the number of that type of road traffic crash. Thus, weighting has particular application to improving data collections for crashes involving motorcyclists, bicyclists and pedestrians.

Weighting results in more accurate counts of the number of crashes of particular types but does little to improve the quality of the data. The contrast should be made with linking of databases which improves quality without necessarily improving the accuracy of counts.

The greater the degree of under-reporting, the larger the weighting factor and it is likely that the variability of the weighted estimate will be larger (see Hakkert and Hauer, 1988, for a discussion of related issues). Thus weighting would have little effect on data for drivers (for example) but much more effect on estimated frequencies and their variability for, say, bicyclists.

In using weighting, it is assumed that the police reported crash database would form the data to be weighted and the issue is that of which other data source should be used to derive the weights. Possible data sources for crashes resulting in hospitalisation include hospital morbidity files and special purpose data collections. The choice of the data source for weighting affects whether the weighted data are crash-, vehicle- or person-based and its level of specificity. For example, hospital morbidity data are person-based and so the resultant weighted Police crash data would be person-based. Weights derived from hospital morbidity data could be specific with respect to road user type and age but not with respect to, say, number of vehicles involved.

Another issue addressed in Part 1 of this report is that of the generalisability of weights among jurisdictions and across time.

The accuracy of weighted data will be less if there is bias as well as under-reporting in the Police reported crash database. If, for example, the under-reporting of motorcycle crashes to Police is greater for unlicensed motorcyclists, then a weighting factor for motorcycle crashes as a whole derived from hospital morbidity data would not correct for the underlying bias.

4.7 UNIVERSAL THIRD PARTY INSURANCE

Establishment of a national equivalent to the Victorian Transport Accident Commission would greatly enhance methodology for data collection. A comprehensive range of useful information on each crash would be available and national road crash data could then be validated and consistent. It would be reliable and may provide an unbiased estimate of national figures, except for the most minor injuries which are below the claim threshold.

4.8 SURVEYS OF THE GENERAL PUBLIC

The role of surveys of the general public in improving data collection for casualty crashes is discussed in detail in Part 1 of this report. Potential roles of surveys of the general public in improving data collection methodologies include determination of the extent of under-reporting. Surveys could focus on crash types or road user types for which it is expected from previous research that the degree of under-reporting is

large. Survey information could not be used for detailed follow-up and linkage unless confidentiality issues could be overcome.

In framing survey questions, injury should be categorised by severity (killed; hospital admission; other medical treatment; injured, not treated) and road user type to allow a reference base for other data collections. It is likely that a very large sample would be needed to provide national data able to be sufficiently disaggregated. Thus the cost of a national survey could be considerable.

The cost of a specific purpose survey to collect information on involvement in crashes resulting in hospitalisation is likely to be large. A number of possibilities exist for reducing this cost:

1. surveying only once every several years (as occurs with the Survey of Motor Vehicle Usage)

2. using the survey to collect information about crash involvement at all levels of severity

3. including questions about all kinds of injuries, not just those resulting from road crashes

4. inclusion of questions relating to injuries resulting from road crashes in a Census or other wide-ranging survey. The NSW Roads and Traffic Authority competed unsuccessfully to have the ABS supplementary household survey dedicated to traffic crash involvement in NSW in 1992. However, a co-ordinated ABS supplementary survey between more than one state could have good potential for the future.

4.9 IN-DEPTH COLLECTIONS MADE BY TRAUMA CENTRES

Currently, trauma centres and other major emergency departments in NSW and Victoria collect and computerise in-depth major trauma data, particularly relating to the medical management of casualties following road trauma. However, minimal details about the crash are collected. Such systems are designed for the specific purpose of monitoring the quality of medical management and for comparisons with other centres, rather than for the enumeration of cases or for prevention purposes. Early computerised programs did not include statistical analysis packages, though such programs are now increasing in their level of sophistication.

There may be potential for including additional crash data items in such programs in the future for specific purpose major trauma studies. However, the rights to such programs are mostly owned within the United States. Hence program changes are both difficult and costly to incorporate.

Such collections provide more comprehensive quantifiable data than other data systems on severity of injury, which includes the Trauma Score (a physiological

measure) as well as AIS scoring. Limited outcome measures are also included in such collections.

4.10 POTENTIAL FOR SPECIAL PURPOSE STUDIES

There is considerable potential for improving the quality of casualty road crash data for particular issues by means of a wide range of possibilities for specific purposes studies. Many examples of such studies exist in the published literature (for example, Fildes et al, 1991, "Passenger Cars and Occupant Injury").

However, comprehensive studies to quantify road trauma for specific purposes may be more difficult to conduct. If, for example, information beyond normally coded data were required on all cases (or a representative sample) of severe head injury resulting from road crashes identified in the Hospital Morbidity File, each hospital's authority would be required to access additional information from patient medical records and this information would need to be manually extracted (often from a file of considerable length).

This report does not recommend the establishment of a new special purpose hospital based data collection for casualty crashes. Such a system would be expensive to establish and maintain. In addition, a single purpose database for road trauma would compete for limited emergency department resources such as space and staff support with more comprehensive and potentially more useful databases (e.g. for all injuries).

4.11 METHODS OF VALIDATION AND QUALITY CONTROL

For a number of reasons, casualties of road crashes may be treated differently in different places. It is important in monitoring "serious injuries" from road crashes, currently defined as hospital admitted, to compare like with like as far as possible.

Greater than 99.5% of admissions to public hospitals are assigned a diagnosis and are included on the Hospital Morbidity File, according to state health authorities. On-line editing exists in most jurisdictions for injury data entry. Thus, for example, every patient who has a diagnosis in the injury range must receive a mechanism of injury code (E-code).

Medical Records Administrators undertake a three year training course to equip them with appropriate data coding and management skills. Universally accepted coding manuals are used and updated information is published annually in re-prints and reinforced by newsletters within states (e.g. Victoria). However, validation and inter-rater reliability studies are not regularly conducted.

It seems likely that Abbreviated Injury Scale (AIS) scoring would be required in the proposed study to validate the severity of injury required for patients to be admitted to hospital and the variability in this criterion across hospitals. Clearly, it would be

advantageous for data collections of non-hospitalised (and hospitalised) patients to be consistent in this regard.

Possible reasons for differences in the level of AIS severity resulting in admission include the following:

- Single AIS scores are not good indicators of the severity of injury where multiple injuries are present
- AIS scoring alone is of limited value in assessing physiological status (e.g. blood loss)
- Availability of hospital beds
- Distance of residence from hospital for review or follow-up purposes
- Availability of specialist consultation - may need to wait in hospital for a day or two
- Availability of day surgery and short stay wards, which may not be classified as admissions
- Availability of high technology equipment (eg CAT scans) which may eliminate the possibility of serious injuries more quickly in major hospitals

CHAPTER 5 SUMMARY OF RECOMMENDATIONS: CRASHES RESULTING IN HOSPITALISATION

A detailed list and discussion of recommendations for improved data collection methodologies for crashes resulting in hospitalisation is given in Chapter 9 of this report. Briefly, the recommendations detailed there are:

1. Linkage of road crash database and hospital morbidity file to improve data quality.

2. Use of hospital morbidity file to more accurately monitor serious injury rates from road crashes, using age specific population data as the denominator.

3. Abbreviated Injury Scale (AIS) scoring to validate the severity of injury required for patients to be admitted to hospital and the variability in this criterion across hospitals.

4. Augmentation of crash and hospital admissions databases.

5. Inclusion of crashes reported to property damage insurance companies.

PART 3:
DEVELOPMENT OF DATA COLLECTION METHODOLOGY: CRASHES NOT RESULTING IN HOSPITALISATION

This part of the report focuses on those aspects of data collection methodology unique to crashes not resulting in hospitalisation. However, the more seriously injured road crash casualties may pass through common medical treatment systems (e.g. hospital emergency departments). Thus there may be overlap between data collections, and a need to avoid duplication of enumeration.

CHAPTER 6. BACKGROUND

It is often thought that crash numbers form a severity pyramid, which has as its apex fatal crashes and, as its base, property damage only crashes. From this view it is expected that crashes not resulting in hospitalisation would be more numerous than those resulting in hospitalisation. A study by Harris (1990) of the real number of road traffic crashes in the Netherlands concluded that between August 1986 and July 1987, 18,000 crash victims were admitted as inpatients to a hospital, a further 117,00 were treated as outpatients, another 105,000 were treated by their local doctor without needing hospital treatment and slightly more than 100,000 received no treatment at all.

A study of non-admitted road crash casualties would necessarily be of a largely exploratory nature since good data are not precedented in this area in Australia and probably elsewhere. However, MUARC experience suggests that a new system based on parts of several of the methods identified in the FORS project outline and the specific objectives would provide the most appropriate option for an improved data system. Each of these is discussed below. Clearly a defined cut-off point for injury severity would be required, and it is suggested that this would be at the level of crash victims seeking medical attention (but not admitted to hospital).

While it is clear that police reports contain the best vehicle and location data nationally, casualty road crashes are known to be seriously under-reported in this system. They are also likely to be under-estimated in insurance systems which have an "excess" level, below which a claim cannot be lodged ($344 for medical expenses in the case of the Transport Accident Commission). There are a variety of hospital data systems operating in Emergency Departments which could contribute. However, although some of these are widely used, there is not general consistency.

The current data systems that have been used to ascertain casualty road crashes not resulting in hospitalisation have many deficiencies. In seeking to improve the data collection methodology for casualty crashes not resulting in hospitalisation it appears that use of Police road crash data, injury surveillance data (ISIS), other Emergency Department data and General Practitioner sampling hold promise. The latter sources

are rich in information about the injuries sustained by road users and contain useful information on whether follow-up treatment was required, as well as occupant details such as seating positions and restraint use.

6.1. SPECIFIC OBJECTIVES

The specific objectives of this study are:

1. To explore the feasibility and utility of:
    - maintaining the status quo
    - augmenting/expanding and making uniform the existing database by including supplementary data from a range of possible sources
    - weighting the existing collection in areas where it can be shown to be under-representing road traffic crashes not resulting in hospitalisation
    - using a hospital based system possibly based on ISIS and CAS2 or similar systems to create a new specific purpose data collection for casualty crashes
    - surveys of the general public
    - General Practitioner sampling to augment other systems
    - combinations of the above
2. To address the strengths and weaknesses of such systems for the purposes of both macro and micro level uses of the data.
3. To establish methods of validation and quality control for any proposed systems
4. To consider the ethical and privacy implications, particularly constraints on any proposed systems, and possible solutions
5. To provide an outline of the techniques and processes which would be required to develop such systems
6. To examine in general terms the relative costs of proposed systems

6.2 CURRENT STATUS OF POLICE CRASH DATA COLLECTION

Casualty crashes not resulting in hospitalisation (i.e. those resulting in treatment in a hospital Emergency Department or by a general practitioner) are legally required to be reported in each jurisdiction. However, they cannot be identified using the accident severity variable in Victoria, South Australia, Western Australia and the ACT. For this reason, even investigation of the degree of under-reporting of these crashes is difficult. Other studies suggest that under-reporting is likely to be a greater problem at lower severity levels and so is likely to be quite high for casualty crashes not resulting in hospitalisation.

Characteristics of the Police crash data collection are discussed in detail in Part 1 of this report (see Section 2.2).

6.3 INSURANCE COMPANIES

As noted in Part 1, (see Section 2.3) third party injury insurance is compulsory in each State and Territory. Motor vehicle insurance is not compulsory, however. State comparisons of these forms of insurance have been published by the Australian Automobile Association (Australian Automobile Association, 1991).

It should also be noted that insurance claims (whether for third party injury or for property damage) necessarily relate only to those crashes in which a motor vehicle was involved.

6.3.1 Third party insurance

In each jurisdiction the third party injury insurance schemes have a lower threshold for claiming than for property damage only claims, which could influence the proportion of casualty crashes not resulting in hospitalisation which are reported to the scheme. The threshold is generally expressed in monetary terms, rather than in terms of injury severity, however. The threshold is, for example, $344 in Victoria. The levels of the thresholds are lower than the cost of one day in hospital, thus one expects that all motor vehicle related crash injuries requiring hospitalisation would qualify for a claim to be submitted. However, several General Practitioner consultations and/or diagnostic tests such as X-rays would be required to reach the $344 threshold. The proportion of crashes not resulting in hospitalisation which would have costs above the threshold, and therefore possibly be found in the third party insurance database, is unclear.

Another source of data collection is provided by the Victorian Transport Accident Commission database. MUARC has worked extensively on this database merged with the VicRoads database of Police accident reports and produced a data set which has good road user, vehicle and injury information for road crashes with relevant environmental and crash data on a case by case basis (Fildes, 1990). The Transport Accident Commission database provides information on a wide variety of variables including such items as nature of services provided under medicare rebates, costs of

services, payouts rendered, and other information on people seeking compensation for injuries as a result of road crashes.

6.3.2 Motor vehicle insurance

Motor vehicle insurance is offered by a range of Government- and privately-owned insurance companies. There are multiple providers in each jurisdiction.

The overlap between crashes reported to motor vehicle insurers and those in the road crash databases is likely to be less than was the case for third party injury insurance because not all claims are crash-related and not all crashes result in claims (see Part 1, Section 2.3.2 for more details).

Workers compensation schemes should not be overlooked as a source of data for work-related road crashes.

6.4 HOSPITAL EMERGENCY DEPARTMENT DATA SYSTEMS

Emergency Department data are likely to be progressively computerised. The CAS2 system is used in Emergency Departments for patient management purposes in at least two States in Australia and its use and that of similar systems is increasing. These systems may be useful in identifying non-admitted road crash victims in a general sense and could contribute information about injuries sustained and patient discharge (home, outpatient referral, etc). As a minimum, they have the capacity to count all injured patients attending for treatment. A further advantage is that in some hospitals these data could potentially be linked to NISU data, thus providing more comprehensive information about the crash and circumstances leading to the injuries.

The development of a more useful nationally agreed data set (an expanded minimum data set on injury compared with CAS2) is under discussion between the National Injury Surveillance Unit, the Public Health Association's Injury Special Interest Group and the College of Emergency Medicine and initial data collections are currently being trialled in at least one cluster of hospitals in Victoria. Centralization of data collections would be required for the purposes of enumerating and monitoring trends in road trauma.

Other hospitals have good but unique systems for recording emergency attendances. These are probably of little use nationally apart from their potential contribution to validation exercises or for helping to determine weighting factors.

No hospital based system is ever likely to be able to provide details about uninjured vehicle occupants because this information is simply not reliably available to hospitals, and will remain irrelevant to their primary function of medical treatment.

The potential disbenefits of introducing an entirely new hospital based collection are enormous particularly in terms of cost and such a system could place at risk existing

systems with wider functions at risk. Since road trauma contributes only approximately 15% of all injury cases presenting to hospital emergency departments (VISS), this would be difficult to justify.

6.5 NATIONAL INJURY SURVEILLANCE SYSTEM

The National Injury Surveillance System is purpose designed for the collection of injury data including that resulting from road crashes. It aims to collect data on all injury cases presenting to participating hospitals around Australia. The large majority of these cases (approximately 80%) are not admitted to hospital. Details of the rationale for such systems is provided in the recent medical literature (Vimpani 1989; Vimpani and Hartley, 1989).

In this System, clusters of treatment centres (mostly hospital Emergency Departments) in all States and Territories, except the Northern Territory, collect information on the circumstances of injury in presenting patients. These data are largely self-reported and do not yet have a well developed sampling framework. Nevertheless, useful information such as road user category, occupant seating positions, use of restraints and helmets, etc is recorded. One line case narratives are also available and these have the capacity to provide details of non-collision injuries such as dinking injuries related to bicycles and vehicle door finger-jam injuries are identified.

Some of the advantages of this purpose designed system, which is still in its development phase, are its potential to develop a national sampling framework, its current concentration on quality control issues including aiming to achieve close to 100% ascertainment of all cases at participating hospitals (already achieved in some Victorian hospitals), its adaptability, and its timeliness. For example, the Victorian Injury Surveillance System (VISS) includes location of injury incident (by post-code), as well as post-code of residence in its collection, and other Centres are expected to follow suit. This addition would be of considerable importance for FORS purposes. Most data input occurs within two weeks of the injury and becomes immediately available for public access. A recent example of the usefulness of this timeliness was the publication of a VISS report on the effectiveness of the Victorian bicycle helmet legislation introduced in July 1990 (Ozanne-Smith and Sherry 1990).

Injury Surveillance data are not designed to provide information about non-injured road users (from the same crashes) or precise crash location or vehicles involved. The data may not reveal much about some pre-crash factors relating to the injured road user (eg a driver's length of time at the wheel).

The National Injury Surveillance System has the additional advantage of the potential for individual patient follow-up to obtain further specific information where required. This has been precedented by several MUARC studies. This methodology is made possible by the fact that approximately 80% of patients give preliminary consent for follow-up at the time when they complete the initial Injury Surveillance form. This largely overcomes the confidentiality/privacy issues in reaching the initial patient consent stage which can be a major barrier in negotiations with hospital ethics

committees who have responsibility for the approval of research of this nature on an individual hospital basis. One example for this type of study could be simply to determine the level of under-reporting of crashes by road user type by means of telephone interviews of injured persons.

The NISU system also has the potential for being incorporated into a more detailed data system. For example, such an expanded system is being used in a research study at the Royal Victorian Eye and Ear Hospital, where the front page of the NISU data form is being used together with hospital generated additional data collection forms to collect comprehensive eye injury data.

The current future of the ISIS system is promising, but unclear. If a data collection methodology were to rely heavily on NISU data, means for guaranteeing the future survival of the system would need to be put in place.

Quality control measures in the ISIS system include training of coders, auditing of inclusion rates, reviews of inter-rater reliability in coding, and duplicate coding of 10% or more of cases (at least in Victoria). In addition, statewide hospital admission data comprise a useful source for validating the quality of Injury Surveillance data and the representativeness of its catchment populations for the admissions component of the total injury presentations.

Importantly, the ratios of non-admitted to admitted patients at rural hospitals and clusters of metropolitan hospitals participating in injury surveillance can be used as the basis for state and national estimates of non-admitted hospital presentations by road user types.

Similarly, multipliers for general practitioner attendances as the result of road crashes could be estimated from population studies of general practice where injury surveillance is also conducted and the catchment area is known (the Latrobe Valley could offer good potential for a pilot study of this nature, because of its injury surveillance system and known catchment population).

6.6 SURVEYS OF THE GENERAL PUBLIC

Surveys of the general public are discussed in some detail in Part 1 of this report (see Section 3.5). Such surveys are probably better suited to collecting information about crashes not resulting in hospitalisation because the current status of data collection about these crashes is so poor.

Surveys of the general public can be conducted in each jurisdiction, thus avoiding problems of lack of standardisation among jurisdictions of Police crash data systems.

6.7 SAMPLING OF GENERAL PRACTITIONER PRESENTATIONS

To date, it has not been possible to identify the size and nature of the injury problem in Australia at the less severe end of the severity scale (that is, injuries treated in General Practice). Sampling of GP's could provide estimates of non-hospital treatments for road crash casualties. General practitioner records ***could*** provide one of the best sources of morbidity data since they originate with the usual doctor or first contact and in the last 30 years there has been increasing recognition of the importance of morbidity studies for epidemiologic purposes.

Two major large-scale morbidity surveys were undertaken in Britain by the Royal College of General Practitioners and the Office of Population Cencuses and Surveys over 12 month periods in 1955-1956 and 1970-1971. In Australia, the 1962-1963 Australian National Morbidity Survey was organised jointly by the Australian College of General Practitioners and the National Health and Medical Research Council (Bridges-Webb, 1976). Eighty five GP's throughout Australia recorded data from February 1962 to January 1963.

A larger survey, the Australian General Practice Morbidity and Prescribing Survey, began in April, 1969 and extended over a six year period to 1974. In this period information was obtained about more than one million doctor-disease contacts and over half a million new disease episodes from more than 7000 doctor-weeks of recording. This survey shows patterns of disease presentation, patient contacts and medical care across Australia, reported by General Practitioners in each capital city and in the non-metropolitan area in each state with the aim of being proportional to its population. Comparisons of the two Australian General Practice studies showed the relative proportions of accidents, poisoning and violence to be 12.9% of all disease contacts in 1962-63 and 4.9% in 1969-74. The male/female ratio changed from 71:29 in 1962-63 to 60:39 in 1969-74. This decrease may be partly accounted for by an increase in casualty services from public hospitals, particularly in the cities (Bridges-Webb, 1976).

In 1973 the work load of a typical General Practitioner included approximately 280 episodes a year (6-7% of all new episodes), requiring 500 contacts, classified as accidents, poisoning and violence. It was estimated that this meant more than three million general practitioner attendances Australia wide in 1973, or 4.6% of presentations. Assuming 9% (from Shire of Bulla study discussed below) of these cases to be road trauma, the national total general practitioner visits for new cases of road trauma would have been 270,000 for 1973. A comparison of relative frequencies of new episodes of accidents, poisoning and violence presenting to metropolitan and non-metropolitan General Practitioners in 1973 showed 2162 cases (7.51%) in the metropolitan sample and 2202 (8.19%) in the non-metropolitan sample (Bridges-Webb, 1976).

Unfortunately, these General Practice studies provide no further disaggregation of accidents, poisoning and violence so that road trauma cannot be separately identified, and it can only be concluded that it accounted for less than the total injury component of General Practice attendance.

If road trauma by road user type were identifiable within such General Practice surveys, they could provide an important reference and a base line for road safety research particularly for those casualties not resulting in hospitalisation. These studies reflect the types of illnesses brought to the average GP and in what proportions, from which age groups the bulk of patients come, the number of contacts required for each episode of a particular disorder, and many other variables.

More recently a National General Practice Evaluation Program co-ordinated by the National Centre for Epidemiology and Population Health commenced in January 1991 and is currently running for a three year period. One major aim of this program is to provide a growing body of data about general practice, and the interactions which occur within it, which could provide useful information for data collection methodologies for non-hospitalised casualties.

A pilot study of injuries presenting to General Practice was undertaken by the Monash University Accident Research Centre in the Shire of Bulla over a one month period in 1991, as part of a community based injury prevention project. Of 193 new injury cases reported by 17 General Practitioners, only 9% occurred on public roads or footpaths. None of these required referral to hospital. The 11 cases which occurred on public roads comprise 5 vehicle occupants, 5 bicyclists and 1 pedestrian. Further, more comprehensive studies of this nature are recommended for known populations, in order to determine rate data.

Another system with potential for Australian application comes from the Read Clinical Classification (RCC) now accepted as the standard for British General Practice and operating in 90% of General Practice in the United Kingdom. The Read Codes were designed and developed primarily for clinical use and are structured so as to facilitate the analysis of clinical data for management purposes. They are a coded classification/nomenclature of medical terms specifically for use by clinicians in day to day patient care covering areas such as diseases, occupations, history/symptoms, diagnostic procedures, preventative procedures, examinations/ signs and administration. They enable a complete medical record to be coded and stored in a computer system and contain mapping fields to enable the data to be linked to, and reviewed by, the structures of common statistical classifications, including E-codes.

Currently the codes are being used in consultations by some 10,000 GP's. They have been implemented in several major hospitals in Britain, a further 20 - 30 hospital implementations are planned in England and Scotland and there is some interest in adopting the codes in Australia.

Despite the widespread computerisation of information using the Read Classification in the United Kingdom, centralization and analysis of injury data have not been reported.

6.8 USE OF WEIGHTING TO IMPROVE DATA COLLECTION

Weighting is discussed in some detail in Section 3.4. In that section it was noted that weighting was more relevant to improving data collection for crashes not resulting in hospitalisation than for more severe crashes. A complete data collection for crashes not resulting in hospitalisation is not feasible because of the very large amount of resources required and weighting allows improved data collection while collecting data on only a subset of the relevant crashes or injuries.

The base data to be weighted could be collected by injury surveillance systems Emergency Department data systems, General Practitioner sampling, surveys or special purpose data collections. As noted elsewhere in this report, these data sources vary in their degree of coverage and degree of detail. It is likely that all of the data sources would be person-based, rather than crash-based. Thus the final data would also be person-based, with no simple method for counting the number of crashes not resulting in hospitalisation.

It is likely that weights would be derived by scaling up from a known catchment for the base data to the population as a whole. For example a survey of a road crash injury presentations to 1 in 100 Australian General Practitioners could be weighted by a factor of 100 to obtain an estimate for the country as a whole.

As noted in Section 3.4, weights could differ across geographical areas or change with time. Such discrepancies might result from, for example, different injury thresholds for admission to rural or city hospitals or with changes in this threshold over time. Periodic auditing of weights would be necessary for this reason.

Weighting has the potential to improve estimates of casualties in crashes not resulting in hospitalisation (or, more strictly, numbers of casualties not admitted to hospital) but weighting the data collection will not necessarily improve data quality. If there is a weakness in the data base, then this weakness will be retained in the weighted data. Such a weakness could take the form of a bias in reporting to injury surveillance systems or in presentations to General Practitioners.

6.9 METHODS OF VALIDATION AND QUALITY CONTROL

The greatest problem in the quality of non-hospitalised casualties is the incomplete nature of data collections. This could be addressed, in time, by the methods outlined above.

Several issues of definition of cases overlap with those applied to hospitalised crash casualties (section 4.10 of this report). In particular, clarification of the criteria which determine hospital admission versus non-hospital admission (which loosely corresponds with serious or non-serious injury in the current systems) is required in all jurisdictions.

Quality control methods currently applied to police, hospital admission, and injury surveillance data collections are outlined in sections 4.2, 4.10 and 6.5 of this report.

6.10 COSTS OF THE SYSTEM

The plausible cost of a final system depends on its sophistication. It is possible that data might be collected on a periodic basis, perhaps every second or third year. A system in which outcome data are collected less frequently than occurrence and crash type data is possible.

Integration of, and other improvements to, existing systems would be expected to be most cost effective. The estimated costs of the specific purpose studies recommended by this report are outlined in terms of person days in Chapters 9 and 10.

CHAPTER 7. SUMMARY OF RECOMMENDATIONS: CASUALTY CRASHES NOT RESULTING IN HOSPITALISATION

Because of the large numbers of non-hospitalised road crash injuries it would seem unlikely to be feasible (and also unnecessary for FORS purposes) to attempt a complete collection. The development of a sampling frame would appear to be both feasible and sensible given potential Police and hospital database sources and the possibility of sampling of General Practitioners and Community Health Centres, who service the same populations, from time to time. A sampling methodology of this type should also provide possibilities for increasing the amount of data items collected and adequate quality control.

In seeking to improve the data collection methodology for casualty crashes not resulting in hospitalisation it appears that use of Injury Surveillance System data, other Emergency Department computerised data and General Practitioner sampling hold promise. Such sources are rich in information about the injuries sustained by road users and contain useful information on whether follow-up treatment was required. Statewide hospital admissions data comprise a useful source for validating the quality of Injury Surveillance data and the representativeness of its catchment populations, at least for admitted patients. It is recognized, however, that health sources are currently weak on pre-crash data, and that relating to non-injured vehicle occupants.

A detailed list of recommendations for improved data collection methodologies for crashes not resulting in hospitalisation is given in Chapter 10 of this report. Briefly, the recommendations detailed there are:

1. Use of hospital Emergency Department data to identify non-admitted road crash victims for the purpose of enumeration, and other limited descriptive epidemiological purposes.

2. General Practitioner sampling to estimate the proportion of primary (and repeat) GP attendances which result from road crashes and then scaling up using Medicare information on total numbers of GP attendances, or using emergency department presentations and hospital admissions for scaling purposes.

3. Use of Injury Surveillance System data for case identification to follow up injured persons not admitted to hospital.

4. Use of Injury Surveillance data to link with road crash databases to better describe crash types resulting in less severe injuries and to determine the extent of under-reporting of injuries of this severity in Police reports.

PART 4:
CONCLUSIONS AND RECOMMENDATIONS

This section of the report presents conclusions and recommendations from Parts 1, 2 and 3. It begins in Chapter 8 with those conclusions and recommendations about casualty crash data collection in general. More specific conclusions and recommendations of proposed studies then follow in Chapters 9 and 10.

The major issues addressed by these projects are improvements to the quantitative (counting) and qualitative (research) aspects of casualty crash data. Improvements to road crash statistical collections would be expected to lead to more accurate costing of crashes and may cause a change in direction of prevention programs if the size of the problem is found to vary from that previously understood.

While most of the report focuses on the collection of data, it should be noted that the contribution that the data can make to prevention of crashes and resultant injuries is also determined by the use that is made of the data once it is collected. How much use is made of data depends on its availability (feedback), ease of use and access to resources to examine the data and implement changes.

It should be noted that, for the purposes of intervention, a casualty crash data collection can be most effectively used if the appropriate exposure information is available.

Summary of the status quo

Background

The Federal Office of Road Safety (FORS) has, in the past, relied almost exclusively on data about fatal road crashes to develop road safety policy. Although such data are of high quality and relatively accessible, there is concern that they do not adequately describe the factors involved in less severe crashes - which, because of their relatively high frequency, are estimated to account for the bulk of total costs associated with road crashes.

Each state and territory government has its own databases which describe road crashes taking place within that jurisdiction. All jurisdictions collect information on fatal crashes and those involving "serious injury", defined consistently since 1980 as resulting in at least one night's stay in hospital. The amount of information collected about crashes below this level of severity varies among jurisdictions.

The information about all crash types, for the most part, reflects only what has been recorded by the police. Thus the amount of information collected is somewhat limited, and there is a certain degree of unreliability in the data. In addition, there is considerable incompatibility between the various collections across the country.

The Australian Bureau of Statistics currently provides to FORS an aggregation of compatible variables from each of the various state and territory databases (based mainly on police records). Although relatively inexpensive, this collection is limited in the range and reliability of information available, and is likely to be unrepresentative of total serious injury crashes.

In addition, much road safety research has been based on the use of Police-reported crash data.

Report Findings

This report confirms that road crash databases have major problems in terms of under-reporting and inaccuracy in coding of crash severity and lack of information on the nature of injury. The magnitude of these problems varies among jurisdictions and among crash types, and non-standardisation of reporting between states and territories compounds the problem. Under-reporting is greater for crashes involving children and non-motor vehicles.

The report has identified a number of sources of data for casualty crashes, some in the road crash data area and others in the health data area. These include Police Accident Reports, Hospital Morbidity Files, the National Injury Surveillance System, Ambulance Service Reports, and others. Differences between health and road data should be recognized. Health data are person based while Police road crash data are generally crash based. Health data provide good information on the nature and severity of injuries by road user type and broad categories of mechanism of injury. However, they provide no information on uninjured persons in the crash and there is an inability to link injured persons from the same crash, while road data provide little personal information on injured persons other than the driver (in some jurisdictions) such as postcode of residence. Little pre-crash information and no precise crash location are provided in health data.

Each data collection is primarily for its organisation's own purpose, yet gives information on a variety of road crash and injury characteristics which is relevant to road safety research.

The strengths and limitations of these systems and a comprehensive description of their current status is provided in Chapter 2.

The detailed recommendations in Chapters 9 and 10 of this report emerge from the deficiencies identified in the status quo and the identified potential for improvements in data collection methodologies.

CHAPTER 8. GENERAL CONCLUSIONS AND RECOMMENDATIONS

8.1 WHO PAYS AND WHO BENEFITS

While it is relatively easy to identify and suggest improvements to data collection methodologies, there needs to be some consideration of why the improvements have not already been implemented. Often it is the case that the benefits and costs of improvements to these systems accrue to different agencies. As an example, the Police would be unlikely to benefit directly from improvements to data collection although they would be likely to bear much of the cost. The benefit would accrue to the road authorities and others with responsibility for road safety who have neither the financial responsibility nor control of the initial data collection. However the distinctions are not always clear cut, for example in Victoria (and perhaps other States), users such as VIC ROADS and the Transport Accident Commission already contribute to the cost of Police Traffic Accident Data collection and processing, while Police have direct road safety responsibility.

Although the health system theoretically benefits from reductions in road crash casualties, the savings over costs of data collection could be expected to simply be re-distributed to other sectors of health care to meet increasing demands (due to the demands of the ageing population, increasingly expensive technology, etc). This would be particularly likely because of the gradual rather than sudden savings from road trauma. Thus nett cost savings would not be expected, and no direct benefit to those responsible for data collection may accrue. Indirect benefits to the health sector may result from improvements to the injury data collection, particularly for their administrative and clinical research purposes.

8.2 PROMOTION OF DATA COLLECTION

Completion of data collection forms competes with a range of other tasks for the priorities of both individuals and organisations. It is likely that data collection receives low priority. This may be one cause of poor quality of data collection or lack of timeliness.

In approaching this difficulty, it is suggested that the collection of data be promoted. As Drummond and Vulcan (1989) suggest, this can be addressed by:

- emphasising the importance of prompt data reporting and the important role that the person/organisation plays in furnishing data
- providing feedback on the uses to which the data has been put
- providing feedback on timeliness ***to*** the organisation or section thereof.

Mechanisms for promoting collection of data could include input into training of persons responsible for data collection (police officers, medical personnel).

8.3 INTERPRETATION OF PAST FINDINGS

Much road safety research has been based on the use of Police-reported crash data. This report has shown that these data have three major problems: under-reporting and inaccuracy in coding of crash severity, and lack of information on the nature of injury. The magnitude of these problems varies among jurisdictions and among crash types. As shown earlier, under-reporting is greater for crashes involving children and nonmotor vehicles.

> Basing decisions on reported accidents makes the safety problem appear to be smaller than it really is; it also mixes and confuses changes and trends in safety with changes and trends in the inclination to report or record accidents.
>
> Second, virtually all that has been said (in safety) about the statistical significance of the differences between means, about the significance of a deviation from an expected value or about the size of confidence intervals, requires re-examination. (Hakkert and Hauer, 1988, p.8)

Hakkert and Hauer also note that the accuracy of estimation of road safety improves sharply as the reporting rate increases and the accuracy with which the reporting rate is known increases. "This serves to emphasize the importance of completeness in accident reporting and supports the need for better information about the magnitude of p_i [reporting rate] by accident type" (p.9).

"If one is interested only in ... the relative change of safety, the requirement of paramount importance is that the entities the reported accident histories of which are being compared ('before' vs. 'after' or 'without' vs. 'with') have the same probability of an accident to be reported. If that requirement is satisfied, the effect of incomplete reporting is merely that of prolonging the time required to collect a fixed amount of accident data. In as much as the probability of an accident to be reported increases with its severity, each severity class has to be considered separately". (p.9)

"As the amount of accident data increases, the uncertainty about the differences in the probability of reporting begins to dominate and soon forms the limit on the accuracy of which the safety effect of a treatment can be known" (p.9).

What are the implications of these problems for the interpretation of past research findings? Clearly recorded crash numbers should be considered as under-estimates of the true number of crashes. This also has implications for cost of road trauma studies.

Perhaps studies of bicycle injuries which utilised Police data should be treated with most caution because they are likely to be based on a biased sample of bicycle crashes, over-representing those involving a motor vehicle.

8.4 EXPOSURE

A crash data collection system can be most effectively used if the appropriate exposure information is available. Exposure surveys for specific road user groups (e.g. cyclists and pedestrians) need to be purposely designed to measure their "exposure to risk" of crash involvement. A recent study undertaken by MUARC for child and adolescent pedestrian and bicyclist exposure in metropolitan Melbourne provides an example of methodology for such studies (Drummond and Ozanne-Smith, 1991).

8.5 AUGMENTING OR IMPROVING THE EXISTING POLICE *ROAD CRASH DATABASES*

The two major problems which were identified were those of under-reporting and inaccuracies in coding (particularly of accident severity).

Requiring that Police accident report forms be filed as a condition of claiming third party injury insurance would increase reporting rates for crashes involving motor vehicles at least.

Standardisation of road injury data among jurisdictions has potential benefits but the likelihood of this occurring is remote (except for a small number of data items only). Thus while this would be a very helpful outcome, it is considered to be unlikely to occur and thus is not discussed in any detail in this report.

There would be some advantages if details of property damage only (PDO) crashes were made available for inclusion in the road crash data system. General information on PDO crashes is important for overall costing of traffic crashes, and in devising appropriate road and traffic engineering treatments. Moreover, Sanderson & Hoque (1987) estimated that costs associated with PDO accidents represent some 50% of the cost of all road crashes.

8.6 ESTABLISHMENT OF A NATIONAL THIRD-PARTY COMPULSORY INJURY INSURANCE SCHEME

An ideal method to improve data collection for casualty crashes involving motor vehicles would be the establishment of a national third-party compulsory injury insurance scheme (a national equivalent to the Victorian Transport Accident Commission). Such a scheme would be most successful if it required Police accident reports with each claim, recorded the accident report numbers to facilitate matching data and supplied this number to the hospital and Coronial data systems where appropriate. This would greatly enhance methodology for data collection. A comprehensive range of useful information on each crash would be available and national road crash data could then be consistent. Unfortunately, the future of even

State-run third party insurance schemes is currently uncertain. In a number of jurisdictions a change of government could lead to privatisation of the scheme, as occurred in New South Wales.

8.7 PROMOTION OF DATA LINKAGE

Data linkage offers promise for improvement of the quality of data for casualty crashes and for identification of parts of the data collection system that are not working well (see Recommendation 1 in the following section). It is recommended that the Prime Minister's Road Trauma Advisory Group be encouraged to promote data linking and that the possibility of a national workshop on linking for road crash data and, possibly, for other types of injury data be investigated.

8.8 IMPROVEMENTS TO THE RATE OF BLOOD ALCOHOL LEVEL REPORTING FOR ROAD CRASH CASUALTIES ATTENDING HOSPITAL

Information on the blood alcohol levels of persons involved in crashes resulting in hospitalisation (and those crashes not resulting in hospitalisation) is generally far from complete. Data comprise the results of breath tests of persons who do not attend hospital (e.g. non-injured drivers), which are taken by police officers, and blood tests of injured persons who attend hospital, which are taken by hospital staff.

The reasons for the missing data are likely to differ for the two sources of alcohol levels information. This project focuses on the latter problem.

In addition to an apparently poor compliance rate in taking samples within the hospital sector, there is also a poor match between samples and police reports, so that full utilisation of available data is not possible. It is recommended that a study should be undertaken to determine the reasons for poor compliance and failures to match cases, and to make recommendations for improvements to the current systems.

8.9 MISCELLANEOUS

The identification of the nature of the service provided under Medicare rebates, should it be implemented, could be a further potential source for validating national road crash injury data. Finally, the potential exists for the inclusion of Census questions relating to injuries resulting from road crashes. This too could be a means of validating the inclusion rates determined from other sources on a one-off basis.

CHAPTER 9. RECOMMENDATIONS FOR IMPROVING DATA COLLECTION METHODOLOGIES FOR CRASHES RESULTING IN HOSPITALISATION

The following were identified as possible approaches to data collection:

1. Status quo - this has the advantage of not requiring additional expenditure
2. Weighting of Police data - this would allow estimation of total numbers but may be expensive if large scale surveying was needed to estimate the weights
3. Augmenting Police information - sampling may be possible, rather than augmenting all the records. This method has a number of confidentiality problems, however.
4. Hospital based systems - are generally representative but contain only limited crash data.

The recommendations presented here are independent, no recommendation requires the implementation of others for it to be adopted. The first and third recommendations seek to improve data quality without necessarily improving the completeness of the collection. Implementation of the second recommendation would allow improved counting of cases. For comparative purposes, a summary of the status quo is provided in the introduction to Part 4 of this report.

9.1 Recommendation 1
Linkage of road crash database and hospital morbidity file to improve data quality.

Aim
To efficiently and accurately link unit records in road crash database(s) and hospital morbidity file(s) to improve data quality.

Rationale
Data file linkage would greatly enhance the potential to accurately define road trauma statistics. The data linkage process would also identify those cases which cannot be matched by linkage procedures and possible reasons for these discrepancies e.g. certain crash types are not reported to the police; the severity of a proportion of injuries is not recognised at the time of the crash; etc.

Importantly, linked data would also provide scope for research on the nature and costs of injuries received in particular types of crashes (eg side-impact; rear-end collisions) in order to develop protective vehicle design or appropriate traffic engineering measures.

Linkages of health sector data have been the subject of several recent recommendations including those in the Australian Institute of Health's "Report of the forum on priorities for national health statistics" (February 1991).

A pilot study in one or two states or territories is recommended for data linkage between police reported data and hospital admissions data. While there has been some experience with data linkage in Western Australia, it is felt that a separate pilot project is needed. This is because the Western Australian approach involved

- matching on names and that is unlikely to be possible (or the easiest approach) in other jurisdictions

- linkage with the Police casualty file, rather than all of the Police file and so may have missed cases that were not coded correctly for injury severity by the Police

Methodology

For a pilot study, it is anticipated that an experienced computer programmer would need to work closely with persons familiar with the police reported data and the hospital admissions data in order to create appropriate linkages. Several cuts at linkage would probably be required in order to determine the most effective method resulting in an appropriate level of reliability eg. probabilistic or deterministic matching?

It should be noted that there may be a lengthy lead in time due to the ethical and administrative issues involved in the release of data. In addition, the timeliness of the linked data may be further reduced by delays in completion of the candidate files.

The files that should be examined for linkage should be the entire road crash database for the selected time period and those records in the Hospital Morbidity File which have E-codes of 810-829. Use of the entire road crash database reduces problems due to miscoding of injury severity by Police.

The first stage of the project would be an examination of the possible matching variables from the two data files and their compatibility. It is anticipated that the most likely variables would be age, sex and date of occurrence but it is likely that even these variables might require some recoding before being able to be used for matching.

Once the matching variables are chosen, linkage should be attempted using a strict criterion, i.e. two cases are only said to match if the values of each one of the matching variables are identical. The resulting match rates should be examined as a function of road user type, age of road user and motor vehicle involved or not.

The process should then be repeated after allowing date of hospitalisation to take on values up to several days after date of occurrence and, possibly, age to differ by a year (if initial records differed in whether age or date of birth were coded). Match rates should be compared with those obtained from the strict linkage and an assessment made of how many duplicate matches occurred as a result of the looser match criteria.

Analysis of the matched data will allow an estimate of to what extent injury severity is miscoded by Police, i.e. for how many matched cases is injury severity coded as other than "admitted to hospital"? This estimate would be expected to be a little more accurate in jurisdictions where private hospitals are included in the Hospital Morbidity File.

In addition to examining the linked data set, an important aspect of the project is the examination of the characteristics of non-linked data. An assessment needs to be made as to the extent that non-linking results from imprecision in the recorded data, under-reporting of crashes or other factors. The information about non-linked data has a number of potential uses:

- identifying and quantifying under-reporting of road crashes
- identifying crash types for which hospital morbidity data provides better frequency information than the road crash database
- interpreting the results of previous studies which have relied on road crash data alone
- making recommendations for improvements to data collection systems

Demonstration project

The study should include a demonstration project to indicate the usefulness of the linked data file. An appropriate project would be an examination of the pattern of injuries resulting from side impacts. The match rate is likely to be quite high for vehicle occupants, particularly drivers.

Ethical issues

A number of ethical, confidentiality and privacy issues must be addressed in any proposal to link data. There are both short and long term implications to be considered, and it will be essential to obtain ethics approval and that of privacy commissioners, where applicable.

Certain identifiers will be needed during linkage including age, sex, date of crash and possibly names. In addition, some identifiers are necessary for analysis and so will need to remain in the linked file. However it may be possible to blur identifiers in the final file - e.g. day of week and month remain but date be removed.

It is possible that the range of identifiers which remains could differ according to the usage of the file (e.g. some researchers might need accurate location information but be unconcerned about when the crash occurred). Hence, the organisation holding the linked data file could release data in a format to meet ethics and privacy considerations on a case by case basis.

Access to and use of linked data including longer term considerations

Clear guidelines will be required for the control of access and purposes of the use of the linked data. In particular, strict control will be required to avoid further linkage in the short or long term. As for other sensitive databases, it may be appropriate for the

controlling organisation to provide aggregated, de-identified output to other users rather than making the raw data available.

Security of the linked data
It is anticipated that undertakings would need to be made regarding the security of the linkage and storage locations of the file.

Resources
Resources can be classified in terms of skills, time and money. The cost to FORS of a project requiring a given amount of skills and time depends to some extent on the degree to which State authorities charge for resources.

The resources required for the recommended data linkage project are influenced by where the project is undertaken. The data files in different States vary in terms of:

- number of records
- which variables are recorded and in what form
- degree of completeness of road crash data collection

Wherever the project is undertaken, there is a need to relate the situation in the chosen State to other States in order to assist in determining the degree to which the results of the study can be generalised.

It is considered that the project would require the input of a team which combined expertise with road crash data, hospital morbidity data and programming. Estimates of the amount of time required for these personnel are as follows:

Project manager	60 days
Road data representative	20 days
Health data representative	20 days
Programmer	60 days

In addition, access to the two data files and computing facilities would be required. It would be hoped that there would be no charge for the data files but it would be wise to budget for computing facilities.

Some costs could be recouped by selective charging for output from the database.

9.2 Recommendation 2
Use of hospital morbidity file to more accurately monitor serious injury rates from road crashes.

Project definition:

Aim

To determine in detail the relationships between hospital morbidity and hospitalised road crash casualty data for each jurisdiction and to establish systems for the ongoing monitoring of hospital morbidity data.

Rationale

It has been shown by O'Connor (1992) and in Part 2 (Section 4.3.3) of this report that major discrepancies exist between police reported injuries and hospital admission data for each state. This project would also identify the major areas of discrepancies in each jurisdiction and could assist in the development of a quality control process.

It is recommended that serious injury statistics from each state and territory be maintained in parallel from police reports and hospital admissions data by the Federal Office of Road Safety in order to more accurately determine rates and trends in casualties requiring hospitalisation. This would require either accessing a centralized collection of hospital admissions data, such as that held by the Australian Institute of Health, or accessing state by state collections. Discussions would need to be held with appropriate health authorities to determine these mechanics together with the other issues identified below. Many of the issues regarding implementation of this recommendation are similar to those encountered for the first recommendation.

There are precedents for the centralized supply of police reported data in all jurisdictions, and at least some states have previously made their hospital morbidity file available for research and monitoring purposes.

It is anticipated that this project would be relatively simple to establish, although the timeliness of data and initial administrative and ethics approvals for the supply of data may result in some delays.

Methodology

Since many issues here relate to the compatibility of road crash databases held by different jurisdictions, this project should be attempted using data from each jurisdiction, rather than be undertaken as a pilot project in one jurisdiction. It should be noted that inclusion of private hospitals in state hospital morbidity files varies between jurisdictions. The timeliness of completion of data files for a given period also varies markedly between jurisdictions.

It is recommended that the project examine overall frequencies of hospital admissions as a result of road crashes and frequencies disaggregated to the extent possible. Disaggregation is necessary because the relationship between casualty frequencies according to road crash and hospital morbidity data sources has been shown to differ according to road user type and whether or not a motor vehicle is involved (see Part 1 of this report and O'Connor, 1992, Part 2, Section 4.3.3).

The first step would be to determine the degree of disaggregation that is possible. This is likely to differ among jurisdictions and a decision about the way in which national data are presented will need to be made. The lowest acceptable level of disaggregation would be to separate motor vehicle and nonmotor vehicle crashes.

Ethical issues

State data have previously been released to research organisations such as the Monash University Accident Research Centre by both roads and health authorities for research purposes. Such authorities could be expected to provide data for the specific purposes of the study. They would probably seek guarantees that the data would not be used for other purposes, such as linkage, nor published in a form that could identify individuals or hospitals.

Undertakings would need to be given to provide security of data storage and limitations on access to the files.

Resources

The time and effort needed for this project would depend largely on the sources of the data. If hospital morbidity files were available from the Australian Institute of Health, rather than applying to each State, it is anticipated that the time needed to obtain the relevant ethical approval would be much reduced.

It is considered that the project would require the input of a team which combined expertise with road crash data, hospital morbidity data and programming. Estimates of the amount of time required for these personnel are as follows:

Project manager	40 days
Road data representative	10 days
Health data representative	10 days
Programmer	40 days

In addition, considerable computing facilities would be required.

9.3 Recommendation 3

Abbreviated Injury Scale (AIS) scoring to validate the severity of injury required for patients to be admitted to hospital and the variability in this criterion across hospitals.

Project definition:

Aim

By means of AIS scoring, to validate the severity of injury required for patients to be admitted to hospital and the variability in this criterion across hospitals.

Rationale

For a number of reasons, casualties of road crashes may be treated differently in different places. It is important in monitoring "serious injuries" from road crashes, currently defined as hospital admitted, to compare like with like as far as possible.

Possible reasons for differences in the level of AIS severity resulting in admission include the following:

- Availability of hospital beds

- Distance of residence from hospital for review or follow-up purposes
- Availability of specialist consultation - may need to wait in hospital for a day or two
- Availability of day surgery and short stay wards, which may not be classified as admissions
- Availability of high technology equipment (eg CAT scans) which may eliminate the possibility of serious injuries more quickly in major hospitals.
- Other admission policy differences (e.g. different clinical practices between hospitals)

It should be noted, however, that single AIS scores are not good indicators of the severity of injury where multiple injuries are present. In addition, AIS scoring alone is of limited value in assessing physiological status (e.g. blood loss).

If it is too expensive to code AIS scores in hospital admission data, conversion of ICD9CN codes (which are available in hospital records) to AIS by computer program may be an option of sufficient reliability.

A validation study could be conducted on an existing Australian dataset where both AIS and N-codes are available to determine whether the currently available electronic conversion program be would sufficiently accurate for this task, particularly in view of its much lower cost.

This methodology could be trialled in more than one State.

Methodology

It may be necessary to consult with US experts who are experienced in developing and using electronic conversion programs to clarify the appropriate methodology for this study.

As an alternative to the approach outlined above, a pilot study could be undertaken, particularly to address the last two items identified as possible reasons for differences:

- -single AIS scores are not good indicators of the severity of injury where multiple injuries are present
- -AIS scoring alone is of limited value in assessing physiological status (e.g. blood loss)

Such a study would require accessing patient records to retrieve the necessary data to provide a broader base for comparison of injury severity (e.g. the components of the Trauma Score as a physiological measure, and the AIS scores by body region in order to determine an ISS score to indicate the effects of multiple trauma).

Ethical issues

The major ethical consideration in this study is likely to be concern by hospitals about comparisons of patient management between hospitals.

There should be no major problems with accessing hospital morbidity files for AIS coding purposes. However, if it were considered necessary to AIS code and possibly

to extract Trauma Score details directly from patient medical records, it would be necessary to obtain ethics committee approval from each participating hospital.

Resources
The magnitude of resources required would depend on how many States the trial was conducted in and the number of admissions in those States (e.g. a study using data from South Australia and Western Australia would be likely to require less resources than a study using data from New South Wales and Victoria).

The major determinant of the resources required for this project is whether the electronic conversion program from ICD9CN codes to AIS scoring is used or whether AIS scoring from hospital records would be necessary. The first step in the study would be to determine whether electronic conversion produced satisfactory results. Resources for electronic conversion. This approach would require purchase of the program (several thousand dollars), staff with skills in both ICD9CN and AIS scoring and a programmer.

Estimates of the amount of time required for these personnel are as follows:

Project manager	20 days
Medical records officer (or nurse researcher)	10 days
Programmer	20 days

Resources for AIS scoring. This approach would require staff with skills in both ICD9CN and AIS scoring and a programmer. The estimates below assume AIS scoring of approximately 4000 records from the Hospital Morbidity File.

Estimates of the amount of time required for these personnel are as follows:

Project manager	30 days
Medical records officer (or nurse researcher)	40 days
Programmer	20 days

If AIS scoring and additional data extraction needed to be performed in-hospital, the length of time taken to score each record would increase considerably, resulting in only about 20 records being scored per day.

9.4 Recommendation 4
Augmentation of crash and hospital admissions databases.

Crash database
Possible means include adoption of ACRUPTC set of common core data items, scanning of crash sketches, linkage with registration and licensing databases. The increased use of on-line editing in data entry from accident report forms would also enhance data quality.

The inclusion of date of birth for all injured road users could assist in identifying the nature of the problem and targetting interventions. Similarly, recording of the post-code of residence of injured persons is required to facilitate the emerging community-based approach to road safety. Use of clip-board computers for data input at the scene could be trialled as a means of improving data quality, including completeness and accuracy, and the timeliness of data. Further improvement to compatibility and interpretation of data could be achieved by all jurisdictions recording and computerising whether police attend the crash scene (recorded but not computerised in NSW, Queensland, SA).

Hospital admissions database

Augmentation could be achieved by improving coding of the fourth digit E-codes to allow more disaggregation by road user type. Inclusion of private hospital data will also be increasingly important as more private emergency departments are established. Improved timeliness of data will result from new funding arrangements for hospitals to be introduced in 1993. Standardisation of inclusion of identifiers in centralised data collections would enhance the potential for data linkage. It is strongly recommended that all Australian Health Departments introduce the ICD 10 injury components fully, and as soon as ICD 10 becomes available.

It should be noted that ICD10 coding for hospital data will be introduced internationally in 1994. Improvements to E-coding are anticipated.

Project definition:

Aim

To develop implementation strategies for augmentation of crash and hospital admission databases as outlined in Recommendation 4.

Rationale

Augmentation of crash database

The report has identified the need to improve the quality of coding for a number of variables in the crash database and also the current state of change in crash databases in some states (e.g. increasing computerisation, police desire to collect fewer items of information). These two factors form the rationale for augmentation of the crash database.

Methodology

Augmentation of crash database

Pilot programmes could be established for scanning of crash sketches, and linkage with registration and licensing databases. A controlled trial of the timeliness, completeness and quality of data collected using clip-board computers, compared with standard data collections could be conducted in one or two jurisdictions. On-line data entry by police using standard data collection methods could also be trialled. A national workshop could address the possibility of adopting ACRUPTC and any agreed enhancements, and the possibility of some form of incentive could be considered.

Scanning of crash sketches. Crash sketches provide valuable information for coding of crash patterns and interpretation of events which occurred during the crash. They

often provide the only evidence of the role of otherwise uncoded third or fourth vehicles. It is anticipated that scanning take place over a three month period and that the quality of reproductions and its utility be evaluated in one or two jurisdictions. Initial scanning could be undertaken by providing equipment and paying those persons who currently process accident report forms to scan crash forms or by arranging for it to be done by another agency.

Linkage with registration and licensing databases. Many of the variables which have been identified as poorly coded in road crash databases relate to details of registration and licensing. This project relies on the assumption that these data are more accurately recorded in the registration and licensing databases. Thus linkage should allow improvement in data quality for these variables.

In addition, a number of registration and licensing variables of interest are not currently recorded on the crash form but may be available in the registration and licensing databases. One such variable is vehicle identification number (VIN) which is very useful for model identification for vehicle occupant protection research. Recording of VIN by Police officers at crashes is not recommended because it is a very long number and rates of transcription errors are likely to be very high.

The increasing reluctance of Police to continue to collect the whole range of data items in some states may make linkage with registration and licensing databases necessary in the future in order to collect variables which are currently collected by Police.

The project should begin with an examination of what data items are available in registration and licensing databases in each of the jurisdictions and how these compare with those recorded on the crash reporting form. The degree of agreement between variables entered by Police and those gained by linking should be examined.

Pilot evaluation of clipboard computers. One main aim of clipboard computers is to speed up processing of Police crash report forms, for the increased operational efficiency of the Police and the improved timeliness of the crash data system. A trial of clipboard computers could identify the operational issues associated with their introduction and examine their effect on Police efficiency and timeliness of the crash data system.

Augmentation of hospital admissions database. Discussions with each State and Territory health authority indicated that progress is underway in improving fourth digit E-coding, timeliness of data entry and inclusion of private hospitals. However, there may be some scope to seek further advance by means of direct submission to the Australian Health Ministers Conference or to the National Road Trauma Advisory Council which advises the Prime Minister. All available means should be applied to ensure the timely and complete introduction of ICD10, when it becomes available.

Ethical issues

There are no major ethical issues associated with these projects.

Resources

The time required to gain necessary operational approvals would comprise a large part of the time required to undertake this project.

Separate resource estimates can be made for each of the possible components of this proposed project.

Augmentation of crash database
Scanning of crash sketches. The cost of three months data collection would depend on which jurisdiction was chosen (i.e. greater in NSW than Tasmania).

Linkage with registration and licensing databases.

Pilot evaluation of clipboard computers. The cost to FORS would depend on who paid for the clipboard computers (say $5000 each) and whether the jurisdiction charged for linkage with registration and licensing databases.

The project would require the services of a programmer.

Augmentation of hospital admissions database
FORS resources would be required to alert each health department to the need for improvements to E-coding, timeliness and inclusion of private hospitals and the early implementation of ICD10, to improve road trauma data. Submissions to the Australian Health Ministers Conference and to the National Road Trauma Advisory Council would also need to be FORS initiatives.

9.5 Recommendation 5

Investigation of low rates of blood alcohol level reporting for road crash casualties attending hospital; and recommendations for improvements to current systems.

Project definition

Aim

To explain the low compliance and matching rates for blood alcohol sampling on road crash casualties and to recommend changes to substantially increase these rates.

Rationale

While quite good data are available to relate fatal injury and blood alcohol levels, it is currently difficult to define the role of alcohol in non-fatal road trauma. While legislation requiring blood alcohol sampling on road crash casualties attending hospitals is in place in all jurisdictions, exemptions exist and the legislation is not well applied. It is recognised that there has been some industrial disputation regarding the taking of samples, but this does not appear to be a ***comprehensive*** nor satisfactory explanation for the extent and nature of this problem.

Methodology

The sensitive nature of this issue requires that appropriate consultation is undertaken with the authorities involved. These include hospital emergency department administration and staff, hospital administration and police and road authorities.

It would be necessary to obtain copies of the relevant legislation for each state and territory, and to determine precise commonalities and differences. Obtaining road authority and hospital sector views on the scope of the legislation and the extent to which common practice is in accord with the legislation would also be fundamental to explaining the current data quality. Matching rates between hospital and police reports should also be examined by state, road user type, age, and injury severity.

A second component of the project would be to examine procedures and compliance rates within several hospitals, including tracking individual cases, their blood samples and the analysis results within the hospitals and the police system.

Ethical issues
While ethics committee approvals would be required for this study, most of the confidentiality/privacy issues are already addressed by existing legislation.

Resources
An experienced road safety researcher would be required to manage the project. However a medical graduate would ***be*** most suited to investigating the issue of compliance with the College of Emergency Medicine. The hospital component of the research would be likely to meet the approximately three-month research requirement of the College's post-graduate training program.

Project manager	20 days
Medical officer	20 days
Programmer/analyst	5 days

This study should be undertaken in more than one state since differences between states are a matter of interest and concern.

9.6 Recommendation 6.
Inclusion of crashes reported to property damage insurance companies.

Project definition:
Aim
To examine the usefulness of crash information collected by property damage insurance companies and ways of incorporating this information into road crash data collection systems.

Rationale
Property damage insurance companies collect a very large number of claims for crashes each year. Most of these crashes involve property damage only but it is likely that a substantial number of injury crashes are also reported. Thus, these reports may provide an additional source of data for linking injury outcome with vehicle damage or circumstances of the crash. Information about the property damage only crashes is

also important for overall costing of traffic crashes and devising appropriate road and traffic engineering treatments.

Methodology

The project should commence with a review of previous reports that have addressed this issue. While some may not have been favourable, increasing computerisation may have changed the picture.

A number of issues need to be addressed

1. Whether a complete collection is needed or whether information from a small number of large insurers would be enough.
2. How many injury crashes are included in the crashes reported to property damage insurance companies.
3. Can crashes which have been reported to Police, and an accident report form completed, be distinguished from crashes which do not fall into this category?
4. Do identifiers exist that would permit linkage of crashes between the insurance and road crash data files?

Ethical issues

Previous investigations in this area have found the major barrier not to be that of ethics but of commercial confidentiality. Steps would need to be taken to reassure insurance companies that information would not be presented in such a way as to be commercially damaging.

Resources

This project would require the services of staff experienced in the analysis of insurance and road crash data. The degree of resources required would depend to some extent on how far the project managed to progress. Thus the estimates given below are very approximate.

Project manager	30 days
Industry consultant	10 days
Programmer	20 days

CHAPTER 10. RECOMMENDATIONS FOR IMPROVING DATA COLLECTION METHODOLOGIES FOR CRASHES NOT RESULTING IN HOSPITALISATION

Because of the large numbers of non-hospitalised road crash injuries a complete collection appears not to be feasible. Instead, a sampling frame involving police and hospital database sources and sampling General Practitioners is recommended. Recommendations 1 and 2 focus on improving the proportion of persons injured in crashes not resulting in hospitalisation that are counted. Recommendations 3 and 4 seek to improve the quality of injury data available for crashes not resulting in hospitalisation, and to further define the strengths and weaknesses of police reporting of non-hospitalised casualties.

For comparative purposes, the status quo is described comprehensively in Chapter 2 and summarised in the introduction to Part 4 of this report.

10.1 Recommendation 1. Use of hospital Emergency Department data to identify non-admitted road crash victims for the purpose of enumeration.

Project definition:

Aim

To facilitate the widespread implementation of minimum data-set emergency department injury data collections.

Rationale

Emergency Department data are likely to be progressively computerised. CAS2 and similar programs which are being used increasingly widely would supply some injury and outcome data and would at least provide a count of injured patients attending for treatment. The development of a more useful nationally agreed data set is under discussion and initial data collections are currently being trialled in at least one cluster of hospitals in Victoria. Further refinements of this agreed minimum data set are proceeding. Victorian Health Department specifications for software development for hospital emergency department data additions include the minimum data set which has been agreed to by some agencies. Centralization of data collections would be required for the purposes of enumerating and monitoring trends in road trauma.

Methodology

The project would consist of monitoring the use of Emergency Department injury data collections, and particularly the potential for centralization and analysis of data collections. Support could be provided to appropriate organizations such as the College of Emergency Medicine to enhance the implementation process for such collections, at least in one state.

It is unlikely in the short term that the project could achieve a complete national count of nonadmitted road crash victims given the current status of Emergency Department

data systems. However, it is possible to count both admitted and nonadmitted road crash victims in a sample of hospitals and derive a ratio of nonadmitted:admitted which could be applied to Hospital Morbidity Files to estimate the number of nonadmitted road crash victims.

It is likely that ratios would differ for rural and urban hospitals. Unfortunately, there are currently few rural hospitals who can provide Emergency Department data. The project needs to ascertain whether sufficient rural data is available, or whether ratios need to be developed from urban hospital data only and the appropriate caveats used when the ratio is applied to rural data.

The Latrobe Valley rural injury surveillance collection in Victoria provides one point of comparison with urban data. However, there may also be considerable variation in admission/nonadmission ratios between rural centres. Preliminary estimates of ratios from the Victorian Injury Surveillance System are as follows: urban<15 years, 12% of road trauma cases admitted; rural 9%; urban 15 years or greater 15% admitted; rural 12% (see also Section 2.4.2).

While estimates could be made using weighted multipliers for nonadmissions from known admission data, based on existing centralised National Injury Surveillance Unit data, it may be some years before an emergency department minimum data set collection is sufficiently widespread to be reliable.

Ethical issues

In order to protect confidentiality and privacy of individuals, personal and hospital (if necessary) identifiers would need to be removed from centralized data. Safeguards may also be required to prevent publication of small cell data to protect privacy.

Resources

1. The National Injury Surveillance Unit would be well placed to undertake an estimate study of hospitalised/nonhospitalised road trauma casualty ratios based on injury surveillance and hospital admission data from selected hospitals since it holds both national data sets.

These ratios and hence frequency estimates could be monitored over time.

2. Given the anticipated long lead times for widespread emergency data collections and the unknown mechanisms for centralisation of data, it would be premature to estimate the required resources for this project.

3. FORS, or another agency acting for FORS, should monitor progress in emergency department data collections. Minimal resources would be required.

10.2 Recommendation 2. General Practitioner sampling to estimate the proportion of primary (and repeat) GP attendances which result from road crashes and then scaling up using Medicare information on total numbers of GP

attendances, or using emergency department presentations and hospital admissions for scaling purposes.

Project definition:

Aim

To estimate the proportion of primary general practice attendances as the result of new injuries sustained in road crashes.

Rationale

An unknown number of persons injured as the result of road crashes seek primary medical care from General Practitioners (Section 6.7). If these minor injuries are frequent, there may be a large human and financial burden of road trauma which is currently virtually unrecognised in this country. Apart from understanding the nature and extent of this less severe road trauma, it would be of interest to monitor trends over time in minor injury as occupant protection and other road safety improvements are made. One possibility is that their frequency will rise, and that more health sector resources will be required in this area. There may also be policy implications for the appropriate allocation of road trauma insurance funds, since there is currently a cut-off level which probably excludes most General Practice primary care of road trauma.

Sampling should collect, at least, some basic information about patient demographics, road user type and nature of injury.

Methodology

A pilot project should be undertaken in a circumscribed geographic area in which complete GP coverage could be obtained (approximately 70 GPs for a population of 70,000 to 80,000). This would ideally be in an area where injury surveillance data are also collected in the local hospital Emergency Departments. Since hospital admissions data are available from all public and possibly private hospitals, the ratios of rates for the three levels of severity could be determined.

It would be important to clearly define the parameters for inclusion of road crash casualties in the GP survey. Decisions would be required about the desirability to collect information only on new cases presenting for primary care, or whether the full burden of road trauma seen in General Practice were of interest, in which case repeat visits, follow-up visits for cases primarily treated in hospital, and presentations regarding late effects of road trauma might be included. Considerable attention would need to be paid to these factors in the proposed scaling exercise using Medicare data.

It is envisaged that such a survey would take place over selected, or rotating, one month periods to account for seasonal and holiday variations in injury rates.

This project relates to a Ph.D. study currently being undertaken by Dr Rod McClure at the ANU, for the Canberra population. His study could probably be regarded as an appropriate pilot for the wider purposes of this FORS proposal.

The feasibility of this study is dependent on the strong support of General Practitioners in an appropriate geographic area. The release of Medicare data, which

is not entirely unprecedented, would provide much more comprehensive results, in terms of General Practice. However, scaling on the basis of ratios between hospital and non-hospital treatment would be possible in the absence of Medicare data.

Validation of the described ratios and definition of possible urban/rural differences could be undertaken in a range of geographic areas.

It should be noted that the utility of this study to the community would be greatly enhanced by including all injury. Hence, a jointly funded study with the health sector could be considered.

Ethical issues

General Practitioners would need to be assured that individual patient names would not be required, and that no individuals could be identified after the data were computerized and data collection forms were destroyed. Security of data transport and storage, and the use only of trained research professionals would also need to be guaranteed.

The issues of release of Medicare data are probably more organisational than of concern regarding confidentiality or privacy, though this would need to be explored.

Resources

MUARC piloted a one-month General Practitioner injury data survey in conjunction with a community based injury prevention program. This pilot study, which achieved a 55% compliance by General Practitioners, provides useful insights into the additional resources required to obtain closer to 100% compliance.

In this Shire of Bulla study, consultation with General Practitioners was arranged through the municipality and the intervention program. Data collection forms were developed and pre-tested in consultation with local General Practitioners. In addition, each General Practitioner or Practice manager was telephoned individually and agreed to collect data both prior to and during the survey period, and appropriate reassurance was provided about both patient and Practice confidentiality. The doctors were also assured that results from the study would be available to them. Incidentally, several non-participating General Practitioners have now agreed to a possible additional survey.

It was apparent, following this study that its success would have been greatly enhanced by the inclusion of a weekly visit by a nurse researcher (or similar) to each Practice to encourage compliance, to validate full inclusion of cases in the doctor's survey records, and/or to assist in extracting injury data from other sources within the Practice (e.g. patient's files).

Project manager	25 days
Nurse researcher	130 days
Data coder/entry	45 days
Programmer/data analyst	10 days

These estimates assume a population of approximately 75,000 for a one year sampling period (road trauma cases only).

10.3 Recommendation 3. Use of Injury Surveillance System data to follow up injured persons not admitted to hospital.

Project definition:

Aim

To increase the utility of Injury Surveillance System data on road crash casualties treated in hospital emergency departments, but not admitted to hospital.

Rationale

Injury Surveillance data, collected as part of the ISIS system, seeks consent for follow-up at the time of presentation and completion of the Injury Surveillance form in the Emergency Department. The rate of consent varies between hospitals and age groups of patients.

Telephone follow-up studies based on injury surveillance data have been conducted successfully for a variety of injury causes. Compliance with such studies has been high.

Methodology

While information is collected in the ISIS system about the type of road user, nature of injury, level of treatment and other relevant data, more detailed information could be obtained about these non-hospitalized casualties by means of a telephone interview. For example, among vehicle occupants, it would be of interest to confirm seating positions, to seek details of the crash (side-impact, frontal, single vehicle, etc), and to determine the number and injury status of other occupants. The length of incapacity could also be determined for particular categories of minor injuries.

In addition, by the inclusion of an appropriate question, this study could give some indication of the proportions of minor casualties not reported to police, by road user categories, nature of injury, etc.

This project could be piloted in one injury surveillance unit and later expanded to provide a broader sampling frame.

Ethical issues

Ethics committee approval would be required from each participating hospital. Although delays could be anticipated, past experience with similar studies indicates that approval would be granted provided that usual guarantees of professionalism and confidentiality were given.

It should be noted that ethics committees would be unlikely to allow follow-up on patients who failed to agree to "provide further information if required" on the original injury surveillance form.

Resources
Components of this project would include Ethics Committee applications - customized by hospital, data extraction from database, extraction of further patient details such as length of stay, from patient medical records, retrieval of patient contact details from hospital medical records systems, questionnaire development, telephone calls (allow 30 mins per call, to take call back, etc into account), data entry and analysis, reporting, etc.

Resource requirements would clearly depend on the sample size. Assuming a sample size of 500, the following personnel would be required:

Project manager	20 days
Nurse researcher	70 days
Programmer/data analyst	10 days

10.4 Recommendation 4. Use of Injury Surveillance data to link with road crash databases to better describe crash types resulting in less severe injuries and to determine the extent of under-reporting of injuries of this severity in Police reports.

Project definition:
Aim
To link injury surveillance system data with road crash databases to improve the quality of data and to determine the extent of under-reporting in the crash database.

Rationale
Linked data on non-hospitalised casualties would provide scope for research on the nature and costs of less severe injuries received in particular types of crashes (eg side-impact; rear-end collisions) in order to develop protective vehicle design or appropriate traffic engineering measures. These data would also assist in identifying the nature as well as the extent of police under-reporting of less serious casualty crashes. Linked data on non-hospitalised casualties may also introduce high quality data on crash types that are not represented in sufficient numbers for research among linked hospitalised casualties.

Methodology
This linkage would need to be in the direction of beginning with injury surveillance cases and seeking matching cases in the police reported database, since the former are likely to be complete for an unknown population, and the latter are likely to be incomplete.

Within the Victorian Injury Surveillance System, for example, approximately 4350 cases of road trauma present each year and approximately 3828 injuries would not be of sufficient severity to be admitted (assuming a 12% admission rate from current indications).

Ethical issues

In terms of consent to linkage, it is not clear whether injury surveillance data belong to the injury surveillance collection unit or to the hospital at which data were collected. Clearly, ethics approval at an appropriate level (State health department or individual hospitals) would be required for linkage.

It is unclear whether or not the consent to follow-up provided at the time of completion of injury surveillance forms could be taken as consent to link data. If this were so, the approval for linkage could be simplified for limited linkage of only those casualties for whom consent was obtained.

Resources

Components of this project would include Ethics Committee applications - customized by hospital, extraction of cases from injury surveillance database, matching, reporting, etc.

Resource requirements would depend on the number of hospitals providing data. An estimate of personnel required to undertake linkage and to determine the level of police under-reporting would be:

Project manager	20 days
Programmer/data analyst	40 days

Additional resources would be required to undertake specific studies using the linked data.

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APPENDIX A: Hypotheses to be investigated in discussions with State authorities

Some specific questions are included to indicate the types of issues which are covered in discussions. Use of a prescriptive set of questions would inhibit the collection of new information and the formulation of new hypotheses.

1. a) Linkages are feasible between Police accident reports for casualty crashes and hospital admissions data.

Specific questions
Do hospital admissions data include E-codes?
Are there any ongoing or recent linkage studies?
Do unique UR numbers exist?

b) Linkages are feasible between Police accident reports for casualty crashes and emergency department presentation data.

Specific questions
Is information on ED presentations computerised?
Are injury cases identifiable?
Is there sufficient information on mechanism of injury cases to identify motor vehicle related injuries?
Are there any ongoing or recent studies?

2. Information is available on the completeness and accuracy of

a) **Police reported casualty data**
b) **hospital admissions data**

Specific questions
Are internal validation checks incorporated?
Are there any specific studies of the validity of data?
What is the definition of a road crash?
What type of crashes are underreported?
Which variables are not likely to be useful?
Which variables are poorly coded?
[For which variables are data collected but not computerised? (covered in 5. below)]
For hospital data, is there a complete collection or sampling only?
Is the sampling of hospital data representative for (a) admissions (b) ED presentations?
Is there scope for a representative sampling system for ED presentations? (e.g. To what extent are the various types of collections compatible?)

3. Private hospitals admission data are available or will become available as a road crash data source.

Specific questions
What admission data are currently collected and centralised from private hospitals?
What changes are expected and when?
Have special studies been conducted?

4. Comparable hospital admission data items are collected and computerised around Australia - or this could occur.

Specific questions
What data items are collected?
Do all injury cases receive ICD9 N codes and E codes?
Can readmissions, transfers and late effects cases be identified?
Are additional injury coding systems used for road trauma cases e.g., AIS/ISS?

5. Comparable Police reported data items are

a) collected

b) computerised

around Australia. A useful minimum data set which is an improvement on the status quo could be developed.

Specific questions
Request copy of Police accident report form and coding manual
Are some variables collected but not computerised?
Are some variables removed from data files (e.g. names)?
Which variables are considered important?
What additional variables would be useful?
Are Police accident reporting systems linked with other collections e.g. registration, blood alcohol, road systems?

6. Costing systems in hospitals (DRG's for inpatients and AVG's or equivalents for Emergency Department presentations) could be used to assist costing of casualty crashes.

Specific questions
What is the current status of implementation of DRG's/AVG's?
When is implementation expected to occur?
Will there be a central data collection?
Will uniform or compatible systems be implemented around Australia?

7. Emergency Department case mix systems could incorporate an E-code and therefore be used to count non-hospitalised casualties.

Specific questions
What is the current status of case mix systems?
Is there potential for E-codes to be recorded?
Which data items are collected?
How complete are the data expected to be?

8. Sampling of GPs could provide estimates of nonhospital treatments for road crash casualties.

Specific questions
Are there data collections for GP visits?
Is there coding of visits as road crash related?
Have specific studies been conducted?
Is there potential for representative sampling?

9. That the 1989/90 Australian Health Survey is unlikely to contribute useful data (to be released late 1991).

10. There may be other solutions of which we are unaware?

Specific question
Can you provide any additional ideas or information which could assist with improvements to data collection methodologies for hospitalised or nonhospitalised casualties of road crashes, or casualty crashes?

APPENDIX B List of organisations consulted

Tasmania

Office of Road Safety
Department of Roads and Transport

Health Department of Tasmania

Tasmanian Injury Surveillance and Prevention Programme

Victoria

Australian Road Reasearch Board

Road Safety Division
VIC ROADS

Health Department of Victoria

Victorian Law Reform Commission

New South Wales

Road Safety Bureau
Roads and Traffic Authority of NSW

Traffic Operations Group
NSW Police

N.S.W. Health Department

Worksafe Australia

Queensland

Road Safety Division
Department of Transport

Queensland Injury Surveillance and Prevention Programme
Mater Children's Hospital

Epidemiology and Prevention Unit
Queensland Department of Health

South Australia

Office of Road Safety
Department of Road Transport

South Australia Health Commision

National Injury Surveillance Unit

NH&MRC Human Ethics Committee

Western Australia

Department of Health

Research Section
Police Department

Charles Gairdner Hospital
Emergency Department

Police Traffic Branch

Road Research Unit

W.A. Injury Surveillance System

Northern Territory	Australian Capital Territory
Northern Territory Health Department	A.C.T. Board of Health
Royal Darwin Hospital	A.C.T. Traffic Authority
Department of Transport	Australian Institute of Health

Overseas

University of Virginia

Centre for Coding and Classification, Loughborough U.K.

APPENDIX C

Copies of Police Accident Report forms from each State and Territory

C-1 Victorian 1989 Police Accident Report Form
C-2 Australian Capital Territory Police Road Traffic Accident Report Form
C-3 Tasmanian Police Traffic Accident Report Form
C-4 New South Wales P4 Police Traffic Collision Report Form
C-5 South Australian Police Road Traffic Accident Form
C-6 Queensland Police Traffic Incident Report Form
C-7 Northern Territory Police Accident Report Form
C-8 Western Australian Police Accident Report Form

APPENDIX C-1. Victorian 1989 Police Accident Report Form.

APPENDIX C-2 ACT Road Traffic Accident Report Form

APPENDIX C-3 Tasmanian Police Traffic Accident Report Form

APPENDIX C-4 NSW P4 Police Traffic Collision Report Form

APPENDIX C-5 South Australian Police Road Traffic Accident Form

APPENDIX C-6 Queensland Police Traffic Incident Report Form

APPENDIX C-7 Northern Territory Police Accident Report Form

APPENDIX C-8 Western Australian Police Accident Report Form

APPENDIX D. ROAD CRASH DEFINITIONS

Queensland (taken from Department of Transport Coding Manual)

"REPORTABLE ROAD CRASH - means an incident involving:

(1) any road vehicle on any road; or
(2) any motor vehicle elsewhere than on a road

which results in injury to or death of any person or damage of greater than $1,000 to any property (including an animal in the charge of any person, a vehicle or a train) shall be reported to the police....

MINOR CRASH - means an incident involving any road vehicle on any road which does not result in death or injury but damage of $1,000 or less occurs to any property....

ROAD VEHICLE CRASH - means any apparently unpremeditated event reported to the police or other relevant authority and resulting in death, injury or property damage attributable to the movement of a road vehicle on a road.... [inclusions and exclusions follow]

ROAD VEHICLE CRASH EXCLUSIONS - certain death, injury or property damage producing events involving moving road vehicles are EXCLUDED from classification as road vehicle crashes."

These include crashes

- after a stabilised situation (3.1.6.1)
- involving deliberate intent (3.1.6.2)
- involving legal intervention (3.1.6.3)
- not attributable to vehicle movement (3.1.6.4)
- off-road crashes (3.1.6.5)

APPENDIX E List of Variables contained in the New South Wales Hospital Morbidity File

NSW PUBLIC HOSPITAL INPATIENT STATISTICS FORM

Variables collected

Hospital/area
Hospital code no.
Medical record no.
Sex
Marital status
Street no.
Street name
Suburb, town or locality
Postcode
Language used at home
Country of birth
Aborigine
Birth date
Birth weight (qualified babies only)
Source of referral
Admission date
Hospital insurance
Admitted to psych unit
Patient type on admission
New patient type
Date of separation
Leave days
Patient status on separation
Referred to
Mode of separation
Transfer within area/region?
Presenting problem
Principal diagnosis
Other conditions present
Principal operation or major procedure
Other operations or procedures
External cause of injury or poisoning
Place of occurrence of injury or poisoning