Developing Valid Injury Outcome Indicators

A report for the New Zealand Injury Prevention Strategy

This report was commissioned by the Accident Compensation Corporation (ACC) Secretariat for the New Zealand Injury Prevention Strategy. The views expressed in it are those of its authors and do not necessarily reflect those of the Secretariat, or any other agency or individual that we consulted.

Colin Cryer
John Langley
Shaun Stephenson

Injury Prevention Research Unit
Department of Preventive and Social Medicine
University of Otago
PO Box 913
Dunedin
New Zealand

September 2004
Contents

Executive Summary ..............................................................................................................1

Part 1: The Case

1.1 Introduction ..................................................................................................................7
1.2 Criteria for judging the face validity of an injury outcome indicator ......................11
1.3 Definition of injury .........................................................................................................15
1.4 Options available for arriving at good generic indicators ........................................17
1.5 Quality of numerator data ............................................................................................24
1.6 Denominators for calculating rates .............................................................................26

Part 2: Proposed Indicators

2.1 Identification of the proposed indicators ...................................................................27
2.2 Proposed injury outcome indicators ............................................................................31
  A) All Injury ..................................................................................................................32
  B) Assault .....................................................................................................................38
  C) Work-Related injury ...............................................................................................44
  D) Intentional self-harm ...............................................................................................53
  E) Falls (unintentional) ...............................................................................................58
  F) Motor Vehicle Traffic Crashes .................................................................................64
  G) Drowning and near-drowning ................................................................................70

Part 3: Concluding comments and future directions

3.1 The proposed indicators ...............................................................................................75
3.2 Why no ACC indicators? .............................................................................................76
3.3 Future directions .........................................................................................................79

References ..........................................................................................................................85
Appendices

1. ICISS ..............................................................................................................................................91

2. Indicator specifications .....................................................................................................................99

3. Selected readings .............................................................................................................................141


Abbreviations

AIS Abbreviated Injury Scale
ACC Accident Compensation Corporation
A&E Accident and Emergency Department
CYFS Department of Child, Youth, and Family Service
CAA Civil Aviation Authority
CDC Centres for Disease Control and Prevention
ESS Energy Safety Service
HARM Harborview Assessment for Risk of Mortality
HSE Health and Safety in Employment
ICISS International Classification of Diseases-based Injury Severity Score
ICD International Classification of Diseases
ICD-9 International Classification of Diseases 9th revision
ICD-10 International Classification of Diseases, 10th revision
ICD-9-CM International Classification of Diseases, 9th revision, Clinical Modification
ICD-10-AM International Classification of Diseases, 10th revision, Australian Modification
IIM Injury Information Manager
IPRU Injury Prevention Research Unit
ITL ICD Injury Threat-to-Life scale
LTSA Land Transport Safety Authority
MSA Maritime Safety Authority
MCA Ministry of Consumer Affairs
MoH Ministry of Health
MoJ Ministry of Justice
MSD Ministry of Social Development
MVTC Motor Vehicle Traffic Crashes
MYD Ministry of Youth Development
NOHSAC National Occupational Health and Safety Advisory Committee
NZDF New Zealand Defence Force
NZHIS New Zealand Health Information Service
NZHIS NMDS New Zealand Health Information Service National Minimum Dataset
NZIPS New Zealand Injury Prevention Strategy
OSH Occupational Safety and Health, Department of Labour
PHI Ministry of Health Public Health Intelligence
SLBF Serious long-bone fracture
SRR Survival Risk Ratio
SOLAS Safety of Life at Sea
TCR Traffic Crash Report
WRFIS Work-Related Fatal Injury Study
WHO World Health Organisation
Process of writing this report

Many agencies and individuals were consulted in the drafting of various chapters of this report. In June 2004 a draft of the entire report was circulated by the NZIPS Secretariat to various agencies and individuals inviting written comment. In parallel with this process the draft was sent out for national and international peer review as follows:

   Dr Gary Jackson (Auckland),
   Assoc. Prof. James Harrison (Adelaide), and
   Ms Lois Fingerhut (Washington DC)

In June we presented an overview of the methods an International seminar on Injury Research Methods in Vienna. Early July 2004 the authors presented their findings in Wellington to various interested agencies and individuals and sought oral comment. Subsequently, the NZIPS Secretariat invited further written/oral comment and the report was then finalised.

Acknowledgements

The authors wish to thank the following for their assistance:

Accident Compensation Corporation / Strategy Secretariat: Ms Megan Bly, Mr Tim Boyd-Wilson, Ms Rachel Depree, Dr Keith McLea, Ms Bhama Rajiv Kumar, Mr Geoff Wilson

Civil Aviation Authority: Mr Rick Bulger

Department of Labour: Dr Carol Slappendel

Land Transport Safety Authority: Dr Wayne Jones, Ms Rachel Petrus

Maritime Safety Authority: Ms Sharon Forsyth

Ministry of Health: Dr Barry Borman, Ms Niki Stefanogiannis, Dr John Wren

Ministry of Justice: Ms Christine McKenzie

Ministry of Youth Development: Ms Sue van Daatselaar

Ministry of Social Development: Mr Peter Carr

New Zealand Defence Force: Ms Lisa McKubre

New Zealand Police: Mr Gavin Knight

Statistics New Zealand: Mr Paul Brown, Mr Darren Evans, Ms Jenny Mason

Water Safety New Zealand: Ms Sarah Tomlinson

We would also like to thank Lois Fingerhut, James Harrison and Gary Jackson for their peer review of a draft of this document.
New Zealand Injury Prevention Strategy
Developing Valid Injury Outcome Indicators

Executive Summary

Part 1: The case

We were asked to propose injury outcome indicators that focus on ‘all injury’ as well as for the 6 priority areas identified in the New Zealand Injury Prevention Strategy (NZIPS), namely:

i) Assault
ii) Work-related injury
iii) Intentional self-harm
iv) Falls
v) Motor vehicle traffic crashes (MVTCs)
vi) Drowning

This work was commissioned by the NZIPS Secretariat to inform lead agencies.

An injury indicator is a summary measure that denotes or reflects, directly or indirectly, variations and trends in injuries, or injury-related or injury control-related phenomena.

We described the operational definition of injury in terms of the International Classification of Diseases diagnosis and external cause of injury codes. This operational definition excludes medical injuries, pathologies resulting from chronic exposures over time, and the consequences of injury (e.g. the injury event is counted but not subsequent episodes of treatment and care).

The proposed fatal injury indicators present numbers and rates of injury death. For the serious non-fatal injury indicators, the operational definition of serious is explained. Injuries are regarded as serious if their estimated survival probability is 94.1% or worse. This threshold has been chosen to minimise threats to validity.

Part 2: Proposed Indicators

A) All injury

• Age-standardised injury mortality rate, per 100,000 person-years at risk (NZHIS mortality data)
• Number of injury deaths (NZHIS mortality data)
• Age-standardised serious non-fatal injury rate, per 100,000 person-years at risk (NZHIS NMDS)
• Number of serious non-fatal injuries (NZHIS NMDS)

B) Assault

• Age-standardised assaultive injury mortality rate, per 100,000 person-years (NZHIS mortality data)
• Number of assaultive injury deaths (NZHIS mortality data)
C) Work-related injury
   No proposed indicators, only provisional – see below.

D) Intentional self-harm
   • Age-standardised intentional self-harm injury mortality rate, per 100,000 person-years (NZHIS mortality data)
   • Number of intentional self-harm injury deaths (NZHIS mortality data)

E) Falls
   • Age-standardised fall-related injury mortality rate per 100,000 person-years (NZHIS mortality data)
   • Number of fall-related injury deaths (NZHIS mortality data)
   • Age-standardised fall-related serious non-fatal injury rate, per 100,000 person-years (NZHIS NMDS)
   • Number of fall-related serious non-fatal injuries (NZHIS NMDS)
   Indicators are proposed for (i) all ages, (ii) age 0-74, and (iii) age 75 and older.

F) Motor vehicle traffic crashes
   • Age-standardised MVTC-related injury mortality rate, per 100,000 person-years (NZHIS mortality data)
   • Number of MVTC-related injury deaths (NZHIS mortality data)
   • Age-standardised MVTC-related serious non-fatal injury rate, per 100,000 person-years (NZHIS NMDS)
   • Number of MVTC-related serious non-fatal injuries (NZHIS NMDS)
   • MVTC-related death rate per billion vehicle-kilometres (NZHIS mortality data)
   • MVTC-related death rate per 10,000 vehicles (NZHIS mortality data)

G) Drowning
   • Age-standardised drowning rate, per 100,000 person-years (NZHIS mortality data)
   • Number of drownings (NZHIS mortality data)

Provisional indicators
The indicators below are provisional either because they provide more timely interim measures in advance of the proposed indicators (i.e. the indicators below for motor vehicle traffic crash and the drowning) or because we were unable to identify more valid alternatives (the remaining priority areas).

B) Assault
   • Age-standardised assaultive serious non-fatal injury rate, per 100,000 person-years (NZHIS NMDS)
   • Number of assaultive serious non-fatal injuries (NZHIS NMDS)

C) Work-related injury
   • Age-standardised work-related injury mortality rate, per 100,000 workers (NZHIS mortality data)
   • Number of work-related injury deaths (NZHIS mortality data)
• Age-standardised work-related injury mortality rate, per 100,000 workers (ACC mortality data)
• Number of work-related injury deaths (ACC mortality data)
• Age-standardised work-related serious non-fatal injury rate, per 100,000 workers (ACC-NMDS linked data)
• Number of work-related serious non-fatal injuries (ACC-NMDS linked data)

D) Intentional self-harm
• Age-standardised intentional self-harm serious non-fatal injury rate, per 100,000 person-years (NZHIS NMDS)
• Number of intentional self-harm serious non-fatal injuries (NZHIS NMDS)

F) Motor vehicle traffic crashes
• Age-standardised MVTC-related injury mortality rate, per 100,000 person-years (TCR-based)
• Number of MVTC-related injury deaths (TCR-based)
• MVTC-related death rate per billion vehicle-kilometres (TCR-based)
• MVTC-related death rate per 10,000 vehicles (TCR-based)

G) Drowning
• Age-standardised drowning rate, per 100,000 person-years (based on DrownBase)
• Number of drownings (based on DrownBase)

Part 3: Concluding comments and future directions

The proposed indicators
• Our principal driver was a need for indicators that are forward looking – that cover the period of implementation of the New Zealand Injury Prevention Strategy.
• Our approach to indicator development is consistent with the view that before newly proposed indicators are promulgated, they should be subject to formal validation.
• In arriving at the recommended indicators we have sought to strike a balance between ease of derivation of the indicator, ease of understanding, and validity.
• We have largely based our indicators on ICD-10, because national death and hospitalisation data are coded using this classification system. (The principal advantage of ICD-10 is that it is a WHO classification system used by many other countries – it will permit future comparisons with other countries for the indicators we have developed).
• We are unaware of any other comparable effort overseas to exercise the degree of rigour we have applied here to the development of these national injury indicators.

Why no ACC indicators?
• It has been our experience that large administrative sets of non-fatal injury data (e.g. NZHIS NMDS of hospital discharges, and ACC data) cannot be used to produce valid indicators without some pre-processing.
• Typically, we can minimise the biases in these data by using a severity threshold for our case definition.
• The goal is to identify a severity threshold (above which the probability of a successful claim is very high) as the basis for ACC-based injury outcome indicators.
In the absence of a threat-of-disablement scale that can be applied to large administrative databases (such as to the ACC Entitlement Claims data), we consider the difficulties of using ACC data for the development of NZIPS indicators.

1. The nature of the diagnostic information captured by ACC has made it impossible to derive severity of injury using the methods developed for ICD diagnostic codes.
2. We cannot accurately identify cases relevant to some of the priority areas from the circumstances of injury codes used by the ACC.

The use of ACC data for national indicator development awaits significant investigative and development work, which would result in state-of-the-art non-fatal injury outcome indicators.

**Recommendations**

**Recommendation 1**
There is a commitment to update the trends in indicators on an annual basis.

**Recommendation 2**
2.1 Work be commissioned to develop a tested proposal for the empirical validation of these NZIPS indicators
2.2 The NZIPS indicators be empirically validated once an appropriate method has been identified.

**Recommendation 3**
Work be commissioned to investigate methods / means for developing indicators based on lower severity thresholds (e.g. through the identification of sentinel diagnoses and suitable data sources; and through surveys – see below.)

**Recommendation 4**
Work be commissioned to further develop ICISS and ICISS-based indicators, namely an ICD injury threat-to-life scale (ITL):
4.1 A re-labelling of standardised survival probabilities from SRR
4.2 The ITL scores would reflect probability of death rather than survival rate; thus aligning them with other severity scales.
4.3 The ITL score would be an n-point ordinal scale, each point of which would attract a qualitative descriptor.
4.4 The development of a single injury ITL score for each diagnosis in ICD-10-AM; and for each ITL score the list of single injury diagnoses that would be included.

**Recommendation 5**
Work be commissioned to investigate the means of developing indicators based on threat-of-disablement; focussing initially on ACC data as the primary source.

**Recommendation 6**
Regular data audit of primary data sources be carried out, and published, to identify problems with the source data for numerators and denominators for the indicators, as a first step to improving these sources.

**Recommendation 7**
NZIPS commission the undertaking of regular surveys to facilitate (a) indicators based on
temporary disablement; (b) indicators that are aimed at monitoring both safety behaviours and exposures to hazards.

Recommendation 8
We recommend that NZIPS commission further work to enhance the indicators proposed for selected priority areas as follows:
8.1 Work is carried out to permit the development of work-related indicators that include work-related motor vehicle traffic crashes.
8.2 The NZIPS Secretariat refer to NOHSAC the problem of identifying what mark needs to be put in train to facilitate the identification and production of valid indicators of occupational disease occurrence.
8.3 Periodically, cases from the DrownBase database be linked to cases identified from NZHIS mortality file (using diagnostic code T75.1) to identify reasons for any discrepancies between the two sources and if appropriate identify cases of drowning missing from each data source.

Recommendation 9
We recommend that NZIPS commission additional work to identify further indicators in response to significant advances in the measurement of the severity of injury and/or improvements in administrative databases.
New Zealand Injury Prevention Strategy: Developing Valid Injury Outcome Indicators

Part 1: The case

1.1 Introduction

We have been asked to propose injury outcome indicators that focus on ‘all injury’ as well as for the 6 priority areas identified in the New Zealand Injury Prevention Strategy (NZIPS). This work was commissioned to inform lead agencies.

An injury indicator is a summary measure that denotes or reflects, directly or indirectly, variations and trends in injuries, or injury-related or injury control-related phenomena. (1)

The 6 priority areas are:

i) Assault
ii) Workplace injury
iii) Suicide and deliberate self-harm
iv) Falls
v) Motor vehicle traffic crashes (MVTCs)
vi) Drowning and near-drowning

In writing this report, we acknowledge the work of Ministry of Health Public Health Intelligence report: ‘An indication of New Zealanders’ Health 2003’. Whilst this does not systematically address the NZIPS priority areas, it does include a number of indicators relevant to our work. These have been described and discussed in Section 2.2 of our report, where we have identified our proposed injury outcome indicators.

In this work, our goal was to identify valid injury outcome indicators. The methods that we used, therefore, were aimed at examining the validity of existing indicators – that are currently used to measure performance overall and in the 6 priority areas – as well as to propose additional valid indicators.

In the context of the NZ Injury Prevention Strategy, we wish to identify injury outcome indicators that accurately reflect trends in the incidence of injury, i.e. indicators that are valid.

For the purposes of this project we have used the term validity to mean the degree to which the indicator is capable of measuring what it is intended to measure. For instance, the intention may be to measure trends in serious motor vehicle traffic crashes (MVTCs). If the indicator selected for this purpose relies on MVTCs reported to the police (i.e. Traffic Crash Reports - TCRs) then we would not consider this to be valid, since there is evidence, from New Zealand and overseas, to demonstrate that such data underestimate the incidence of
serious crashes (e.g. as defined by admission to hospital for serious injury) and that this varies significantly by road user and type of crash. (2, 3) These biases can change significantly over time, so influencing the trends in serious MVTCs and so compromising validity, as we illustrate below.

We investigated the potentially misleading nature of previous national road safety indicators and contrasted these with more valid serious injury alternatives. This work was published in the peer-reviewed journal: Traffic Injury Prevention. (The full paper has been reproduced in the selected readings Appendix 3). (4) A synopsis of this work is given in the following box and in Figures 1 and 2, below.

**Example: Validity of NZ national road safety indicators.**

From indicators based on Traffic Crash Reports (TCRs), it is difficult to determine whether a downward trend in injury crashes is due to a real effect (i.e. a trend in the incidence of injury) or is due to other extraneous factors. Trends in TCR-based indicators are heavily influenced by reporting behaviour and the police response to this. Recent work (4) found that these TCR-based indicators showed a downward trend from 1988 to 2000, after which they showed a sharp increase (see Figure 1). We were advised by LTSA that this sharp increase was due to the enthusiasm of some police districts to improve their completion rates of TCRs rather than due to a real increase in MVTCs. Empirical investigation has reinforced this view.

Figure 1 indicates why trends in indicators based on police reports may reflect reporting behaviour, and may not reflect trends in the incidence of injury. Our further investigations add more weight to this view. We found that the trend in serious MVTC injury rates, using a more valid injury outcome indicator (Figure 2), did not show the same trends as the TCR-based indicators.
Figure 1: Percentage Deviation from 1988 Base in Frequency or Rate of MVTC Official Indicators
1988 - 2001

Figure 2: Percentage Deviation From 1988 Base in Age-Adjusted Rate (per 100,000 population) of serious MVTC hospitalisations 1988 - 1999
In the following, we used a two-pronged approach to identify valid injury outcome indicators for ‘all injury’ and for the 6 NZIPS priority areas:

(1) we identified existing New Zealand national indicators relating to ‘all injury’ and to the 6 NZIPS priority areas, assessed their validity, and retained only valid indicators;

(2) we proposed generic* indicators that have been demonstrated to be valid using the criteria described in Section 1.2 below (valid across all injury/all cause/all intents/all settings/all activities), assessed their validity when applied to the NZIPS 6 priority areas, and retained those found to be valid.

Before moving on to discuss our proposed indicators for each of the priority areas (Part 2), in the remaining sections of Part 1 we have outlined: the criteria used to assess validity (1.2); the definition of injury that we used (1.3); options available for arriving at valid generic indicators (1.4); the quality of the numerator data on which the generic indicators are based (1.5); and finally, a description of the denominator data we used for calculating rates (1.6).

In Part 2, we describe the methods used to identify national indicators, to derive the generic indicators - overall, and for the 6 priority areas - before going on to propose indicators for each of the areas.

Part 3 includes some concluding comments, discusses why we have no ACC based indicators, and future directions and recommendations.

*These indicators are described as ‘generic’ in the sense that they are applicable to many different subgroups of injuries – in this case to the six NZIPS priority areas.
1.2 Criteria for judging the face validity of an injury outcome indicator

Our goal is to identify indicators that are valid. We have argued in the past that a valid injury outcome indicator should satisfy the following 6 criteria as well as is possible (1)(5). The papers discussing these 6 criteria are included in Appendix 3.

These 6 criteria can be denoted by the acronym C-SiDARS:

- C – Case definition
- Si – Serious Injury
- D – Data availability
- A – Case ascertainment
- R – Representativeness
- S – Specification

They provide a necessary, but not sufficient, assessment of validity. A more complete assessment of validity should include some empirical investigation.

As discussed in our previous ‘Measure for measure’ paper (see Appendix 3) (6), before newly proposed indicators are promulgated they should be subjected to formal validation. This should include the following aspect of validity:

- Face validity: through an assessment of the indicator against explicit validation criteria.
- Criterion validity: estimates of the indicator’s characteristics against
  - a ‘gold standard’ measure, or
  - a future outcome (if the indicator aims to predict that future outcome)
- Consistency: investigate trends in the indicator against other measures (including a ‘gold standard’ measure, if it exists) that aim to estimate the same or a similar parameter.
- Completeness and accuracy of the source data: incomplete or inaccurate data would undermine the validity of the indicator, so this type of investigation is an important part of validation.

We use the first of these in this document to assess the validity of indicators. We make a recommendation in section 3.3 regarding the other approaches.

(1) Case definition
- The indicator should reflect the occurrence of injury satisfying some case definition of anatomical and/or physiological damage.

A cornerstone of methods for measuring population health and disease (i.e. epidemiological methods) is a sound case definition. Case definition should be based on diagnosis, defects, pathology, etc. rather than use of service or on reports to agencies – since use of services and reports are heavily influenced by extraneous factors unrelated to injury incidence.
(2) Serious injury
• The injury should be based on events that are associated with significantly increased risk of impairment, disability, functional limitation, or death, decreased quality of life, or increased cost.

The indicators should focus our attention on ‘important’ injuries. ‘Important’ injuries are those that have serious consequences – i.e. they have a significant chance of resulting in impairment, loss of function, significantly reduced quality of life, threat-to-life, or significantly increased cost. The case for focussing on serious injury, and not assuming that minor injury reflects serious injury, is made in the box below.

“The specification of injury severity is an essential element of the use of injury epidemiology for injury control. In any given year, virtually everyone experiences minor injuries, such as small scratches, bruises and burns. Most of these heal with little or no treatment and do not interfere with one’s activities. The energy sources, vehicles and vectors, and other circumstances of injuries are often not the same for those that are relatively severe and those with trivial consequences. Since trivial injuries are so common, priority in the devotion of resources to control of injuries based on total numbers in a given category can result in substantial misallocation of resources with respect to reducing the cost of injuries and the improvement of the quality of life of the severely injured or their families”. (7)

(3) Data availability
• It should be possible to use existing data systems, or should be practical to develop new systems, to provide data for computing the indicator.

Given the cost associated with collecting and analysing data on a regular basis, we need to capitalise on existing data systems. Typically, there is a desire to avoid any delay in the production of indicators. The use of existing data would avoid such delay. Finally, there is often a desire to consider future trends relative to historical trends. This is only possible with existing data systems.

The data captured by any large administrative database that is used to derive indicator(s) could be improved with a resultant improvement in the indicators. Consequently, although for the development of these current indicators we recommend the use of existing sources, we also recommend that strategic investment be made to improve the source data for indicators.

(4) Case ascertainment
• The probability of a case being ascertained should be independent of social, economic and demographic factors, as well as service supply and access factors.

Ideally, we want the indicators to measure, in an unbiased way, the incidence of injury rather than the use of services. Use of services is heavily influenced by factors other than disease incidence. For example, age and social factors appear to influence propensity to admit to hospital, independent of injury severity.
Likewise reporting systems, e.g. to the police for MVTCs, are influenced by socio-demographic factors, within crash severity bandings. All the above suggests that trends in indicators based on admission to hospital or on reporting systems will not necessarily reflect trends in the incidence of serious injury, as described above.

(5) Representativeness
• The indicator should be derived from data that are inclusive or representative of the target population that the indicator aims to reflect.

We want the injury outcome indicator to measure the incidence of events relating to all sub-populations in the target population equally well. For example, a number of papers have indicated that amongst crashes that result in ‘serious’ injury as defined by the police, there is differential reporting of these events to the police by type of road user. In particular occupants of 4 wheeled vehicles are highly likely to report a crash resulting in ‘serious’ injury to the police, but other groups less so. (3) An indicator based on police reports of serious injury will not, therefore, represent all road users in proportion to the incidence of these ‘serious’ events, and so will be biased towards the injury experience of occupants of 4-wheeled vehicles.

(6) Indicator specification
• The indicator should be fully specified to allow calculation to be consistent at any place and at any time.

In order to be able to replicate the indicator consistently across populations, places and over time, a comprehensive written specification is required. This includes definitions, specification of data sources, and methods of calculating the indicator.

A good indicator ‘points’ at the ‘thing’ we want to measure, i.e. the characteristic of the population. Technically, this ‘thing’ is referred to as the population ‘parameter’. One important aspect of the specification is to be explicit about the parameter the indicator strives to measure. This is referred to as ‘concept of interest’ in the indicator specifications shown in Appendix 2.

In this project, each of the above criteria were used to assess the validity of existing and our newly proposed generic injury outcome indicators.

The criteria described above are those agreed at an international meeting in Washington DC in 2001.(1) However, since that time, other criteria have been suggested, namely:

• Completeness and accuracy of source data
• Timeliness
• Ability to measure change over time
• Measurement that is practicable
• Readily comprehensible
Although these additional criteria have not been considered systematically when assessing the validity of the indicators, we were aware of their importance when developing the new indicators and when assessing existing and new indicators.
1.3 Definition of injury

The NZIPS does not explicitly address the scope of its interest by defining ‘injury’. Nevertheless, the data which was provided to the NZIPS for the purposes of determining priorities demonstrates that the implicit definition is largely consistent with what most practitioners and academics consider is ‘injury”. However, as we will show below there are difficulties reconciling common theoretical and operational definitions of injury. Moreover, there is a significant constituency who consider neither the theoretical nor the operational definition, or cover the scope of injury prevention, adequately - this is particularly the case for what is often referred to as psychological injury. To complicate issues further the NZIPS has taken the unusual step of including "occupational disease" within its mandate. We discuss these issues below.

1.3.1 Theoretical

We take as the theoretical definition of injury that given by Waller. (8) That is:

“Injury is tissue damage resulting from either the acute transfer to individuals of one of the five forms of physical energy (kinetic or mechanical, thermal, chemical, electrical, or radiation) or from the sudden interruption of normal energy patterns to maintain life processes”.

There are several variations that have been quoted by other authors; however, they effectively carry the same message.

As has been argued elsewhere (see “What is an Injury?” (9) (Appendix 3)), definitions of this nature do not align well with what many in the field consider is the business of injury prevention and control. For example, many consider psychological injury, irrespective of whether there was physical injury, to be a legitimate domain of concern for the field.

The difficulty with such an approach is that no theoretical definition has been proposed and widely accepted which places boundaries on what is to be considered as psychological injury.

1.3.2 Operational

Internationally, the most commonly accepted operational definition of injury are those pathologies in the “Injury” chapter of the International Classification of Disease codes (ICD-codes). ICD codes are used by the New Zealand Health Information Service (NZHIS) to code mortality and hospitalisation data. (10) However, even here there is some dispute in the international community as to which codes within the ICD injury chapter are in fact injuries. It is of interest to note that the “Injury” chapter of ICD-10 includes “Maltreatment syndromes” (T74). This category includes “Neglect and abandonment”, “Physical abuse”, “Sexual abuse”, and “Psychological abuse” without any reference to physical injury. In other words, some forms of intentional psychological harm / injury are covered by the “Injury” chapter of ICD.

For the purposes of this project we accept that intentional psychological injury, as encompassed by the ICD “Injury” chapter, is within the scope of this report.
Some have argued that “Medical injuries” are outside the domain of traditional injury prevention and control. For the purposes of this report, we agree. Using a strict definition of injury, all surgical and some medical procedures can be regarded as injury events, whether or not there are complications. It has been argued that to include complications as being injury events, but to remove surgical incisions as injury events is somewhat arbitrary. (9) The International Collaborative Effort on Injury Statistics recommended that these events be tabulated separately in routine statistics in recognition that these events occur under a very distinct set of circumstances. Within our operational definition we have taken the extra step and excluded them.

The “Injury” chapter of ICD excludes pathologies resulting from chronic exposure to low energy over time e.g. occupational overuse syndrome. These events lie at the interface between injury and disease. To have a theoretical definition of injury that included occupational overuse syndrome would mean changing the theoretical definition from one of tissue damage resulting from acute transfer of energy, to simply tissue damage (whether due to acute energy transfer, or to chronic exposure). Such a change would, for example, also permit cancers resulting from low-level radiation exposure to be included. NZIPS has made one exception by including occupational disease in its ‘Workplace injuries’ priority area. This is a matter we address in the section dealing with that priority area (section 2.2C).

Finally, we have excluded sequelae of injuries as these relate to the late consequences of an injury, rather than the injury itself. In our indicators, we are focusing on measuring injury incidence (i.e. the injury event itself) and so have excluded episodes of inpatient care resulting from the sequelae of injury. For example, a burn victim often has multiple hospital admissions relating to their treatment and rehabilitation. The first admission would be included. Subsequent admissions would not.

Many of these issues are discussed by Langley in two papers published in 2004. (9) (11) These are reproduced in Appendix 3.

For the reasons explained in one of our previous publications (12) we also propose to identify cases of injury as those that had a principal diagnosis of injury, and were first admissions. This paper is also reproduced in Appendix 3.

Consistent with the discussion above, we have used the following code ranges for our operational definition of an injury:

Principal diagnosis: S00-T78
First external cause: V01-Y36.

Although the above operational definition is couched in terms of the coding and classification system used by the NZHIS, it could, in theory, be used to identify cases of injury from ACC data. The use of ACC data for the derivation of indicators is discussed in sections 1.4 and 3.2.

This definition is likely to exclude many cases of injury that occur whilst in hospital. We cannot identify a case definition, however, that would result in valid indicators of injury occurrence outside hospital which could also capture injury that occurs whilst in hospital. To measure these latter injuries reliably would require a focussed piece of work.
1.4 Options available for arriving at good generic indicators

Our options for identifying generic injury outcome indicators were driven by the availability of national all cause / setting / activity injury data. The three main sources of data are:

- mortality data,
- hospital discharge data and
- ACC data.

The indicators we have proposed draw attention to ‘important’ injury as judged by their resulting in death, or because of their threat-to-life. We are also interested in indicators that are ‘important’ in terms of impairment, loss of function, significantly reduced quality of life, or significantly increased cost - for example, back injury/pain. However, significant development effort would be needed to develop valid indicators for injuries that are important in terms other than mortality or threat-to-life. ACC data should be the initial focus for the development of these threat of disablement indicators.

1.4.1 Fatal injury indicators

NZHIS mortality data (based on death registrations and Coroner’s reports) have been used as the basis for our proposed generic fatal injury indicators.

1.4.2 Non-fatal injury indicators

It has been our experience that large administrative sets of non-fatal injury data (e.g. NZHIS NMDS of hospital discharges, and ACC data) cannot be used to produce valid indicators without some pre-processing. Typically, we can minimise the biases in these data by using a severity threshold for our case definition. A discussion of these issues is provided by the papers in Appendix 3.

Neither the NMDS, nor the ACC databases capture severity of injury. However, we have adapted a published method to derive a severity score from routinely collected data within the NZHIS NMDS, but we have been unable to determine how this approach can be adapted for ACC data. Work is required to identify how valid injury indicators can be produced using ACC data. Such work would result in state-of-the-art non-fatal injury outcome indicators that reflect outcomes other than death, for example threat-of-disablement, or cost. (A discussion of ACC data in the context of national indicators is presented in section 3.2.) Whilst this work is pending, we have not based our proposed indicators on ACC data (with the exception of work-related injury indicators).

1.4.2.1 Hospital discharges-based indicators

What we mean by hospital discharges, or hospitalisations, are those circumstances where a patient is assigned to and occupies a hospital bed. It excludes patients who attend A&E for their injury but who are not assigned a hospital bed for the treatment and care of their injury.

---

b For example, admissions are influenced by socio-demographic, service supply and access factors independent of injury; entitlement claims are influenced by personal and health service factors, employment status, and business cycle, independent of injury.
For hospitalisations, the source of data is NZHIS NMDS. This captures data on patients attending public hospital; it excludes cases that attend private hospital. Only a small number of relevant cases would not be identified through the exclusion of injury admissions to private hospital. (13)

For hospitalisations, we have investigated threat-to-life severity scales on which to base our indicators. We compared four measures based on the Abbreviated Injury Scale (AIS) with the International Classification of Diseases-based Injury Severity Score (ICISS). We found that ICISS was one of the best performing measures. It also has the advantage that ICISS scores can be derived directly from the ICD injury diagnosis codes. (14) A synopsis of ICISS is given in Appendix 1. A copy of the paper that describes this work (Stevenson 2002) is included in Appendix 3.

We will focus on serious non-fatal injury cases that are hospitalised with an ICISS score of less than or equal to 0.941. This is equivalent to selecting patients whose injuries give the patient a survival probability of 94.1% or worse – in other words, a probability of death (at admission) of at least 5.9%. This represents around 15% of all injury discharges. This severity threshold includes the majority of the following injuries: fracture of the neck of femur, intracranial injury (excluding concussions only injury), injuries of nerves and spinal cord at neck level, multiple fractures of the ribs, asphyxia, hypothermia, and many other injury diagnoses of similar severity or which are more serious.

The injury cases selected using this definition of serious injury have high face validity. Since we are using hospital admissions to identify our serious non-fatal injury cases, we must be confident that the injuries satisfying our definition have a very high likelihood of admission to hospital. The injuries captured by selecting patients with ICISS<0.941 include the diagnoses shown in Appendix 1. Each of these injuries will almost inevitably result in admission to hospital.

This is not true of less serious injury; i.e. minor and moderately severe injury with an ICISS score greater than 0.941. Amongst minor injuries (e.g. laceration to the arm less than 10cm long, ankle sprain), the probability of admission to hospital, given that an event resulting in injury has occurred, is low and varies by time and place. These injuries are most likely to be treated by a general practitioner, or at Accident and Emergency department (A&E) without admission. If a victim sustains a moderately severe injury (e.g. spinal fracture without cord contusion or laceration, knee dislocation), the likelihood of admission is higher, but this still varies by time and place. Hence an indicator based on these injuries, with cases enumerated from all admissions to hospital, would not be stable either over time or between areas.

---

< All hospital discharges from public hospital are considered, even ones with 0 days stay; however, only cases that exceed the severity threshold of ICISS<0.941 are selected as cases.
1.4.3 Alternatives to the generic non-fatal indicators

We chose these generic non-fatal injury indicators since we could not identify any valid alternatives. Others have proposed indicators based on:

- total admissions to hospital
- admissions resulting in
  - 1 or more days stay in hospital
  - 3 or more days stay
  - 4 or more days stay

Each of these have problems of validity. We consider total admissions to hospital, and admissions resulting in 4 or more days stay as examples to illustrate that indicators based on this type of method of selection can result in misleading trends.

Example A: Assaults resulting in hospitalisation

Consider the 20-year trend in hospitalisations for assault from 1979 to 1998. The trend shows a general increase in the rates over this period. However, if one were to plot the same graph, but excluding cases with 0 days stay in hospital, the trend shows a decline over the same period.

These contradictory results were caused by a change in the convention of what is regarded as a hospital inpatient stay. In the late 1970’s / early 1980’s, people who attended A&E but who occupied a bed within A&E for observation, diagnosis, treatment and care were classified as outpatients. From the mid-1980’s onwards, more and more of these cases have been classified as hospital inpatient stays. Thus, the apparent upward trend in assaults is an artefact of this drift in classification, and as such is misleading.

Obviously, a simple solution to this would be to exclude cases of 0 days stay from the definition of the indicator. However, there are many other and less remediable problems when using total hospitalisations (or for that matter admissions resulting
in 1 or more days stay) as the basis for a non-fatal injury indicator. These are illustrated by the examples below.

**Example B: Head injuries resulting in 1 or more days stay**
The trend in head injuries resulting in 1 or more days stay in hospital from 1988 to 1996 shows a steadily declining trend (Figure 3). If one were to disaggregate these head injuries by severity of injury, then the trends shown in Figure 4 are obtained. Injuries had been classified to ‘minor’, ‘moderate’ and ‘serious’ using the Abbreviated Injury Scale (15) derived from ICD using the software package ICDMAP-90 (16). The results show a decline in minor and moderately severe injuries but no decline in serious injuries.

At least part of the explanation for these differing trends is the increased use of scanners in outpatients / A&E to diagnose the nature of the head injury. In the late 1980’s, many minor and moderately severe head injuries were being admitted for observation and diagnosis; whereas, the same head injuries would have been diagnosed and treated in outpatients in the 1990s.

This decline in hospitalisations for head injury of any severity is at least partly due to changes in medical practice. It affects minor and moderately severe injury, whereas it has limited or no effect on serious injury – injuries of this severity would be admitted whether or not initial investigation occurred at outpatients or as inpatients.

It is generally true that the effects of extraneous factors (e.g. changes in service provision) have minimal impact on admissions for serious injury, but can have a substantial effect on admissions for minor or moderately severe injury. Thus, injury indicators based on admissions to hospital that include minor and / or moderately severe injuries carry significant threat to validity – and can be highly misleading.
Figure 3: Trends in head injuries requiring inpatient treatment 1988-1996.

Figure 4: Trends in head injuries requiring inpatient treatment 1988-1996, by anatomical severity defined by AIS.
**Example C: Injury resulting in 4 or more days stay for 0 to 19 year olds**

In 1999, the health strategy for England – *Saving Lives: Our Healthier Nation* – was published. (17) It included a target for the reduction of serious injuries, where serious was defined as an injury resulting in 4 or more days stay in hospital. We had theoretical concerns that, like total admissions to hospital, it would be susceptible to extraneous health service provision effects. We investigated trends in this indicator amongst people aged 0 to 19 years during the period 1981 to 1999 in one region of England.

Trends in injury hospitalisations of 4 or more days showed a **downward trend** over this period. (6) The majority of serious injuries, as defined by the Abbreviated Injury Scale, are serious long bone fractures - SLBFs (i.e. fractures of the femur, or complicated fractures of the other long bones). Given that SLBFs form the majority of serious injury, one would expect the trend in these injuries to be similar to the trend for injury of any diagnosis which results in 4 or more stays in hospital (if hospitalisations of 4 or more days stay are truly a reflection of serious injury occurrence). In fact the trend in SLBFs was **increasing**. What accounts for this apparent contradiction?

Average lengths of stay in hospital declined during this period, for reasons such as improved / changed methods of treatment, as well as pressure on hospital beds. Hence, the proportion of cases of any injury diagnosis with a length of stay in hospital of 4 or more days were likely to have declined during this period. In fact, if one considers the proportion of SLBFs which resulted in 4 or more days stay, this declined from around 80% to around 30% during this 20 year period. So health service factors contribute substantially to the decline in injuries resulting in 4 or more days stay in hospital to such an extent that we must seriously question whether any decline in the incidence of serious injury occurred during this period. The use of indicators based on service utilisation measures of injury occurrence are, therefore, potentially highly misleading.
1.4.4 Burden of Injury

Not only do our proposed indicators draw attention to injury mortality and to injuries that result in significant threat to life, these indicators also account for a significant proportion of the cost of injury. Work by Watson, reported in Hazard in Autumn 2003, presents the cost of death and hospital treated injury in 2001 in Victoria. (18) This is shown in Figure 5 below. Although the number of A&E attendances far exceeds deaths and hospital admissions, their costs are a fraction of those that result in death or hospital admission. It shows that the cost of injury increases, on average, with severity. The net effect of this was that deaths and hospital admissions accounted for 90% of the cost of all injury deaths and hospital presentations.

Figure 5:

Cost of death and hospital treated injury, Victoria 2001

\[
\text{INCIDENCE} \times \text{COST PER INJURED PERSON} = \text{TOTAL LIFETIME COST}
\]

- Deaths: 1,638, $590,716
- Hospitalisations: 75,934, $24,389
- ED presentations: 254,245, $1,221

\[
331,817 \times \$9,433 = \$3,130m.
\]
1.5 Quality of numerator data

It is difficult to comment on the quality of the numerator data for our proposed indicators when there is very limited published work that has assessed the quality of the NZHIS mortality and hospitalisations data. (Note: ACC data is not discussed here since it does not provide the source data for our generic indicators. Rather, it is discussed in Section 3.2.)

There have been overseas studies carried out, and synopses of their findings are described in what follows. Care is needed in inferring from the findings of one country to another, however. For example, there are variations between countries in death certification and coding practices. (19) This makes inference about the quality of mortality data from one country to another problematical. Despite these difficulties, we have provided a synopsis of overseas findings in order to highlight some of the problems that may exist.

1.5.1 Deaths

Diagnosis

There is the potential for under-ascertainment of injury cases for older people. For example, deaths from falls in people aged 65 and over are often due to complications that result from the falls injury, e.g. pneumonia or other infection. Similarly, where an operative procedure is necessary (e.g. to repair a hip fracture), and the patient has an underlying heart condition, for example, the death could result from the failure to recover from the operation due to the concomitant pathology. In these instances, the certifying physician may incorrectly list these complications and not the fall or the falls’ injury as the underlying cause of death. (19)

The example described by Langlois and colleagues (19) suggests the problem may be less in New Zealand than in the USA; nevertheless until verified that this is not a problem in New Zealand, one cannot be certain that these will not affect the validity of our proposed indicators. Given the preponderance of falls in older age, this will have greatest impact for falls-related mortality indicators.

Problems of inaccurate diagnosis captured on electronic databases may not be as extreme for other age groups (i.e. children and adults of working age). In a recent report from the US CDC, they comment that they expect accuracy of diagnostic coding to be high. (20)

Inaccuracies in diagnosis codes would affect the ascertainment of relevant cases for our indicators.

External cause

For people who died in hospital, a Swedish study compared the ICD-9 external cause of injury coding of death certificates against that coded to hospital discharge records. (21) They found that the underlying cause differed at the 3-digit level for more than 50% of the linked records. For example, a ‘fall on or from ladders or scaffolding’ miscoded to ‘fall from or out of building or other structure’. The suggestion was that the greatest inaccuracies were for the death records.

Work from the USA indicated the following: “lack of specificity with regard to the circumstances of injury and inconsistencies in the definition and specification of the manner or intent of death may contribute to bias for some injury deaths.” (p17) (20)
If significant inaccuracies exist in current New Zealand external cause coding (e.g. a fall coded as a MVTC), then this could affect both the identification of cases consistent with our case definition, as well as the identification of cases relevant to many of the priority areas.

1.5.2 Admissions to hospital

Diagnosis

A small New Zealand study (174 cases) was carried out by Smith (1989) which assessed the accuracy of the hospital discharge diagnoses for a sample of data from July 1986. (22) This was based on an assessment of diagnostic codes (ICD-9 codes) on the national electronic database of hospital discharges, against a re-coding of these data based on information in patient records. Patients with any diagnosis were selected for this study – not just injury. A key finding was that there was an estimated 29% (50/174) error rate in the recorded codes when accuracy was compared at the 3 digit level (the most specific ICD-9 diagnosis codes were coded to a maximum of 4 digits). If this level of error has persisted, it would influence the selection of cases for our proposed indicators.

Campbell and colleagues (2001) carried out a review of 21 studies in Great Britain that had investigated diagnostic and operative procedure coding accuracy, nine of which investigated the accuracy of ICD-9 coding. (23) Many of these considered all diagnoses (of which injury is a small part) or non-injury diagnoses. Those published prior to 1995 exhibited worse than 75% diagnostic coding accuracy; whereas those published in 1995 and since showed better than 75% accuracy.

A study by Dixon and colleagues (1998), included in the Campbell review, looked at the accuracy of diagnostic coding for all diagnoses as well as for specific diagnoses, one of which was fractured femur. (24) This was carried out in 2 hospitals (labelled A and B). For all diagnoses, there was exact agreement for around 50%, and agreement at the 3-digit level for 55% and 72% for hospitals A and B. For fracture of the femur the 3-digit level of agreement was better: 84% and 89%. This excluded older people aged 75 and over, who have the highest risk of femoral fracture, but for whom there can be a problem of identifying principal diagnosis for reasons similar to those explained for mortality above.

In Victoria Australia, a study to investigate the accuracy of ICD-9-CM codes (an extension of ICD-9) for a sample of 480 discharges with a principal diagnosis of injury found 81% agreement in a coding audit of principal diagnosis. (25)

There have been audits of hospital coding for a number of years carried out by NZHIS, as well as by bodies independent of NZHIS. Whilst not published in the public domain, these audit results provide evidence of a reasonable standard of diagnostic coding in New Zealand (Gary Jackson, personal communication, 2004). Additionally there are financial (e.g. inaccurate coding can cost hospitals money) and structural reasons (e.g. process measures put in place to improve recruitment, the terms, conditions, and training of coders, and improve performance) why diagnostic coding in New Zealand hospitals have improved and are now of a good standard.
(Gary Jackson, personal communication). Also, provisional results in work currently being conducted by IPRU on injury diagnosis supports Jackson’s communication.

**External cause**

In the Victoria study there was 84% agreement in external cause coding. (25) In the USA, the agreement between ICD-9-CM external cause codes (E-codes) on electronic records with those derived by the investigators from medical records was investigated. (26) For cases where an E-code was assigned, in 67% of cases there was agreement at the 4-digit level, a further 7% at the 3-digit level, and a further 8% at the section level. At these levels of misclassification, this could result in large inaccuracies in case ascertainment.

In another study from the USA that investigated the correspondence in external cause coding between computerised hospital discharge records and an external reviewer, agreements were found in 85% of cases, with 95% agreement for intent. (27) Regarding the external reviewer’s assessment as the gold standard, use of electronic discharge records identified over 90% of falls and MVTCs.

One important message that can be taken from the above is as follows. In the absence of published audit studies to assess the accuracy of diagnostic and external cause of New Zealand injury data, collected on either the NZHIS mortality data system or the NZHIS NMDS, one cannot presume these data are accurate. Throughout the rest of this report, inaccuracies in the numerator data could be important threats to the validity of our proposed indicators.

It is important that audits of the coding of hospitalisation data are carried out regularly (e.g. bi-annually), and their findings published so that for this work, and for the many other pieces of work that are based on these data, we are aware of the threats to validity posed by these source data.

### 1.6 Denominators for calculating rates

Rates, where recommended in this document, are expressed as per 100,000 person-years (i.e. per 100,000 population per year of exposure). Person-years have been used as denominators for the rates since: these are the natural units for a rate; and, where the indicator is based on moving averages, then the use of person-years naturally takes account of the effect of using multiple years to construct the rates.

Population data were obtained from Statistics New Zealand population estimates (see [www.stats.govt.nz](http://www.stats.govt.nz)). These are mid-year estimated resident population values. These estimates are for the usually resident population so do not include short-term overseas visitors to New Zealand (e.g. tourists). As such there may be a small mismatch for some rates between the numerator and denominator. However, this is likely to have little impact on the indicators or their trends.
Part 2: Proposed Indicators

2.1 Identification of the proposed indicators

2.1.1 Introduction

The NZIPS indicators were selected from the generic indicators (section 2.1.2) and current national indicators relating to all injury\(^d\) and to each of the 6 priority areas. The generic indicators were based on mortality and hospitalisation (inpatient) data, for absolute numbers and rates. Absolute numbers reflect the societal burden of injury, while rates reflect individual risk. Rates are age-adjusted to compensate for societal changes in the age distribution of the population over time.

The number of injury cases, on which these indicators are based, will be accumulated over 12 months - unless the number falls below 100. The reason for this is as follows. Year to year variability is greater than ±20% for counts less than 100. This variability may hide trends in numbers and rates of injury. In these circumstances, cases will be accumulated over sufficient years to meet this threshold requirement – in which case, indicators will be calculated as moving averages.

Our focus was on indicators relevant to the whole of the priority area (ie. high level indicators). Even so, this has resulted in around 40 indicators (28 proposed, and 14 provisionally proposed) across all injury and the 6 priority areas. We leave it to the lead agency to identify subpopulations within the priority area that are a particular policy focus, and so attract their own indicator. In this respect we note that one of NZIPS’s underlying principles is to recognise the special relationship between Maori and the Crown under Te Tiriti o Waitangi (the Treaty of Waitangi). In developing indicators for Maori, agencies should be mindful of the changes which have occurred in the numerator and denominator definitions over time and the implications these changes may have for interpreting trends. (28)

2.1.2 Method overview

For ‘all injury’ (section 2.2A) and for each of the six priority areas (sections 2.2B to 2.2G), we used the following methods:

- we considered the scope of the priority area and defined terms
- we identified existing indicators through a named contact within the lead agency for the NZIPS priority area
- we suggested new fatal and non-fatal injury indicators (based on the ‘generic’ indicators described in section 2.1.4)
- we subjected all of the candidate indicators to a systematic assessment of validity
- based on the results of that validation, we proposed indicators for each priority area.

2.1.3 Existing New Zealand National Indicators.

The following method was used to identify currently used/proposed indicators.

\(^d\) That is, all pathology and all causes which satisfy our definition of an injury – see section 1.3.
Representatives from each of the lead agencies for the 6 priority areas were asked to identify any official national fatal or non-fatal injury outcome indicators relating to their priority area. It was explained that what was meant by official indicators were those that have been documented or used by a government or other national organisation. This resulted in either the provision of indicators, and / or suggested others that we should contact.

The process was repeated with these “others”, and following correspondence with the initial contact and suggested “others”, the process was terminated when no additional indicators were forthcoming.

This process was supplemented by scrutiny of relevant documents from national agencies. The indicators identified were included in the relevant subsections of Section 2.2.

Once an indicator had been identified, the agency was also asked whether they could supply a written specification of the indicator. This yielded no written specifications of the type shown in Appendix 2. Rather, we were referred to reports, or were sent descriptions referring to the indicators. The failure to specify indicators in this manner is, we believe, a significant shortcoming. For example, trends need to be reproducible over time and place, and this will involve different personnel calculating the indicator values. Without an explicit specification, there is opportunity for variations in the method of case selection and indicator derivation.

We then systematically assessed the existing national indicators that were identified against our validation criteria. If we found no significant threats to validity, we considered the existing indicator as an NZIPS indicator. If we identified significant threats to validity, we dropped the indicator completely from our consideration.

There were instances where the same indicator had been used by a national agency repeatedly for various subpopulations, e.g. subpopulations defined by age, gender, ethnicity, deprivation and geographic area. An example of this is the youth suicide indicators used by Ministry of Health Public Health Intelligence – see Section 2.2D. In keeping with the goal of choosing only high-level indicators, only the underlying indicator was considered as a candidate NZIPS indicator – for this example it was suicide rates per 100,000.

2.1.4 The generic indicators

Mortality-based indicators

The proposed mortality-based generic indicators are:

- The age-standardised injury mortality rate, per 100,000 person-years at risk in the whole New Zealand population.
- Number of injury deaths.

These indicators are derived from NZHIS mortality data. Cases were selected to be consistent with our definition of injury; i.e. based on primary diagnosis and accompanying external cause code (see section 1.3). Unlike some data sources (e.g.
Traffic Crash Reports), the length of time between injury and death was not a factor in whether or not a case of injury death was counted. The critical issue in case selection for our indicators was whether the Coroner regarded the death to be caused by an injury irrespective of time between injury and death.

Measurement of fatal injury incidence requires specification of a date for each death – to enable each case to be allocated to the appropriate year for the calculation of incidence. Consistent with the indicators produced by MoH Public Health Intelligence, we used the date of registration for these indicators.

Denominators were derived from Statistics New Zealand population estimates (see section 1.6).

**Validity**

When matched against our 6 criteria, these indicators appear valid. As with all indicators, one potential threat to validity is inaccurate coding. Data quality issues are discussed in Section 1.5. Additional issues of validity specific to each of the indicators for each priority area are discussed in their own subsections of Section 2.2.

**Hospital admission-based indicators**

The proposed hospital admission-based generic indicators are:

- The age-standardised serious non-fatal injury rate, per 100,000 person-years at risk in the whole New Zealand population.
- Number of cases of serious non-fatal injuries.

The source of morbidity data proposed for these generic indicators is the NZHIS NMDS of discharges from public hospital.

A serious injury case was defined as a case with an ICISS score of less than or equal to 0.941 (see section 1.4 and Appendix 1 for a description of ICISS, the threat-to-life severity scale). This included (but wasn’t limited to) most cases with the following diagnoses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>S72.0</td>
<td>Fracture of the neck of the femur</td>
</tr>
<tr>
<td>S06.1</td>
<td>Intracranial injury (excluding concussion)</td>
</tr>
<tr>
<td>S14</td>
<td>Injuries of nerves and spinal cord at neck level</td>
</tr>
<tr>
<td>S22.4</td>
<td>Multiple fractures of ribs</td>
</tr>
<tr>
<td>T71</td>
<td>Asphyxiation</td>
</tr>
<tr>
<td>T68</td>
<td>Hypothermia</td>
</tr>
</tbody>
</table>

A full list of single injury diagnoses captured by this definition of serious injury is included in Appendix 1.

This particular threshold was chosen as a compromise. As described in section 1.4.2, we must be confident that the injuries satisfying our definition have a very high likelihood of admission to hospital, in order to avoid defining indicators that could be
susceptible to influences other than the occurrence of serious injury. These influences include changes in hospital admission policy, technological changes that affect diagnosis, treatment and care, etc. However, we did not want to set the severity threshold so high that it excluded too many injuries known to be serious for which the likelihood of admission is very high.

We are confident that the injuries captured by an ICISS threshold less than or equal to 0.941 have a very high likelihood of admission. To choose a threshold below 0.941 (a higher severity threshold) would eliminate some reasonably common serious injuries that are known to be admitted in almost all circumstances. For example, a lower threshold would exclude many cases of fractured neck of femur. These are serious injuries that we know are admitted to hospital in almost all circumstances. On the other hand, to relax the threshold would capture more injuries; however, for these injuries we were not so confident that the vast majority would be admitted. If the threshold was raised to values greater than 0.941 (lower severity thresholds), a significant number of cases with 0 days stay in hospital were captured. We felt uncomfortable with this, and were concerned that to include these cases may affect the validity of the indicators.

We have taken a conservative approach and chosen a threshold for which we are confident that the injuries captured are serious, would be admitted to hospital in the vast majority of instances, and so would satisfy our validity criteria.

These are non-fatal injury indicators, so that any deaths within hospital are excluded from the numerators of the indicators. (However, the numerator includes the relatively small number of people who die as a result of their injury following discharge from hospital).

Date of discharge was used to group hospitalisations by year. For example, if a person was injured and admitted to hospital in 2003, but they were discharged in 2004, their injury would be counted towards the 2004 indicator value.

Denominators were derived from Statistics New Zealand population estimates (see Section 1.6).

**Validity**

When matched against our 6 criteria, these indicators appear valid. The choice of this severity threshold (ICISS score \( \leq 0.941 \)) is assumed to remove the effect of extraneous factors on case ascertainment. As with all indicators, one potential threat to validity is inaccurate coding. Data quality issues are discussed in Section 1.5.

Additional issues specific to each of the indicators for each priority area are discussed in their own subsections of Sections 2.2.
2.2 Proposed injury outcome indicators

The following subsections consider indicators relating to ‘all injury’ and to each of the 6 NZIPS priority areas in turn. In each section we describe the scope of the indicators we have proposed, the existing national indicators that were identified, our newly proposed indicators based on the generic fatal and non-fatal injury outcome indicators, and we discuss the validity of each of the candidate indicators. In the final paragraphs we describe the proposed indicators.
A. All Injury

A1 Scope / Definition of terms
This subsection addresses injury outcome indicators across all diagnoses, all causes, and all intent, satisfying our operational definition of an injury – see section 1.3.

A2 Candidates for NZIPS indicators

A2.1 Existing national indicators

A2.1.1 Description
The ACC have lead responsibility for all accident/injuries. The ACC has not, at this point, developed injury indicators for ‘all injury’. Our work has been commissioned to advise ACC on valid national indicators to measure injury prevention performance.

Ministry of Health Public Health Intelligence
Over the past year, Public Health Intelligence of the Ministry of Health, has been preparing a report - "An Indication of New Zealanders’ Health 2003". The goal of this report is to provide a quick reference/overview of the health of New Zealanders through a set of key indicators. That report contains the following ‘all injury’ indicator:

Ministry of Health PHI Indicator:
• Child injury mortality (5-14 years), rate per 100,000.

New Zealand Injury Data Review
The Injury Data Review was established in 2000 and reported in 2002. (29) The objectives of the review included to identify “a set of statistical indicators that meet the requirement to inform on injuries in New Zealand at a high level”. The review team identified over 30 policy questions and, for each, proposed one or more indicators to inform those policy questions. The ‘all injury’ outcome indicators identified were as follows (using the review team’s words) :

a) Number of deaths as a result of injury
b) Injury-related deaths per 100,000 population
c) Injury-related deaths as a proportion of all deaths
d) Number of injuries
e) Number of injured persons
f) Injuries per 100,000 population
g) Injured people per 100,000 population
h) Years of potential life lost
i) Proportion of new injuries that result in hospitalisation
j) Count of injuries that result in hospitalisation
k) Hospitalised injuries as a proportion of all hospitalisation discharges.
l) Hospitalisation because of injury per 100,000 hospitalisation cases in time period
m) The proportion of injuries that occurred in the previous year that have resulted in permanent disability.
n) Total number of people that suffered permanent disability as a result of an injury that occurred in the previous year.

o) Count of injuries that required long term treatment

p) Proportion of injuries that result in long term treatment

Some additional indicators, included in the New Zealand data review, considered the sex ratio of injury incidence, gender, age-specific, and ethnic group-specific rates, proportion of injuries occurring in particular geographic areas, in deciles of deprivation, by activity, by agent, by external cause, etc.. In fact many of the additional items referred to as indicators are in fact descriptions of the type of epidemiological analysis which might be carried out to describe injury in New Zealand. Consequently, we have limited our attention to the 17 indicators listed above.

**Injury Information Manager**

The future work of the Injury Information Manager (IIM) includes the identification of indicators. The conceptual framework introduced by the New Zealand Data Review will be considered by the IIM and where necessary revised. This framework is intended to better organise and structure official injury statistics, in order to better improve links to decision making. Indicators will flow from this process. This work is ongoing - none of their indicators have been finalised. It is therefore inappropriate for us to quote from their work at this stage. Once this work has been released to the public, their indicators should be considered in the same way as other indicators assessed in our report.

**A2.1.2 Validity**

**Ministry of Health, Public Health Intelligence (PHI)**

The PHI are currently developing written specifications for their indicators. In the absence of these, it would be reasonable to assume that this indicator will be calculated in a manner similar to the ones described below (Section A2.2), and so their validity characteristics will be similar. That is, the indicator appears valid when assessed against our validation criteria.

**New Zealand Injury Data Review**

The Injury Data Review indicators were proposed on the premise that data systems would be developed and data collected routinely to support their calculation. Some of the indicators listed above will fail on the ‘data availability’ criterion until those data systems become available. Additionally, at the time of writing, a full written specification has not been produced for any of the indicators.

In regard to the specific indicators:

- The mortality indicators ((a) – (c) and (h)) satisfy our remaining criteria.
- Indicators (d) – (g) have numerators that are counts of ‘injuries’ or injured people. It is proposed that injuries will be ascertained from several sources including NZHIS, ACC, Land Transport Safety Authority (LTSA), and reporting systems to OSH* and other occupationally-related agencies. The discussion in section 1.4 highlighted the problems of using the occurrence of injuries from these sources

* OSH : Occupational Safety and Health Services, Department of Labour
without applying some severity of injury criteria. Without doing so, the ‘case ascertainment’ criterion will not be satisfied.

• The same concern exists for indicators (i) – (l).
• Current data sources cannot support the valid enumeration of indicators (m) and (n). As we have discussed in section 1.4, work is urgently needed to develop indicators based on (threat-of-) disability as an outcome.
• Indicators (o) and (p) are likely to suffer from service utilisation biases, which will pose a threat to validity. Nevertheless, if diagnoses can be identified for which the probability of case ascertainment is high, and which generally result in long-term treatment, then indicators based on these diagnoses would satisfy our criteria and would be worthwhile pursuing. Again development work is necessary to identify such reliable and valid indicators.

A2.2 Our newly proposed injury indicators - fatal injury

A2.2.1 Operational definition of a case
Cases will be identified from the nature of injury and the external cause of injury codes recorded on the NZHIS mortality data file. The particular codes used are described in section 1.3 and shown in the indicator specifications – see Appendix 2.

A2.2.2 Indicators
• Age-standardised injury mortality rate, per 100,000 person-years at risk.
• Number of injury deaths.

A2.2.3 Validity
When matched against our 6 criteria, these indicators appear valid. As with all indicators, one potential threat to validity is inaccurate coding. Data quality issues were discussed in Section 1.5.

A2.3 Our newly proposed injury indicators - serious non-fatal injury

A2.3.1 Operational definition of a case
Cases will be identified from the nature of injury and external cause of injury codes recorded on the NZHIS NMDS. The codes used to identify cases will be the same as those described for the fatal injury indicators above. Serious injuries are defined as those with an ICISS<0.941 (see Section 2.1).

A2.3.2 Indicators
• Age-standardised serious non-fatal injury rate, per 100,000 person-years at risk.
• Number of serious non-fatal injuries.

A2.3.3 Validity
When matched against our 6 criteria, these indicators appear valid. As with all indicators, one potential threat to validity is inaccurate coding. Data quality issues are discussed in Section 1.5.

A3 Proposed indicators
The proposed indicators that have been selected include only our 4 newly proposed
indicators. Although equally valid, the indicator from the Department of Health PHI report, which focuses on children, has not been included. As indicated in Section 2.1, we leave it to the lead agency to identify subpopulations within the priority area that might be a particular policy focus, and so which would attract their own indicator.

The four indicators below encompass the mortality indicators identified in the NZ Injury Data Review report. This is with the exception of (h) ‘Potential years of life lost’. We cannot recommend the other injury outcome indicators identified by the NZ Injury Data review due to significant threats to validity, or until development work has taken place. This development work is likely to be significant in both time and intellectual effort.

- Age-standardised injury mortality rate, per 100,000 person-years at risk.
- Number of injury deaths.
- Age-standardised serious non-fatal injury rate, per 100,000 person-years at risk.
- Number of serious non-fatal injuries.

Examples of Selected Indicators

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Serious Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>1500</td>
</tr>
<tr>
<td>1995</td>
<td>3000</td>
</tr>
<tr>
<td>1996</td>
<td>4500</td>
</tr>
<tr>
<td>1997</td>
<td>6000</td>
</tr>
<tr>
<td>1998</td>
<td>7500</td>
</tr>
<tr>
<td>1999</td>
<td>9000</td>
</tr>
</tbody>
</table>

\[\text{Number of Serious Injuries By Year - All Injury (101)}\]

\[\text{Points to the left of the dotted line refer to data coded according to ICD-9. This is an approximation of the ICD-10-based indicator. The dotted line indicates the changeover from ICD-9 to ICD-10.}\]
Rate of Fatalities by Year - All Injury (I12)

Rate (per 100,000 popn)

B) Assault

B1 Scope / Definition of terms
In this report we have used a public health approach to describing the scope and defining terms. This can differ from the justice approach where legal considerations can be included in the definition.

We use the term assault to include both fatal and non-fatal interpersonal violence which is used with the intent of causing harm, injury, or death to another. Homicide is death due to injuries inflicted through any means by another person with the intent to injure or kill. (30)

Our definition includes all acts of commission with the exception of injuries due to legal intervention, and operations of war. It includes sexual assault and acts of omission (e.g. abandonment) where injury has occurred.

B2 Candidates for NZIPS indicators

B2.1 Existing national indicators
B2.1.1 Description
The Ministry of Justice (MoJ) and the Ministry of Social Development (MSD) share responsibility for this priority area. Neither agency has at this point developed injury indicators for these areas.

Ministry of Justice
At the time of writing the MoJ was developing an Action Plan to address alcohol related and community violence. That plan had not been “signed off” by cabinet. MoJ is currently working on outcomes and indicators for various crimes including assault.

Ministry of Social Development
The MSD's Social Report for 2003 "provides a comprehensive set of indicators designed to measure our progress as a nation in achieving its social vision" (P3). (31) Relevant here are indicators for child abuse and neglect, and criminal victimisation. As will be illustrated below, these indicators include more than injury outcomes.

The MSD ‘definition/formulae’ for their indicator of child abuse and neglect is :

"The number of children assessed as abused (physically, emotionally, sexually) or neglected following notification to the Department of Child, Youth, and Family Services (CYFS) as a proportion (per 1000) of all children under 17 years of age."
(p100)

The MSD ‘definition/formulae’ for their indicator for criminal victimization is :

"The proportion of the population age 15 and over who have been victims of one or more incidents of criminal offending as measured by the 2001 National Survey of Crime Victims" (p102).
New Zealand Police
The New Zealand Police publish "New Zealand Crime Statistics" each year. The document contains a number of measures of potential relevance to the NZIPS. These measures, while officially not described as indicators, are used as such. There are two ‘Offence Categories’ of relevance: ‘Violence’ and ‘Sexual Offences’. Relevant ‘Offence Classes’ within each of these are:

**Violence**
- Grievous Assaults
- Homicide
- Minor assault
- Serious Assaults,

**Sexual Offences**
- Sexual Attacks

The offence classes are defined in the Crimes Act 1961. The New Zealand Crime Statistics contain recorded number of offences and a rate (per 100,000 population) for each offence class.

B2.1.2 Validity

**Child abuse**
The MSD in discussing the ‘limitations of data’ states:

"There is currently no single measure that can adequately establish the prevalence of child abuse in the community, or establish trends in child abuse over time. Mortality rates capture only the most extreme form of abuse; hospitalisation data on injuries sustained as a result of child abuse are subject to misclassification and reflect changes in hospital admission procedures. Notifications of child abuse and neglect, and hence the number of children assessed as abused, can be affected by the level of resources made available, by administrative changes, and by changes in the likelihood of people reporting suspected abuse" (p153) (31)

**Criminal Victimisation**
The MSD indicator includes many events which do not meet the definition of injury (Section 1.3) (e.g. victim of burglary). In addition the MSD in discussing the ‘limitations of data’ states:

"The 2001 survey had a response rate of 62 percent and the 1996 survey had a response rate of 57 percent. The response rates for Maori and Pacific peoples were much lower. The differences in the response rates between the surveys, and the low response rates among Maori and Pacific peoples, may have impacted on both the validity of comparisons between the two surveys and on the reliability of the findings of the 2001 survey, especially with respect to Maori and Pacific peoples." (p153)

**NZ Police based indicators**
It is important to note that the police database is offence based. Thus one incident could involve the recording of more than one offence. While the police have the capability to identify persons who are injured in any offence category, such data
are not regularly reported. Reports of assault to the police suffer similar problems to those for motor vehicle traffic crashes reported to the police. Namely there is significant under-reporting, and this is biased with respect to the types of incident reported. The level of bias is likely to vary over time. This is well illustrated by the effect of ‘Team Policing’, which is a proactive approach to policing and can result in the police reporting many incidents of minor assault during the proactive period.

We have not systematically judged the above indicators against all of our validation criteria, as sufficient evidence has already been produced to demonstrate there are major threats to validity for all of the indicators.

**B2.2 Our newly proposed injury indicators - fatal injury**

**B2.2.1 Operational definition of a case**

Cases will satisfy our operational definition of injury (section 1.3) and will be identified from external cause of injury codes recorded on the NZHIS mortality data file. The particular codes used are shown in the indicator specifications – see Appendix 2.

It should be noted that this operational definition includes: ‘sexual assault by bodily force’, ‘neglect and abandonment’, and ‘other maltreatment syndromes’ (e.g. child abuse).

**B2.2.2 Indicators**

- Age-standardised assaultive injury mortality rate, per 100,000 person-years.
- Number of assaultive injury deaths.

**B2.2.3 Validity**

We are satisfied that our proposed indicators meet our validation criteria (Section 1.2). One of our criteria, case ascertainment, merits discussion. All sudden deaths are notified to the police. Those due to injury are closely scrutinised by the police to determine whether the incident was unintentional, self inflicted, or purposely inflicted by another person. The latter are the subject of a criminal investigation which is extremely intensive. This process, ultimately via a Coroner, is used by NZHIS to determine the coding of the death as assaultive or not. This process is likely to result in the most accurate identification of cases of assault that can be expected.

**B2.3 Our newly proposed injury indicators - serious non-fatal injury**

**B2.3.1 Operational definition of a case**

Cases will satisfy our operational definition of injury (Section 1.3) and will be identified from the external cause of injury codes recorded on the NZHIS NMDS. The particular codes used are shown in the indicator specifications – see Appendix 2.

**B2.3.2 Indicators**

- Age-standardised assaultive serious non-fatal injury rate, per 100,000 person-years.
- Number of assaultive serious non-fatal injuries.
B2.3.3 Validity

We are satisfied that our proposed indicator meets many of our validation criteria (section 1.2). One of our criteria, case ascertainment, merits discussion. The identification of injury events which are assaultive is likely to be seriously influenced by changing social norms. Victims, care-givers, and the general community are more willing to identify and report these incidents.

Unlike fatal incidents, the police will not automatically become involved in assaultive injury events that result in hospitalisation. For example, a victim may claim to health care providers that their injury was due to assault, but may be insistent that this is not revealed to the police.

In summary, unlike fatalities, there is not a comprehensive and independent verification process by the police of the intent of all injuries that require admission to hospital. This will pose some threat to validity of the indicators. The proposed indicator has a relatively high threshold. For example in 2001 there were 1725 persons who were hospitalised for treatment of injury where the intent was recorded as assaultive. Using the threshold we have developed here we would capture 675 (39%) of those cases. There is ample evidence to demonstrate that more serious assault is more likely to be reported to the police. (32)} We have been unable to identify comparable work on reporting to health care providers, however, there is no reason to suspect the effect would not be the same.

B3 Proposed indicators

Existing national indicators have major threats to validity and as such are not suitable for NZIPS purposes. We propose the following as NZIPS indicators.

- Age-standardised assaultive injury mortality rate, per 100,000 person-years
- Number of assaultive injury deaths

For the equivalent serious non-fatal injury indicators, they are not entirely free of threats to validity. Consequently, we propose the following as provisional NZIPS indicators:

- Age-standardised assaultive serious non-fatal injury rate, per 100,000 person-years (hospitalisation data-based)
- Number of assaultive serious non-fatal injuries (hospitalisation data-based)

It should be noted that many assaultive events, although serious from a psychological perspective, are not so from the perspective of anatomical or physiological damage and as such are unlikely to be captured by the NZHIS NMDS. Thus the indicators proposed here will be heavily biased towards events that result in physical injury.

Unfortunately we have been unable to identify any routine administrative database that could be the source for an indicator of psychological injury that would not, \textit{a priori}, be unduly
influenced by changes in reporting behaviour over time. In our view, psychological injury requires addressing in a different manner and we propose that this be done from a threat-of-disablement perspective (see section 3.3.8). The national Mental Health survey may offer the opportunity for further indicator development.

Examples of selected indicators*

---

* Points to the left of the dotted line refer to data coded according to ICD-9. This is an approximation of the ICD-10-based indicator. The dotted line indicates the changeover from ICD-9 to ICD-10.
Rate of Serious Injuries by Year - Assault (A02)

Three Year Moving Average Rate of Fatalities by Year - Assault (A12)
C. Work-Related Injury

C1 Scope/Definition of terms

The NZIPS priority area is entitled ‘Workplace injuries (including occupational diseases)’. The indicators that we considered in this report were confined to injuries and do not encompass occupational disease. This exclusion is for two reasons. Firstly, we are unaware of any national database that can be used to produce valid estimates of work-related disease resulting in death or morbidity. Secondly, we are unaware of any measure of severity that could be applied to known morbidity data to produce indicators that would have minimal threat to validity.

The phrase ‘workplace’ places the focus on location. There can be work-related and non-work-related injuries that occur at a workplace. (For example, one workplace is the road; however, non-work-related injury also occur on the road.) We understand this wider perspective is not intended and that the focus is work-related injury. We have thus adopted this more specific focus.

Work-related injury has been defined in a number of different ways. It includes injuries to the workforce, but can also include one of more of the following:

- bystanders,
- people travelling whilst at work,
- people commuting to and from work.

People travelling whilst at work are included within our theoretical definition of work-related injury. However, methods for the identification of motor vehicle traffic crashes (MVTCs) that are work-related (either whilst working or when commuting to and from work) and for the identification of bystanders using routinely collected data are unreliable, (33) hence they are excluded from the operational definition of the work-related injury indicators described below.

Work-related MVTCs are a large problem. They represent 29% of all work-related fatal injuries. (34) We recommend that future work should be carried out to permit the development of indicators that include work-related MVTCs (see section 3.3.8). In this document, MVTCs as a whole are considered in section 2.2F.

The scope of this work-related area is unintentional and assaultive injury. Injuries that are purposely self-inflicted, or are of undetermined intent are not included.
C2 Candidates for NZIPS indicators

C2.1 Existing national indicators

C2.1.1 Description
Within NZIPS, the Department of Labour is the designated lead agency for work-related injury.

Department of Labour
The mission statement in the Occupational Safety and Health (OSH) Development Plan 2000-2005 is as follows:
• to achieve a 30% improvement in work-related accident rates by 2005/6.
The plan is no longer current and OSH is not actively seeking to measure its performance in terms of this target.

Although the Department of Labour is the lead agency, their statutory responsibilities do not cover all work-related injury. Other important agencies include the Maritime Safety Authority (MSA), Civil Aviation Authority (CAA), and the Ministry of Consumer Affairs (MCA). These are discussed below.

The New Zealand Defence Force (NZDF) have no statutory responsibility in terms of the HSE Act; however, it is an example of a government agency that is a significant employer and is developing performance indicators. It too is discussed below.

Additionally, the ACC has an important role in workplace injury prevention, and they use their database of claims to analyse the situation. At this time, this does not include the production and publication of injury indicators.

Maritime Safety Authority (MSA)
The Maritime Safety Authority have their own national indicators organised around their strategic targets and associated vessel activities. The strategic targets – relating to injury outcomes - to June 2006 are as follows:
• 25% reduction in the rate of fatalities, accidents and mishaps involving international Safety of Life at Sea (SOLAS) vessels in New Zealand waters and New Zealand SOLAS vessels anywhere
• 50% reduction in the rate of fatalities, accidents and mishaps involving passenger and non-passenger vessels under Safe Ship Management and Safe Operational Plans
• 25% reduction in pleasure boating fatalities
• 50% reduction in the rate of fatalities, accidents and mishaps involving New Zealand commercial and New Zealand foreign chartered fishing vessels
• 50% reduction in the rate of fatalities, accidents and mishaps involving vessels engaged in commercial jet boating and white water rafting
• No increase in the number of fatalities, accidents and mishaps involving paddle craft (other than river rafts) operating commercially
• No increase in the number of fatalities, accidents and mishaps involving all relevant emerging commercial maritime activities

45
Civil Aviation Authority (CAA)
The CAA monitor trends in its injury statistics. These trends are based on reports made to the CAA by the industry in compliance with the CAA Act 1990. They also record information gained by their own field staff from air traffic and the general public.

The CAA sets accident reduction targets for periods of 5 years, the current one of which is 2000-2005. Aircraft are classified (by weight) into 9 categories and the CAA monitor each individually. As well as accidents, it also monitors fatal injuries, and fatal and serious injuries (where serious has been defined based on either hospitalisations for greater than 2 days, or particular diagnostic groups), and publishes these in its 6-monthly reports.

The indicator used to monitor ‘accidents’ lies outside of our remit – ie. a consideration of injury outcome indicators. Consequently, the two main classes of indicators that will be considered here are ‘number of fatal accidents’ and ‘fatal and serious injury rate’.

Ministry of Consumer Affairs (MCA)
The Energy Safety Service (ESS) is part of the MCA and has responsibility for the administration of electricity and gas legislation. This includes the investigation and monitoring of incidents. They regularly publish a “Summary of reported electrical and gas accidents”- the most recent year covered by this series is 2002. ([http://www.ess.govt.nz/safety/pdf/Summaries_of_acc_2002.pdf](http://www.ess.govt.nz/safety/pdf/Summaries_of_acc_2002.pdf)). Monitored are notifiable electrical and gas ‘accidents’, injuries and fatalities. The entities presented in their report are not described as indicators.

New Zealand Defence Force (NZDF)
The NZDF is an accredited employer (in terms of the ACC) and so directly manage all of their own work-related claims. They have a very detailed database of all claims by NZDF personnel since 1 July 2000. They capture data on approximately 3000 new claims per annum.

They are currently working on the development of performance indicators; however, at the time of writing this work had not been completed.

C2.1.2 Validity

Maritime Safety Authority (MSA)
For each of the indicators implied by these targets, there are questions in relation to measurement, definition and accuracy of classification.

How are ‘accidents’ and ‘mishaps’ measured? One can infer from our knowledge of other data sources and reporting systems that minor injury, and ‘no injury’ events are likely to be reported/counted incompletely. This leads to the possibility (some would say likelihood) that the probability of reporting of these events will vary with time and thus will pose a threat to the validity of these indicators.

In the absence of full written specifications of the indicators that underpin the above targets, there remain uncertainties regarding some definitions (e.g.
‘emerging commercial maritime activities’) and classification. Inaccuracies - particularly if the extent or nature of these inaccuracies changes over time - would pose a threat to validity.

**Civil Aviation Authority (CAA)**

The CAA presents annual numbers and rates. The number of fatalities has varied between 11 and 15 per year over the last 10 years. (Civil Aviation Authority. Aviation Industry Safety Update, Revision 13, 11 May 2004). This report shows a similar number of ‘serious’ injuries. Although we are pleased to observe that there are very few of these injuries and fatalities in any given 12-month period, this does create a statistical difficulty. In section 2.1.1 of our report, we recommended that the number of injury cases on which to base indicators be accumulated over 12 months, unless the number falls below 100. Year to year variability will be greater than ±20% for counts < 100. This variability may hide trends in numbers and rates of injury. In these circumstances, we propose that cases be accumulated over sufficient years to meet this threshold requirement – in which case, indicators will be calculated as moving averages. With such low numbers, several years’ data would be needed to meet this requirement - and this would render the indicator less meaningful due to the resultant delay in calculating indicators for a given year, and because of the averaging effect over several years.

In terms of our criteria, the fact that the CAA definition of ‘serious’ includes admissions to hospital means that this will pose a threat to validity; it does not satisfy our criteria for ‘case definition’, ‘serious injury’ or ‘case ascertainment’. Assuming reporting systems are complete, the ‘fatal accident’ indicator would satisfy most of our validation criteria.

**C2.2 Our newly proposed injury indicators - fatal injury**

**C2.2.1 Operational definition of a case**

There has been no existing administrative database that could be used to provide a reliable estimate of the number of work-related fatal injuries each year. Moreover, in the Work-Related Fatal Injury Study, (WRFIS) it was demonstrated that the merging of electronic databases maintained by organisations which held records for selected work-related fatalities only captured 73% of the problem. (35)

Recently NZHIS introduced ICD-10 for the coding of mortality data. ICD-10 makes provision for the coding of activity at the time of injury, and specifically makes provision for coding work-related incidents ‘while working for income’. This opens up the opportunity to create indicators based on NZHIS mortality data; however, NZHIS has yet to apply these codes to the mortality data. Currently the intent is to begin coding deaths for the 2002 registration year and beyond.

In the WRFIS project, the agency that captured the greatest percent (n=513, 68%) of work-related fatalities (excluding bystanders) was the Accident Compensation Corporation (ACC). There were a further 60 cases which the ACC classified as work-related, where we could not confirm that it satisfied the WRFIS definition of work-relatedness, and an additional 53 cases that could not be matched to the
NZHIS mortality file. (35) It may be possible to base indicators on ACC estimates.

Consistent with our introductory comments, we exclude MVTCs from the scope of these indicators.

C2.2.2 Indicators
In the light of the above, four provisional work-related fatal injury indicators are proposed.

- Age-standardised work-related injury mortality rate, per 100,000 workers (NZHIS mortality data-based)
- Number of work-related injury deaths (NZHIS mortality data-based)
- Age-standardised work-related injury mortality rate, per 100,000 workers (ACC data-based)
- Number of work-related injury deaths (ACC data-based)

C2.2.3 Validity
Each of the above indicators demonstrate good characteristics when assessed against each of our 6 validity criteria, with the exception of ‘case ascertainment’. This is discussed below.

NZHIS mortality data-based
There are some concerns, in the short-term, regarding these indicators. No activity codes were captured immediately following the introduction of ICD-10; however, we expect this field to be coded for the 2002 data. For 2002 data and beyond, there are still concerns regarding the validity of the proposed NZHIS mortality data-based indicators, due principally to anticipated problems with completeness and accuracy of the classification of work-related injury cases in the activity field within the database. These concerns are supported by Australian data where activity were “unspecified” much more often in the Australian Bureau of Statistics data than in National Coroner Information System data. (James Harrison, personal correspondence, 2004)

Initially, there is likely to be unfamiliarity by coding staff with a new coding frame. Additionally, absence of information suitable to make a determination of activity is likely to be a problem. The former is a factor that will improve with time; however this would result in unreliable estimates for the purpose of examining trends. Starting with 2002 data, we recommend that these codes be used to identify work-related injury as the basis of a provisional indicator only, and that the percentage of death records that are coded to an unspecified activity in the NZHIS mortality data be monitored.

OSH have proposed that a working party be set up to consider the proposal that “a tick box field labelled Work-Related Death be introduced to the New Zealand Death Certificate”. If implemented, this proposal is likely to improve the accuracy of this indicator. Work towards the systematic determination of work-relatedness of the circumstances of the death by the Coroner will be the ultimate step in the identification of valid cases.
ACC data-based indicators
The concern with the above provisionally proposed ACC data-based indicators is that
a) the indicators would underestimate the size of the problem, but more importantly,
b) the conditions under which dependants were entitled to claim have changed over time – and so may change over time in the future.

Errors would be introduced if there was a disproportionate increase /decrease in work-related fatal events that typically were not the subject of a claim. There is no ready means of determining these effects.

For example, Figure 6 below strongly suggests that the effect of the partial privitisation of ACC in 1999/2000 was a reduction in the frequency and cost of work-related fatal claims recorded by ACC.

C2.3 Our newly proposed injury indicators - serious non-fatal injury
C2.3.1 Operational definition of a case
There is no existing administrative database that could be used to provide a reliable estimate of the number of work-related non-fatal injuries each year. The capture of these events is even more problematic than fatalities. For example Firth and colleagues (1990) (36) showed that OSH received less than 60% of the notifications that should have been reported – based on a study of workers who attended Dunedin A&E for a work-related injury over a 2 month period. (This study is now 15 years old. However, we are unaware of more recent work that confirms or refutes these findings, and so have no reason to believe that the situation has changed).

Like fatalities, NZHIS recently introduced ICD-10 for the coding of hospital discharges, and this coding frame makes provision for the coding of activity at the time of injury. This creates the opportunity to create indicators based on
hospitalisations captured on NZHIS NMDS. Similar to fatalities, for these indicators we exclude work-related MVTCs.

Another source of work-related injury data is the ACC. ACC does not directly code claims as work-related or not. Rather it determines whether a claim should be debited against its various accounts (e.g. Earners, Non earners, Motor vehicle). Classification to the earners account is in effect a proxy for work-relatedness. The difficulty is that reasons for making a claim can vary over time but the incidence of work-related injuries may not. Thus simply using ACC claims could be unreliable for the purposes of examining trends. (See discussion of ACC data, Section 3.2)

Reliability could be improved by matching ACC data with hospitalisations captured on the NZHIS NMDS. For example one could define a population of hospital discharges that met a pre-determined threshold of severity (e.g. ICISS≤0.941 - one which was minimally influenced by changes in service delivery, treatment methods etc). This derived file could then be matched with ACC’s database for the purposes of determining whether these events resulted in a claim and were assigned to the earners account. This would not eliminate bias that may be introduced by variation over time by which persons meeting the hospital pre-determined severity threshold changed their claim behaviour and / or the ACC changed the circumstances under which a claim could be made. It would however remove the minor and moderately severe injuries - which are substantial and as such greatly influence estimates. As we have seen earlier, the probability of hospital admission of these less severe cases can vary over time and, without their removal, this would pose a significant threat to validity.

The use of linked NZHIS NMDS-ACC data to identify cases of work-related serious non-fatal injury is a promising way forward. The opportunity to use these data to derive indicators has arisen from the work of the Injury Information Manager – who have tested the process of linkage of these data, and propose to introduce routine linkage of these data on a quarterly basis.

C2.3.2 Indicators
In the light of the above, four provisional work-related non-fatal injury indicators are proposed.

• Age-standardised work-related serious non-fatal injury rate, per 100,000 workers (hospitalisation data-based)
• Number of work-related serious non-fatal injuries (hospitalisation data-based)
• Age-standardised work-related serious non-fatal injury rate, per 100,000 workers (linked NZHIS NMDS-ACC data-based)
• Number of work-related serious non-fatal injuries (linked NZHIS NMDS-ACC data-based)

C2.3.3 Validity
Each of the above indicators demonstrate good characteristics when assessed against each of our 6 validity criteria, with the exception of ‘case ascertainment’. This is discussed below.
**Hospitalisation data-based indicators**

There are significant concerns regarding the validity of the provisionally proposed NZHIS NMDS-based indicators, due to the anticipated problems with the completeness and accuracy of the classification of work-related injury cases in the activity field within the database. Recent unpublished analyses of hospitalisations for the period 1 July 1999 to 30 June 2001 showed that 44% of eligible cases had an activity code of ‘during unspecified activity’. This level of non-specific coding is a threat to validity. Again, greater familiarity in the use of ICD-10 codes by hospital coders is likely to result in an improvement in coding. With time that will affect trends in work-related injuries identified from these data. However, even with greater familiarity there will remain the problem of information availability on work-relatedness at discharge from hospital. At this time we cannot recommend that NZHIS NMDS data alone be the basis of work-related non-fatal serious injury indicators. However, we suggest that the use of activity codes be assessed on an ongoing basis, and believe that this source and these indicators should be considered again in 5 years time.

**Linked ACC-NZHIS NMDS data-based indicators**

There is still some concern about the stability of case ascertainment of non-fatal serious injuries from these linked data. This can be assessed through reference to linkage rates. If these are close to 100%, then this concern is diminished, and we would fully expect little or no threat to validity. We recommend these work-related serious non-fatal injury indicators, based on these linked data, as our provisionally proposed indicators; but further recommend that linkage rates for serious injury cases are carefully monitored in order to judge the validity of these indicators.

**C3 Proposed indicators**

Historically, the measurement of fatal and non-fatal work-related injury experience based on routine data sources has been fraught with difficulties. The two Work-related Fatal Injury Studies (33)(37) were commissioned because of the difficulties in obtaining reliable estimates of work-related fatal injuries from routinely collected national data sources. It follows, therefore, that the development of indicators based on these sources was not going to be an easy task. It is only since the introduction of ICD-10, and the opportunity it presents to NZHIS to code ‘activity’ on their mortality data and in their NMDS, as well as the initiation of the work of the Injury Information Manager, that the derivation of valid indicators based on routinely collected data have become possible.

It is clear from the previous subsections that each of the newly proposed fatal and non-fatal work-related injury indicators carry some threat to validity. This is due to the recent introduction of, and the need to ‘bed in’ the ICD-10 coding frame. It is also due to the fact that the activities of the Injury Information Manager are still in their early stages, including the linkage of ACC and NZHIS NMDS data. Although impressive linkage rates have been reported as part of their work, there is no other history of linkage of these sources and so there is uncertainty whether these rates can be sustained in future years. This linked data is the basis for two of the provisionally proposed indicators below.

Consequently, despite some concerns that the proposed indicators pose some potential threats to validity, they could provide valid indicators for the future. In the absence of any alternative valid indicators, we have proposed that the fatal indicators be based on the data captured in
the NZHIS mortality data file, and on the ACC mortality data, and the non-fatal serious injury indicator be based on the linked ACC-NZHIS NMDS data.

In regard to the former, these provide a very accessible solution to the problem of identifying valid indicators. A more complete solution would be to link all available sources to ascertain work-related fatal injury cases. This would provide a greater number of cases at the cost of greater resource and time needed to produce such indicators. Given the experience described in the WRFIS study (35) we do not think this is currently justified. We have proposed indicators based on two sources (ACC and NZHIS-based) since neither is ideal, and each can support the other through triangulation. Only if this solution is found not to work should the linkage of all sources be reconsidered. A reasonable period of time in which to judge this is 5 years.

We propose the use of linked ACC-NZHIS NMDS data as the basis of case ascertainment for the non-fatal serious injury indicators. This is because ACC provides a complete classification of work-relatedness, the NZHIS data provides a severity classification based on ICISS (see Section 2.1 and Appendix 1), and current linkage rates are very high.

Finally, we recommend that the NZHIS NMDS-based non-fatal serious injury indicators, discussed as potential indicators above, are tracked over time and that an assessment of their validity be made in 5 years time.

The provisionally proposed indicators are, therefore:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age-standardised work-related injury mortality rate, per 100,000 workers</td>
<td>NZHIS mortality data-based</td>
</tr>
<tr>
<td>Number of work-related injury deaths</td>
<td>NZHIS mortality data-based</td>
</tr>
<tr>
<td>Age-standardised work-related injury mortality rate, per 100,000 workers</td>
<td>ACC mortality data-based</td>
</tr>
<tr>
<td>Number of work-related injury deaths</td>
<td>ACC mortality data-based</td>
</tr>
<tr>
<td>Age-standardised work-related serious non-fatal injury rate, per 100,000</td>
<td>ACC-NMDS linked data-based</td>
</tr>
<tr>
<td>Number of work-related serious non-fatal injuries</td>
<td>ACC-NMDS linked data-based</td>
</tr>
</tbody>
</table>

It is recommended that the performance of these indicators (and the other candidate indicators) should be monitored using the following statistics:

- The percentage coding of the activity field to a specific activity in the NZHIS mortality data
- The percentage coding of the activity field to a specific activity in the NZHIS NMDS
- The linkage rate between NZHIS NMDS and ACC data

We have not provided example graphs of the indicators for the following reasons:

- First and second indicators – data is not available
- Remaining indicators – IPRU does not hold ACC data
D. Intentional Self-harm

D1 Scope / Definition of terms
The NZIPS identified ‘Suicide and deliberate self-harm’ as a priority area. Acts of intentional self-harm can result in non-fatal injury or death. The latter are typically referred to as ‘suicides’. This could be interpreted to mean that all victims so described intended to die. We do not wish to imply this.

Many refer to 'hospitalised self-harming behaviours' as attempted suicide. This is inaccurate since individuals self-harm for a wide range of reasons other than seeking to put their life at risk. Others have used the term ‘Parasuicide’ to refer to suicide attempts and deliberate self-harm inflicted with no intent to die. (38)

The tenth revision of WHO ICD refers collectively to these fatal and non-fatal events as ‘Intentional self-harm’ and in doing so does not seek to classify according to whether death was the intended outcome. We propose to adopt the same approach here. In this report we use the term intentional self-harm to refer to purposely inflicted self-harm which results in non-fatal injury or death.

This approach is consistent with that we have adopted for assault (i.e. the priority area title does not include reference to outcomes-e.g. homicide).

D2. Candidates for NZIPS indicators

D2.1 Existing national indicators
D2.1.1 Description
Ministry of Youth Development (MYD) and the Ministry of Health (MoH) are the joint lead agencies for this priority area.

The MYD performs an advisory and co-ordinating role with respect to prevention of youth suicide and deliberate self-harm and as such has not developed its own injury outcome indicators. Nevertheless it monitors trends in these outcomes by reference to youth suicide and deliberate self-harm statistics published by the MoH.

Over the past year, Public Health Intelligence, of the MoH, has been preparing a report - "An Indication of New Zealanders' Health 2003". The goal of this report is to provide a quick reference/overview on the health of New Zealanders through a set of key indicators. That report contains the following indicators for deliberate self-harm:

- Youth suicide (15–24 years), rates per 100,000 population, by gender
- Youth suicide (15–24 years), rates per 100,000 population, by gender and ethnicity
- Youth suicide (15–24 years), rates per 100,000 population, by gender and deprivation
- Youth suicide (15–24 years), rates per 100,000 population, by District Health Board
The report does not list any other fatal indicators for self-harm either for the total population or other age groups, nor does it list non-fatal outcomes.

D2.1.2 Validity
The major potential threat to validity is misclassification of intent leading to incomplete ascertainment of cases of death as a result of self-harm. This occurs because of various factors (e.g. impact on insurance benefits of suicide; religious and social stigmas of suicide) that may directly or indirectly affect the Coroner's decision in regard to intent. Typically investigators have examined this issue by examining trends in suicide with and without ‘undetermined’ (intent) deaths included in the estimates. The rationale being that most of the ‘undetermined’ deaths are hidden suicides. This matter is not a significant issue for New Zealand since the number of youth deaths classified as undetermined relative to those classified as suicide is small (<5%). For the period 1988-1998, there were 65 undetermined vs 1479 suicide deaths and the ratio was similar for each of the years.

D2.2 Our newly proposed injury indicators - fatal injury
D2.2.1 Operational definition of a case
Cases will be identified from external cause of injury codes recorded on the NZHIS mortality data file. The particular codes used are shown in the indicator specifications (see Appendix 2).

D2.2.2 Indicators
• Age-standardised intentional self-harm injury mortality rate, per 100,000 person-years
• Number of intentional self-harm injury deaths

D2.2.3 Validity
As with the youth suicide indicators, the potential major threat to validity is misclassification bias (see D2.1.2 above). This threat appears to be minor since there are relatively few undetermined deaths relative to suicide deaths (<5%). For example, for the period 1988-1998 there were 255 undetermined vs 5,526 suicide deaths and the ratio was similar for each of the years.

D2.3 Our newly proposed injury indicators - serious non-fatal injury
D2.3.1 Operational definition of a case
Cases will be identified from the external cause of injury codes recorded on the NZHIS NMDS. The codes used to identify cases will be the same as those described for the fatal injury indicators above, and are shown in Appendix 2.

D2.3.2 Indicators
• Age-standardised intentional self-harm serious non-fatal injury rate, per 100,000 person years.
• Number of intentional self-harm serious non-fatal injuries

D2.3.3 Validity
The proposed indicator potentially suffers from misclassification bias. A self-harmer may mask the intent of their injury and health service providers may be reluctant to classify the events as self-harm in the absence of compelling evidence to this effect. To the degree that changing attitudes to mental health may influence the recording of such events over time, there is a threat to the validity of trends in the proposed indicator. Unlike deaths there is no intensive investigation by the justice system to determine intent. Consequently, reference to undetermined injuries does not provide a satisfactory insight into the issue as many of the hidden intentional self-harm events may be classified as unintentional. We wish to emphasise that this threat is speculative. We have been unable to identify any research on New Zealand or overseas populations that confirms or refutes the foregoing speculation. In the absence of new evidence, we put these forward as provisionally proposed indicators.

D3. Proposed indicators

Our proposed indicators are:

- Age-standardised intentional self-harm injury mortality rate, per 100,000 person-years
- Number of intentional self-harm injury deaths

Our provisionally proposed indicators are:

- Age-standardised intentional self-harm serious non-fatal injury rate, per 100,000 person-years (hospitalisation data-based)
- Number of intentional self-harm serious non-fatal injuries (hospitalisation data-based)

The national population survey of mental health may be the basis of reliable non-fatal indicators in the future.
Examples of the indicators

Number of Serious Injuries By Year - Self Harm (S01)

Number of Fatalities by Year - Self Harm (S11)

---

^ Points to the left of the dotted line refer to data coded according to ICD-9. This is an approximation of the ICD-10-based indicator. The dotted line indicates the changeover from ICD-9 to ICD-10.
E. Falls

E1 Scope/Definition of terms

In this section, we are focussing on unintentional injury, and so the definition excludes both intentional self-harm and purposely inflicted injury events. We also exclude cases where the intent is undetermined.

The Kellogg International Working Group on the prevention of falls in older people agreed a definition of an unintentional fall as:

“unintentionally coming to rest inadvertently on the ground or some lower level other than as a consequence of sustaining a violent blow, loss of consciousness, sudden onset of paralysis as in stroke or an epileptic seizure.” (39)

Following this agreement in 1987, other researchers have used this, or similar definitions, for falls. This definition or its variants are equally applicable to younger age groups.

The external cause of injury codes used to select falls cases are stated in the indicator specifications – see Appendix 2. For the indicators identified below, these are based on ICD-10-AM codes. For deaths and hospitalisations data, the range of codes that will be used to identify a fall are: W00-W19. These exclude a fall from an animal, a burning building, into fire, into water (with drowning or submersion), onto machinery (whilst in operation), and in/from a transport vehicle. Furthermore, it excludes the collapse of a building or structure. There are a significant number of these events; however, these exclusions are in line with international coding convention. (40) Although we have adopted this pragmatic solution to the lack of mutual exclusivity of external cause codes, a definition with more comprehensive scope would be preferable and should be sought in the development of any future indicators.

It should be noted that the injury definition used (see section 1.3), which is based on principal diagnosis and first external cause of injury code, means that falls that occur in hospital are unlikely to be picked up by our serious non-fatal injury indicator. This is an inevitable limitation of the operational definition of an injury we have used. In order to accurately describe falls and falls injury in hospital, a special study would be needed.

When considering retrospective trends in these indicators, the codes from both the 9th revision and the 10th revision of ICD need to be specified. For these retrospective analyses, falls will be defined using ICD-9-AM, and the relevant codes are E800-E888. An important coding change that occurred from the 9th to the 10th revision of ICD was in relation to ICD-9 code E887: ‘Fracture, cause unspecified’. This was moved out of the falls category to elsewhere in ICD-10. Work has indicated that many of these may be falls in older people. In Australia, a discontinuity in the trends in falls mortality has been demonstrated (where falls are identified using the code ranges above) at the point of changeover from the 9th to the 10th revision, which supports the view that many of the cases previously coded to E887 were indeed falls. When considering retrospective trends, we recommend that

(a) separate trend lines be produced for ICD-9-AM and ICD-10-AM coded data
(b) separate trend lines be produced for the ICD-9-AM coded data with E887 included for one and excluded for the other.
E2 Candidates for NZIPS indicators

E2.1 Existing national indicators

E2.1.1 Description
The ACC have lead responsibility for falls. At this point, the ACC has not developed injury outcome indicators for this area.

Over the past year, Public Health Intelligence of the Ministry of Health has been preparing a report - "An Indication of New Zealanders’ Health 2003". The goal of this report is to provide a quick reference/overview of the health of New Zealanders through a set of key indicators. That report contains the following falls indicators:

- Falls-related hospitalisation rate in children 0-4 years per 100,000, by gender
- Age-standardised falls-related hospitalisation rate in adults aged 65 years and over per 100,000, by gender

E2.1.2 Validity
We discussed in section 1.4 the problems of indicators based on admissions to / discharges from hospital. For a case of minor or moderately severe injury, the probability of the case being admitted to hospital is influenced by socio-demographic, service supply and access factors. These vary with time and place and so can result in misleading trends. Serious non-fatal injuries are very much less affected by these than cases of minor or moderately severe injury, which is why we have argued for the use of a severity threshold for the case definition.

As a result of the above, there are significant threats to the validity of these indicators due to the failure to satisfy our criteria relating to case definition, or to case ascertainment.

E2.2 Our newly proposed injury indicators - fatal injury

E2.2.1 Operational definition of a case
We propose all-age falls-related mortality indicators based on our generic injury outcome indicators. Injury cases will be identified from the nature of injury and the external cause of injury codes recorded on the NZHIS mortality data file. The particular diagnostic codes used are described in section 1.3. It is proposed that falls cases are identified as those classified to codes within the ICD external cause codes W00-W19, as shown in the indicator specifications – see Appendix 2.

There are good reasons to consider separate falls indicators for older people and for adults / children. The reasons are:

- Firstly, the mechanism of falling is different for frail older people than for the rest of the population
- Secondly, the multiple pathology experienced by frail older people means that identification of injury cases is less certain than for younger age groups
- Thirdly, because of the high numbers and high rates of death from falls in people aged 75 and over
We also propose, therefore, mortality indicators based on our generic fatal injury outcome indicators relating to (a) people aged 0-74, and (b) people aged 75 and over.

**E2.2.2 Indicators**
- Age-standardised fall-related injury mortality rate per 100,000 person-years
- Number of fall-related injury deaths

The above indicators are proposed for all ages and for the age groups 0-74 and 75 and over.

**E2.2.3 Validity**
The indicators relating to people aged 0-74 satisfy our validity criteria. There is likely to be a problem of case ascertainment for the indicators for people aged 75 and over, due to variations in the coding of cause of death for older people. For example, an older person with heart problems falls, fractures their neck of femur, and remains on the ground unable to move. They are eventually found, transported, and admitted to hospital. They are operated on to repair their fracture, but do not recover from their operation due to heart failure. Although the precipitating event for this death is a fall and fractured neck of femur, the principal cause of death is recorded as ‘Ischaemic heart disease’. In this example, this case would not be selected as an injury since it would be coded to a disease category outside the diagnostic range for an injury. Consequently, it would not be ascertained as a fall. In other instances, at other times and places, a similar event would be classified with a principal cause of death as fractured neck of femur, and so would be ascertained as a falls injury. These issues have been discussed by Langlois and colleagues (1995). (19)

Variations in classification practices over time and across the country are a threat to the validity of the indicators which include people in the 75 and over age range, therefore. Despite this problem, many would argue that indicators that focus on falls mortality in those aged 75 and over are important due to the high numbers and rates of death in this age group.

**E2.3 Our newly proposed injury indicators - serious non-fatal injury**

**E2.3.1 Operational definition of a case**
We propose all-age falls-related serious non-fatal injury indicators based on our generic injury outcome indicators. Injury cases will be identified from the nature of injury and the external cause of injury codes recorded on the NZHIS NMDS data file. The particular diagnostic codes used are described in section 1.3. It is proposed that falls cases are identified within the ICD external cause codes W00-W19, as shown in the indicator specifications – see Appendix 2.

Separate falls indicators for older people and for adults/children are proposed for the same reasons as given above.

In what follows, a case of serious injury is defined as one that has an ICISS score ≥ 0.941, as described in section 2.1.4.
E2.3.2 Indicators

- Age-standardised fall-related serious non-fatal injury rate, per 100,000 person-years (hospitalisation data-based)
- Number of fall-related serious non-fatal injuries (hospitalisation data-based)

The above indicators are proposed for all ages and for the age groups 0-74 and 75 and over.

E2.3.3 Validity

The indicators relating to people aged 0-74 satisfy our validity criteria. There is likely to be a problem of case ascertainment for the indicators that include people aged 75 and over, due to variations in the coding of principal diagnosis at discharge for older people – see section 1.5. Variations in coding and classification practices over time and across the country are a threat to the validity of these indicators. Despite this problem, many, including ourselves, would argue that indicators that focus on serious non-fatal injury resulting from falls in those aged 75 and over are important due to the high numbers and rates found for this age group.

E3 Proposed indicators

We have not included the Ministry of Health PHI indicators amongst our proposed indicators below due to significant threats to the validity of these indicators. For the reasons described above, we have proposed 6 fatal injury and 6 serious non-fatal injury indicators.

We are aware, however, of potential validity problems associated with the indicators that include people aged 75 and over. However, since falls as a cause of injury are so important in this age group, they have been included amongst our proposed indicators. Please note that the indicators that include people aged 75 and over should be viewed with some caution.

- Age-standardised fall-related injury mortality rate per 100,000 person-years
- Number of fall-related injury deaths
- Age-standardised fall-related injury mortality rate per 100,000 person-years for people aged 0-74
- Number of fall-related injury deaths amongst people aged 0-74.
- Age-standardised fall-related injury mortality rate per 100,000 person-years for people aged 75 and older
- Number of fall-related injury deaths for people aged 75 and over
- Age-standardised falls-related serious non-fatal injury rate, per 100,000 person-years (NZHIS NMDS data-based)
- Number of fall-related serious non-fatal injuries (NZHIS NMDS data-based)
- Age-standardised fall-related serious non-fatal injury rate per 100,000 person-years for people aged 0-74. (NZHIS NMDS data-based)
- Number of fall-related serious non-fatal injuries amongst people aged 0-74. (NZHIS NMDS data-based)
- Age-standardised fall-related serious non-fatal injury rate per 100,000 person-years for people aged 75 and older. (NZHIS NMDS data-based)
- Number of fall-related serious non-fatal injury for people aged 75 and over. (NZHIS NMDS data-based)
Examples of Selected Indicators

Number of Serious Injuries By Year - Falls (F01)

Number of Fatalities by Year - Falls (F11)

Points to the left of the dotted line refer to data coded according to ICD-9. This is an approximation of the ICD-10-based indicator. The dotted line indicates the changeover from ICD-9 to ICD-10.

---

1 Points to the left of the dotted line refer to data coded according to ICD-9. This is an approximation of the ICD-10-based indicator. The dotted line indicates the changeover from ICD-9 to ICD-10.
F) Motor Vehicle Traffic Crashes

F.1 Scope / Definition of terms
A motor vehicle traffic crash is any crash on a public road involving at least one moving motorised vehicle. A crash is assumed to have occurred on a public road unless another place is specified, except in the case of crashes involving only off-road motor vehicles. (40) This definition excludes all cases where there is no motor vehicle involvement, e.g. pedal cycle only crashes; collisions between pedal cyclists and pedestrians.

The scope of this indicator is unintentional injury. Injuries that are purposely self-inflicted, are due to assault, or are of undetermined intent are not included.

F.2 Candidates for NZIPS indicators
F2.1 Existing national indicators
F2.1.1 Description
The LTSA has responsibility for this priority area. The stated goal in the government’s Road Safety to 2010 strategy is to reduce the number of road deaths per year to no more than 300 and hospitalisations to no more than 4,500 by 2010. There are a number of specific outcomes that the government aims to achieve. Focussing solely on the injury outcomes (as opposed to costs, or to process and output goals), the indicators underpinning these are:

• Total deaths\(^1\) (injuries that result in death within 30 days of the crash)
• Death rate per billion vehicle-kilometres
• Death rate per 100,000 persons
• Death rate per 10,000 vehicles
• Total hospitalisations (Source: NZHIS)
• Hospitalisation rate per billion vehicle-kilometres
• Hospitalisation rate per 100,000 persons
• Hospitalisation rate per 10,000 vehicles
• Number of hospitalisations with more than 1 days stay
• Number of hospitalisations with more than 3 days stay

The strategy indicates that further work on defining safety outcomes for pedestrians and cyclists will take place. (41)

Additionally, the following is an indicator included in the developing Ministry of Health Public Health Intelligence report: “An indication of New Zealanders’ Health 2003”:

• Youth (aged 15-24) motor vehicle ‘accident’ age-standardised mortality rate per 100,000, by gender

F2.1.2 Validity
The indicators from the government’s Road Safety to 2010 strategy document are based on deaths recorded through the system of traffic crash reports (TCRs), and hospitalisations (from the NZHIS NMDS).

---

\(^1\)Identified from traffic crash reports. When a road traffic crash occurs that involves a motor vehicle and results in someone being injured or killed, the law requires that the crash be reported to the police. If a police officer attends the crash, the officer is required to complete a traffic crash report.
The mortality-based indicators satisfy the first 5 of our 6 validation criteria. The sixth deals with the written specification of indicators. The LTSA provided a description of definitions, case ascertainment, denominators, and the concepts the indicators aim to measure.

On the other hand, there are a number of threats to validity for the hospitalisation-based indicators proposed in Road Safety to 2010:

• **Case definition** is not based on anatomical and/or physiological damage.

• **Serious injury** Many admissions to hospital are for cases of only minor or moderately severe injury; although those exceeding the 1 and 3 days stay thresholds will tend to be of greater severity. Nevertheless, if tested against a recognised injury severity scale, a case definition based on either ‘all admissions’, or with thresholds exceeding 1 or 3 days stay in hospital, will capture many minor or moderately severe injuries. (Injuries of this severity are treated in both inpatient or in outpatient settings. (42)

• **Case ascertainment** is dependent on social, economic, and demographic factors, and on health service supply and access factors. Our previous work has suggested that the probability of ascertaining cases for more minor or moderately severe injury cases is not stable over time. (43) The indicator included in the Ministry of Health Public Health Intelligence report: “An indication of New Zealanders’ Health 2003”, when matched against our 6 criteria, appears valid. As with all indicators, one potential threat to validity is inaccurate coding. Data quality issues are discussed in section 1.5.

**F2.2 Our newly proposed injury indicators - fatal injury**

**F2.2.1 Operational definition of a case**

Cases will be selected to satisfy our operational definition of an injury (see section 1.3), and will be identified from external cause of injury codes recorded on the NZHIS mortality data file. The particular codes used (shown in the indicator specifications – see Appendix 2) are based on the recommended framework of external cause code groupings for presenting injury mortality and morbidity data (the external cause matrix) for ICD-10, developed by the International Collaborative Effort on Injury Statistics (ICD-10 Framework: external Cause of Injury Mortality Matrix. Available at [www.cdc.gov/nchs/about/otheract/ice/matrixO.htm](http://www.cdc.gov/nchs/about/otheract/ice/matrixO.htm)).

**F2.2.2 Indicators**

• Age-standardised MVTC-related injury mortality rate, per 100,000 person-years (NZHIS mortality data-based)
• Number of MVTC-related injury deaths (NZHIS mortality data-based)

**F2.2.3 Validity**

Motor vehicle traffic crashes can be identified successfully using the ICD external causes of injury codes. When matched against our 6 criteria, these indicators appear valid. As with all indicators, one potential threat to validity is inaccurate coding. Data quality issues are discussed in section 1.5.
F2.3 Our newly proposed injury indicators - serious non-fatal injury

F2.3.1 Operational definition of a case
Cases will be selected to satisfy our operational definition of an injury (see section 1.3), and will be identified from the external cause of injury codes recorded on the NZHIS NMDS. The codes used to identify cases will be the same as those described for the fatal injury indicators above. Serious injuries cases are defined as those with an ICISS ≤ 0.941 (see section 2.1.4).

F2.3.2 Indicators
- Age-standardised MVTC-related serious non-fatal injury rate, per 100,000 person-years (hospitalisation data-based)
- Number of cases of MVTC-related serious non-fatal injuries (hospitalisation data-based)

F2.3.3 Validity
Motor vehicle traffic crashes can be identified successfully using the ICD external causes of injury codes. When matched against our 6 criteria, these indicators appear valid. As with all indicators, one potential threat to validity is inaccurate coding. Data quality issues are discussed in section 1.5.

F3 Proposed indicators
As a result of the above discussion, the first 4 proposed indicators are our generic injury outcome indicators applied to the MVTC priority area.

Amongst the LTSA indicators, we cannot propose the hospitalisation-based indicators due to the threats to validity described. Two of the four fatal injury outcome indicators used by the LTSA are essentially the same as our generic indicators, leaving an additional 2 which have been included in our proposed set of indicators for MVTCs.

The Ministry of Health PHI youth MVTC mortality indicator is not proposed, since, as discussed in section 2.1.1, only high-level indicators have been proposed for each priority area.

- Age-standardised MVTC-related injury mortality rate, per 100,000 person-years (NZHIS mortality data-based)
- Number of MVTC-related injury deaths (NZHIS mortality data-based)
- Age-standardised MVTC-related serious non-fatal injury rate, per 100,000 person-years (hospitalisation data-based)
- Number of MVTC-related serious non-fatal injuries (hospitalisation data-based)
- MVTC-related death rate per billion vehicle-kilometres (TCR-based)
- MVTC-related death rate per 10,000 vehicles (TCR-based)
There is a problem of timeliness for the NZHIS mortality data-based indicators. Consequently, we recommend that TCR-based mortality indicators be produced as **provisional** indicators for the last available year, to be replaced by the NZHIS-based indicators when the data becomes available.

- Age-standardised MVTC-related injury mortality rate, per 100,000 person-years (TCR-based)
- Number of MVTC-related injury deaths (TCR-based)
Examples of selected indicators

Number of Serious Injuries By Year - MVTC (M01)

Number of Fatalities by Year - MVTC (M11)

k Points to the left of the dotted line refer to data coded according to ICD-9. This is an approximation of the ICD-10-based indicator. The dotted line indicates the changeover from ICD-9 to ICD-10.
G. Drowning and near drowning

G1 Scope / Definition of terms

The NZIPS priority area is ‘Drowning and near drowning’. This has been defined by the World Health Congress on Drowning as follows: (44)

“Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid.”

Since the introduction of ICD-10 by NZHIS to code external cause and nature of injury in both their mortality (since 2000) and hospital discharge (since mid-1999) data systems, it has been possible to identify drownings and near drownings as cases classified to the diagnostic code T75.1.

The indicators will be restricted to unintentional drowning and near drowning, by selecting cases coded to the appropriate external cause of injury codes (see indicator specifications – Appendix 2).

G2 Candidates for NZIPS indicators

G2.1 Existing national indicators

G2.1.1 Description

The ACC is the designated lead agency. At this point, the ACC has not developed injury outcome indicators for this area. Additionally, Water Safety New Zealand has a key role in regard to drowning and near drowning; they collect important information and have their own targets for prevention.

Water Safety New Zealand

Water Safety New Zealand initially collects drowning data from media releases and police reports. (Their focus is drowning, and so do not include near drowning.) Final verification of a drowning occurs after the inquest, from Coroners’ reports from the Department of the Courts. The drowning database collated in this way is called DrownBase.

DrownBase is the information source for Water Safety New Zealand’s activities. They analyse drowning trends, promote drowning prevention, as well as use these data to identify priorities for injury prevention activity.

Water Safety New Zealand produces a number of statistical summaries using DrownBase; none that they call indicators. They do, however, monitor annual numbers of drowning deaths, broken down by age, gender, recreational and non-recreational activity, specific activities within these major groupings, and by place of occurrence (site). These are essentially indicators and so are regarded as candidates in our work via consideration of the following overarching indicator:

• Annual total number of drowning deaths. (Source: DrownBase, Water Safety New Zealand Inc.)

We noted, in section 2.1.1, that we leave it to the lead agency to identify subpopulations within the priority area that might be a particular policy focus, and
would attract their own indicator.

Ministry of Health Public Health Intelligence
Over the past year, Public Health Intelligence of the MoH has been preparing a report - "An Indication of New Zealanders' Health 2003". The goal of this report is to provide a quick reference / overview of the health of New Zealanders through a set of key indicators. That report contains the following indicator relating to drowning:

• Drowning mortality rate in children 0-4 years per 100,000, by gender (Source: DrownBase, Water Safety New Zealand Inc.)

G2.1.2 Validity
Both of the indicators described above are based on the DrownBase database. Historically, there have been more cases captured on DrownBase each year than have been identified from NZHIS mortality data. (45) The reason for this could be threefold: different sources of data used to identify drownings; drownings classified to differing years; a different definition of ‘drowning’ used by both sources.

Ultimately, the source of data used by both Water Safety New Zealand and NZHIS - for their mortality data – is Coroners’ reports. One would expect the numbers of drowning identified from both sources to be similar, therefore. However, the greater number of drownings that have historically been captured in DrownBase could be due to the additional sources (media releases and police reports) that trigger a follow-up by Water Safety New Zealand. Latterly, it appears that the numbers of drownings captured by DrownBase and NZHIS mortality data have been converging; in 2000, the numbers of cases captured by/identified from each source were approximately the same.

Water Safety New Zealand assign ‘year’ according to the year of death, whereas on the NZHIS mortality file the case is classified to the year of registration of the death. This could result in some small discrepancy between annual totals, but insufficient to account for the large differences previously found, and the consistently greater number recorded by Water Safety New Zealand compared with NZHIS.

The third reason could be the use of different definitions of drownings. Work published by Langley and colleagues applied a common drowning definition to both NZHIS and to Water Safety New Zealand cases of drowning and identified a similar number from both sources (46)

Given this historical discrepancy between NZHIS and Water Safety New Zealand, we presume that Water Safety New Zealand used a wider definition than NZHIS. The NZHIS definition is in line with the recently agreed international definition by the World Congress on Drowning. The ‘over-ascertainment’ of cases by Water Safety New Zealand posed a potential threat to validity that does not exist for NZHIS. If the results for the year 2000 were sustained, this threat would no longer be present for future data.
G2.2 Our newly proposed injury indicators - fatal injury

G2.2.1 Operational definition of a case
Since 2000, drowning can be identified using the diagnosis code T75.1, as indicated above. Consequently, drowning cases are operationally defined as those classified to diagnosis code T75.1. The scope is restricted to unintentional drowning.

G2.2.2 Indicators
- Age-standardised drowning rate, per 100,000 person-years (NZ mortality data-based)
- Number of drownings (NZ mortality data-based)

G2.2.3 Validity
Given the specifications in Appendix 2, these indicators satisfy all of our validation criteria. A possible threat to validity is the completeness and coding of diagnostic data on the NZHIS mortality data file (see section 1.5).

G2.3 Our newly proposed injury indicators - serious non-fatal injury

G2.3.1 Operational definition of a case
The determination of the population of near-drowning is extremely problematic. The principal difficulty is what constitutes near drowning. Typically the term is used to describe anything from an incident where someone entered the water, gets into difficulties but did not have any resulting identifiable pathology - through to someone who is essentially vegetative as a result of oxygen deficit due to inhaling water. Most of the former incidents go unrecorded (they are in essence no different from near burns, near fractures etc.) and all of the latter would result in admission to public hospitals.

The application of the ICISS threshold (ICISS ≤ 0.941) to define a case of serious near drowning injury overcomes this problem. Cases will be identified as those discharges with a principal diagnosis of T75.1. The scope is restricted to unintentional drowning.

G2.3.2 Indicators
- Age-standardised serious near-drowning rate, per 100,000 person-years (hospitalisation data-based)
- Number of cases of serious near drowning injury (hospitalisation data-based)

G2.3.3 Validity
Given the specifications in Appendix 2, these indicators satisfy all of our validation criteria. One threat to validity is the completeness and coding of diagnostic data on the NZHIS NMDS data file (see section 1.5). A further difficulty is the very small number of cases captured annually that satisfy our case definition. These small annual rates and numbers are subject to large statistical variation. Given this, these indicators cannot be recommended.
G3 Proposed indicators

Below are our recommended proposed indicators for drowning. Both are based on NZHIS data, rather than DrownBase. This choice has been made in order to use data consistent with international definitions and coding conventions, and since these indicators will be replicable in other countries, thus opening up the opportunity for international comparison.

In order to enhance the validity of the mortality indicators, we recommend that, periodically, cases from the DrownBase database be linked to cases identified from NZHIS mortality file (using diagnostic code T75.1) to identify reasons for any discrepancies and if appropriate identify cases of drowning missing from each data source.

- Age-standardised drowning rate, per 100,000 person-years (NZHIS mortality data-based)
- Number of drownings (NZHIS mortality data-based)

There is a problem of timeliness for the NZHIS mortality data-based indicators. Consequently, we recommend that indicators based on DrownBase (excluding suicide and homicide) be produced as provisional indicators for the most recently available year, to be replaced by the NZHIS-based indicators when the data for that year becomes available.

- Age-standardised drowning rate, per 100,000 person-years (DrownBase data-based)
- Number of drownings (DrownBase data-based)

Note that no graphs have been produced below for our proposed indicators since there is no retrospective data available. Only since the year 2000 have cases of drowning been identifiable from NZHIS mortality data using diagnostic code T75.1.
Part 3: Concluding comments and future directions

3.1 The proposed indicators

We have proposed indicators for ‘all injury’ (satisfying our definition of an injury – section 1.3), and for the 6 priority areas, that have good validity when matched against our criteria. Our approach to indicator development is consistent with the view that before newly proposed indicators are promulgated, they should be subject to formal validation. (6)

In arriving at the recommended indicators we have sought to strike a balance between ease of derivation of the indicator (e.g. we have avoided indicators which would require linkage of data in all but one instance – work-related indicators), ease of understanding, and validity. Our focus has also been forward looking. Nevertheless, we appreciate the need to access data from the 1990’s for the purpose of displaying trends. This has significant drawbacks, however, arising from the changes between ICD-9 and ICD-10 in 1999/2000. This problem will diminish with time as more years of ICD-10 data become available.

We have largely based our indicators on ICD-10, because national death and hospitalisation data are coded using this classification system. ICD-10 has its limitations (e.g. lack of mutually exclusive codes). (47) It also has its advantages, the principal one being that it is a WHO classification system used by many other countries. This will permit future comparisons with other countries for the indicators we have developed.

We wish to emphasise that we are unaware of any other comparable effort overseas to exercise the degree of rigour we have applied here to the development of these national injury indicators. As such, aspects of this work are bound to be debated in the scientific community. (6) (48) Such is the nature of developments in science. The state of the science is well illustrated by our ICISS work. It challenges the conventional way of doing things and is less easy to understand, so we might expect it to meet with resistance from some practitioners.

The ICISS approach to deriving anatomical severity has been adopted in a number of settings – see Appendix 1. Previous research work has tended to be in patients treated in specialist facilities (e.g. trauma centres) and as such are atypical of all seriously injured persons (e.g. trauma centres typically do not deal with burns victims). We believe our work on ICISS is the first application to national all-cause injury data (i.e. hospitalisations in New Zealand and Australia).

Alternatives have recently been suggested (e.g. Harborview Assessment for Risk of Mortality - HARM (49)) but their suitability in the New Zealand context has not been assessed. We also understand that there may be a future initiative to develop a mapping from ICD-10 to the Abbreviated Injury Scale (AIS), although we are unaware of any that are currently underway. (The Abbreviated Injury Scale provides a coding frame for nature of injury; each diagnosis has been assigned an anatomical severity score.) However, we do not favour this indirect method of producing estimates of threat-to-life since the experience with ICD-9 is that many ICD diagnoses do not map well (or at all) to AIS descriptors.

We believe that the proposed indicators are the best that can be identified based on existing research and development.
3.2 Why no ACC indicators?

3.2.1 Background
There are two types of ACC claim: Claims for Medical Fees Only (Treatment Claims) and Compensation or Rehabilitation Claims (Entitlement Claims). Approximately 85% of claims to the ACC are for Treatment Claims. Entitlement Claims include claims that have progressed beyond claims for medical fees only; payment is made by the ACC on successful claims for income maintenance, death benefits, rehabilitation or support for independent living.

In respect of Entitlement Claims, these are managed in various accounts: work-related – employers account, work-related – self-employed account, motor vehicle account, earner’s account (for non work-related injuries to people earning at the time of injury), non-earners account, medical misadventure account, and the residual claims account.

3.2.2 ACC data and Injury Indicators
Historically, a limited set of data was collected by the ACC on claims for medical fees only. This situation has altered with the wider use of electronic claim registration by GPs, and with some legislative and operational changes. A full set of data is now collected for all ‘escalated’ claims – electronically registered claims, all work-related or motor vehicle claims, a further set of claims that are initially expected to become entitlement claims (whether or not they do so), and any claim that becomes an entitlement claim. The implication of the above is that the full ACC database cannot be used currently to develop indicators for our priority areas – we are unable to identify relevant cases from the data collected. At this time, this limits consideration to Entitlement Claims and escalated claims for the development of indicators.

We made the comment, in section 1.4, that in our experience large administrative sets of non-fatal injury data (e.g. NZHIS NMDS of hospital discharges, and ACC data) cannot be used to produce valid indicators without some pre-processing. Typically, we can minimise the biases in these data by using a severity threshold for our case definition. In respect of the ACC data, the reason for this is as follows.

Given that a particular injury has occurred, the likelihood that a person makes a claim and is given entitlement depends on personal factors (socio-demographic and psychological factors, as well as the knowledge of the individual), on health service factors, and on employment status. (50) There is a suggestion that claiming rates are dependent on worker status/working environment, with workers from larger firms less likely to claim, and those who are unionised more likely. (50) Across time, there is evidence that higher unemployment generates lower claim rates and quicker return to work. (50) In these circumstances, indicators based on Entitlement Claims to monitor trends over time would be affected by all of these factors. Simply basing indicators on Entitlement Claims has the strong potential to result in misleading trends.

---

1 Please note that, with the introduction of electronic collection of data, full data will eventually be captured on all Treatment Claims as well as on Entitlement Claims.

2 Although in previous parts of this document we have focused on threat-to-life based measures of severity, thresholds can equally be based on other measures of severity, e.g. threat-of-disableness.
There is evidence to suggest, however, that the independent influence of these factors diminishes with the severity of the injury – the more serious the injury, the more inevitable a claim will be made and will be paid. (50) Given the above, the goal is to identify a severity threshold, above which the probability of a successful claim is very high, as the basis for ACC-based injury outcome indicators.

In the absence of a threat-of-disablement scale that can be applied to large administrative databases (such as to the ACC Entitlement Claims data), we consider the difficulties of using ACC data for the development of NZIPS indicators.

The difficulties are twofold.

1. The nature of the diagnostic information captured by ACC has made it impossible to derive severity of injury using the methods developed for ICD diagnostic codes.
2. We cannot accurately identify cases relevant to some of the priority areas from the circumstances of injury codes used by the ACC.

### 3.2.3 Identification of serious injury

Like the NZHIS NMDS of hospital discharges, the data captured on the ACC databases does not include a direct measure of severity of injury. Whereas, we have adapted a published method to derive a severity score from routinely collected data within the NZHIS NMDS, we have been unable to determine how this approach can be adapted for ACC data. Critical to this process is very specific and accurate diagnostic information. Our investigations suggest that ACC Entitlement Claims do not have diagnostic information at the level required. Moreover, the diagnostic information captured by the ACC derives from an initial assessment of injury. This will lead to inaccurate coding if subsequent tests reveal the initial diagnosis to be incorrect. For example, in the instance where the initial diagnosis is ‘sprain’, but following X-ray, this is revised to ‘fracture’, the diagnosis captured by ACC remains ‘sprain’. This situation contrasts with hospital inpatient data where the diagnosis is on discharge from hospital. The assigning of a diagnostic code in the NZHIS NMDS has had the benefit of information from a full investigative process.

The use of ACC data for national indicator development awaits significant investigative and development work, which could result in state-of-the-art non-fatal injury outcome indicators. The most fruitful line of investigation is likely to be around the development of indicators based on threat-of-disablement severity measures, or which reflect burden of injury as measured by cost.

### 3.2.4 Identification of priority areas

**Assault**

Victims of assault are eligible for ACC compensation. There are uncertainties in regard to the identification of assault cases. ACC has recently contracted IPRU to determine the intent of injury for a set of claimants who were also admitted to hospital for the treatment of their injury.

---

*Note: Since mid-2003, ACC staff have had the ability to indicate which Read code is the primary diagnosis for a claim and to update the diagnosis, where applicable. In these instances ACC then amends its reporting to reflect the primary diagnosis*
**Work-related injury**
For work-related injury, our proposed serious non-fatal injury outcome indicators are based on ACC data linked to NZHIS NMDS data (see Section 2.2 C).

**Intentional self-harm**
Under current legislation ACC covers claims for injuries that have been self-inflicted or are suicide. However, claims for wilfully self-inflicted injuries or suicide are disentitled from all ACC entitlements except treatment. The only exception to this is where the claimant’s actions occurred because they suffered from a clinically significant medical condition. Because of the coding difficulties with claims that are not entitlements, it is difficult to quantify how many claims to ACC are for intentional self-harm. The IPRU’s research, referred to under ‘Assault’ above, will provide insight into this issue.

**Falls**
Identifying cases of falls using ACC data presents difficulties. Relevant to falls are the group of codes 1 to 19: ‘loss of balance or personal control’. However, not all of these codes are relevant to the usual accepted definition of a fall. Various categories traditionally outside of definitions of falls could be excluded, namely:

3 – Pushed or pulled
5 – Something giving way underfoot
9 – Lurching jerks in vehicles etc.
13 – Struck by hand-held tool/implement
15 – Struck by person / animal

However, one final category is problematic, namely code 19 – ‘Other loss of balance or personal control’. IPRU investigations of entitlement claims have found that many claims are allocated this code. This is a problem since cases eligible to be coded to ‘19’ include cases consistent with, as well as outside of, a usual definition of a fall.

**Motor vehicle traffic crashes**
MVTCs can be identified from the relevant ACC account.

**Drowning and near drowning**
Diagnosis of injury is captured using the Read codes and ICD-10. In theory, as for the NZHIS hospitalisation data, drowning and near drowning could be identified using the code T75.1. Investigations of the accuracy of classifications to this specific diagnostic code would be wise prior to reliance on this method of case ascertainment.

Until the difficulties, described in this section, are overcome, or substantial work is put in motion to identify and validate alternative methods of using ACC data, then their use for the development of national injury outcome indicators will remain limited. Nonetheless, ACC data has in theory the potential to provide complementary indicators to those proposed in this report. Such indicators would be threat-of-disablement. For this to proceed, however, improved quality of diagnostic data is required and there needs to be development work to identify thresholds for ‘serious’ disablement that avoid the biasing influence of extraneous factors on trends in ACC data-based indicators.
3.3 Future directions

3.3.1 Update Trends

We believe that our proposed indicators are the best that can be identified based on existing research and development. It is important that this work be exploited, and so we make the following recommendation.

<table>
<thead>
<tr>
<th>Recommendation 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a commitment to update the indicators on an annual basis.</td>
</tr>
</tbody>
</table>

The proposed indicators are not perfect; no indicator based on large administrative databases can be. We have the following concerns:

- They have not been empirically validated
- They focus only on deaths and severe injury
- They are based on data that is not audited
- We have been constrained by available data

3.3.2 Empirical validation

Before the introduction of any new indicator, we have proposed that indicators be subject to empirical validation. (6) For example, as indicated in section 1.2, this could include an investigation of the following:

- The numerators of our outcome indicators are aggregates of cases of fatal or serious injury. We have defined a case of serious injury as one which has an ICISS score less than or equal to 0.941. For a sample of hospital discharges that satisfy our operational definition of an injury (section 1.3), the accuracy of ICISS scores (and hence the accuracy of case ascertainment) could be validated against a ‘gold standard’ severity score (e.g. the Abbreviated Injury Scale score) – the latter produced by directly coding from the medical records of the sample of discharged patients. This is similar to the method used by McClure and colleagues when they validated some UK indicators. (48)

Empirical validation would also include, ideally, an investigation of consistency of the indicator, and also an investigation of the quality of the data on which it is based.

Empirical validation is not straightforward and work is necessary to develop methods relevant to the investigation of these indicators.

<table>
<thead>
<tr>
<th>Recommendation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Work be commissioned to develop a tested proposal for the empirical validation of these NZIPS indicators</td>
</tr>
<tr>
<td>2.2 The NZIPS indicators be empirically validated once an appropriate method has been identified.</td>
</tr>
</tbody>
</table>

3.3.3 Lowering the severity threshold

The generic serious non-fatal injury indicators are based on a high threshold of severity so we can be confident that threats to validity are minimised. There is now
merit in considering the development of non-fatal injury indicators that capture moderately severe cases (e.g. all fractures), but which exclude minor / superficial injury. This is not likely to be possible using hospital inpatient data alone, since many moderately severe injuries are treated in outpatient settings without recourse to admission to hospital.

**Recommendation 3**

Work be commissioned to investigate methods/means for developing indicators based on lower severity thresholds (eg. through the identification of sentinel diagnoses and suitable data sources; and through surveys – see below).

### 3.3.4 Threat-to-life indicators

The non-fatal injury outcome indicators we have recommended are predominantly based on the threat-to-life anatomical severity scale, ICISS. Research and development to improve this scale continues. From the thinking resulting from this work, we recommend improvements to ICISS (see Appendix 1) along the lines recommended below. This would produce a new severity scale, a working title for which would be the ICD injury threat-to-life scale (ITL).

**Recommendation 4**

Work be commissioned to further develop ICISS and ICISS-based indicators:

- 4.1 A re-labelling of standardised survival probabilities from SRR
- 4.2 The ITL scores would reflect probability of death rather than survival rate; thus aligning them with other severity scales.
- 4.3 The ITL score would be an n-point ordinal scale, each point of which would attract a qualitative descriptor.
- 4.4 The development of a single injury ITL score for each diagnosis in ICD-10-AM; and for each ITL score the list of single injury diagnoses that would be included

### 3.3.5 Threat-of-disablement indicators

As we outlined in section 1.4, the generic indicators we have proposed draw attention to ‘important’ injury as judged by their resulting in death, or because of their threat-to-life. Injuries can, however also be important in terms of impairment, loss of function, reduced quality of life or cost. Moreover, it is possible, for example, to have an injury which represents a low threat-to-life, but that has a high threat-of-disablement (e.g. eye injury). Our inability to identify existing indicators that tap into these dimensions reflects the development of the field and data availability issues. The comments of the Ministry of Social Development (MSD) Social Report are pertinent here:

"There is clearly scope for future reports to improve measurement in many areas. This depends, however, on better data becoming available and on conceptual work to develop better measurement frameworks" (p15)
There is particular merit in developing measures based on threat-of-disablement.

ACC data has in theory the potential to provide complementary indicators to those proposed in this report. As indicated above (section 3.2), the use of ACC data for national indicator development awaits significant investigative and development work, which would result in state-of-the-art non-fatal injury outcome indicators. The most fruitful line of investigation is likely to be around the development of indicators based on threat-of-disablement severity measures, or which reflect burden of injury as measured by cost. For this to proceed, however, improved quality of diagnostic data is required and there needs to be development work to identify thresholds for ‘serious’ disablement that avoid the biasing influence of extraneous factors on trends in ACC data-based indicators.

Recommendation 5
Work be commissioned to investigate the means of developing indicators based on threat-of-disablement; focussing initially on ACC data as the primary source.

3.3.6 Data audit
In the course of our investigations, we have been unable to identify any formal and regular systematic audit of injury diagnostic and mechanism of injury coding. There may well be informal ad-hoc audits, but even here we have been unable to uncover any publicly available reports. This is of concern given that quality data is the building block to the provision of accurate indicator information.

Recommendation 6
Regular data audit of primary data sources be carried out, and published, to identify problems with the source data for numerators and denominators for the indicators, as a first step to improving these sources.

3.3.7 Removing some constraints - surveys
The indicators we have proposed in this report were driven by the need to utilise existing data sources. This is critical when comparing recent performance, relative to past. The MSD Social Report comment in this context is very relevant

"A number of indicators from The Social Report 2001 have not been updated for 2003 because they are derived from one-off surveys or surveys that are not repeated on an annual basis. In a report that aims to monitor changes over time, this is a major drawback. However, in areas where there is no good alternative information available, we have had no choice other than to report indicators used in The Social Report 2001 and to work towards identifying data sources that will enable us to update them in future socials reports.” (p15) (31)
Large routine administrative databases are an obvious source of data for the development of indicators but, as has been shown here, they suffer from a number of shortcomings. Some agencies have attempted to overcome this by undertaking community-based surveys. The National Survey of Crime Victims represents one such attempt. Low response rates are one major drawback with such surveys as well as their infrequency and the absence of explicit commitment to ongoing surveys. Furthermore, population surveys of a plausible size have limited power to measure injury in useful ways. This would become particularly acute where measurement of injury occurrence is required for specific subgroups.

Nevertheless, we think there is a need to conduct regular community surveys that have a focus on injury outcomes, and that are of sufficient size to facilitate the production of injury outcome indicators with acceptable precision.

A high priority would be to identify injury events that result in significant disablement as measured by impact on the individual’s functioning in society. The survey instruments should seek to measure prevalence of such injury independent of service delivery. That is to say individuals should not be asked the questions similar to: "Have you had an injury in the last x days which resulted in you seeking medical treatment?" Rather the question should be similar to: "Have you had a injury in the last x days which resulted in you not being able perform your normal activities for more than y days". The latter could be followed up by a question about use of medical services as a means of producing some estimates of the biases which may be associated with using such health service utilisation questions to define an injury in any future survey, or indicators that select their cases from such sources.

Such surveys could be combined with the need to have information about exposure to hazards and safety behaviours that are relevant to all injury and the priority areas (e.g. smoke alarm use, life jacket use while boating). Such surveys need to pay due consideration to differences in exposures, behaviours, and injury outcomes which are associated with seasonal changes.

These surveys should include the collection of socio-demographic data to facilitate the production of indicators relating to subpopulations that have a particular policy focus. Important in this respect are Maori, Pacific, and other ethnic groups.

There are a number of health and other surveys that NZIPS could consider to collect these data. We do not favour relying on this approach for two main reasons, however. Firstly, there would be no guarantees of regularity and, secondly, collection of injury-relevant data may be compromised (e.g. (a) the injury section has to be reduced due to the length of the entire questionnaire; (b) there is no or limited control over when the survey is undertaken).

**Recommendation 7**

NZIPS commission the undertaking of regular surveys to facilitate (a) indicators based on temporary disablement; (b) indicators that are aimed at monitoring both safety behaviours and exposures to hazards.
3.3.8 Work to improve the indicators in selected priority areas.

Within the priority areas of ‘Assault’, Work-related injury’, and ‘Drowning’, we made recommendations regarding how indicators for these areas might be developed further.

**Assault:** Like all other indicators, our indicator for assault is a threat-to-life measure. While our operational definition includes intentional psychological injury (see section 2.2B), very few psychological injuries represent a substantial threat to life. In other words our severity threshold effectively excludes most psychological injury. Moreover, we are not optimistic that any attempt to lower the injury threshold (recommendation 3) would be significant enough to capture these events. We believe it would be more fruitful to capture these events by complementary indicators, namely, a threat-of-disablement indicator (see Recommendation 5, section 3.3.5).

**Work-related injury:** In Section 2.2C, we discussed the scope of work-related injury, and noted that its definition may not include some of the following: bystanders, people driving whilst at work, and people commuting to and from work. We highlighted that the problem of work-related motor vehicle traffic crashes is large – estimated to represent 29% of all work-related fatal injuries (34) – and so we recommended that future work should be carried out to develop indicators that include motor vehicle traffic crashes.

Furthermore, within this section, we excluded occupational disease from the scope of the indicators for two reasons. Firstly, we are unsure of any national database that can be used to produce valid estimates of all work-related disease resulting in death or morbidity. Secondly, we are unaware of any measure of severity that could be applied to known morbidity data to produce indicators which would have minimal threat to validity. Pertinent here are recent requests for proposals by the Department of Labour (on behalf of the National Occupational Health and Safety Advisory Committee) to review methods and systems used to measure and monitor occupational disease and injury, in New Zealand and overseas. We recommend that the NZIPS secretariat refer to NOHSAC the problem of identifying what work needs to be put in motion to facilitate the identification and production of valid indicators of occupational disease occurrence.

**Drowning:** In Section 2.2G, we proposed that case ascertainment for our fatal injury indicators be based on the NZHIS mortality data, rather than the database administered by Water Safety New Zealand – DrownBase. Discrepancies between the number of cases identifiable from DrownBase and NZHIS has previously raised questions about indicators developed from either source. In order to address any uncertainties about validity, we recommend period reconciliation of the cases captured by both sources.
3.3.9 Future NZIPS indicators

Developing the proposed valid indicators for this report, particularly the serious non-fatal injury indicators, was a complex task. We believe that, given the current state of New Zealand’s injury databases and the relevant scientific work, we produced the best possible indicators. We expect over the next several years the databases, severity scoring using data from large administrative databases and methods of developing and validating indicators will improve. We suggest NZIPS responds to significant future developments by commissioning work to improve the existing indicators and to develop new indicators.

Recommendation 9

We recommend that NZIPS commission additional work to identify further indicators in response to significant advances in the measurement of the severity of injury and/or improvements in administrative databases.
References


44. World Congress on Drowning. Recommendations of the project World Congress on Drowning. In: Maatschappij tot redding van denklingen.; 2003; Amsterdam; 2003. 1-30.


Appendix 1: ICISS

Appendix 2: Indicator specifications

Appendix 3. Selected readings
Appendix 1: ICISS

Introduction

ICD-9

Two methods have been shown to be capable of providing fairly reliable threat-to-life (probability of death) estimates based on ICD-9-CM diagnosis codes. One method involves translation of ICD-9-CM codes to Abbreviated Injury Scale (AIS) scores via the proprietary software package ICDMAP-90. (51)(52)(60) AIS has long been regarded as the injury coding ‘industry standard’ with respect to its anatomical injury-specific descriptive abilities. AIS scores derived using ICDMAP-90 are referred to as ICD/AIS scores.

The other method, known as ICISS (ICD-based Injury Severity Score), involves estimating probability of death directly from ICD-9-CM injury diagnoses by examining a large set of cases for which survival status is known. The estimated probabilities obtained (with certain caveats) can be applied to cases in other similar data sets. (53)(60)

There is more experience with ICD/AIS based measures than with ICISS, and early literature suggested that the former might be more effective. (54) More recent evidence suggests that the methods perform similarly. (18)(55) (56) (57) Neither seems to be as good as AIS scoring based on direct case note review. However, both offer an inexpensive way to derive quite good severity estimates for large databases if data with good quality ICD-9-CM coding is available.

ICD-10

In 1992 the World Health Organisation published the 10th revision of ICD (ICD-10). (40) A clinical modification, ICD-10-AM, was developed in Australia. (10) ICD-10-AM was initially introduced in four Australian jurisdictions in 1998, then in the rest of Australia from 1 July 1999. All public hospitals in New Zealand adopted ICD-10-AM coding during the period 1 July 1998 to 30 June 1999; however, the majority of cases were coded to ICD-9-CM-A until 30 June 1999.

Transition to ICD-10 presents problems for both ICD/AIS and ICISS. Formal updating of ICDMAP for use in Australia or New Zealand would require development and validation of a map between ICD-10-AM and AIS.

Three-step mapping could, in principle, offer an easier route:
- ICD-10-AM to ICD-9-CM-A;
- ICD-9-CM to AIS via ICDMAP-90.

However, this would be complex, and predictive power would be lost at each of the translation steps.

ICISS appears to offer a more direct and certain route to severity scores based on ICD-10-AM. The algorithm to derive ICISS is not specific to a particular version of ICD. We know of only one study to date, outside the work of the authors, that has assessed applying ICISS to ICD-10.
data (58). The authors and collaborators’ work has shown ICISS is a reasonable way to estimate severity for large databases using ICD-10 or ICD-10-AM. (59)

Calculation of ICISS

The ICISS method involves calculating a Survival Risk Ratio (SRR), i.e. the probability of survival, for each individual injury diagnosis code as the ratio of the number of patients with that injury code who have not died to the total number of patients diagnosed with that code. Thus, a given SRR represents the likelihood that a patient will survive a particular injury. Each patient’s ICISS score (survival probability) is then the product of the probabilities of surviving each of their injuries individually.

Practical Application of ICISS to Hospitalisation Data

To our knowledge there has been very little research that has applied ICISS to population level hospitalisations data to address injury prevention questions. To date we have published one paper applying ICISS to investigating trends in non-fatal injuries from motor vehicle traffic crashes.(4)

Our ICISS-based indicators

For our non-fatal serious injury indicators, the case was included if the person had an ICISS score less than or equal to 0.941. This included all cases with the diagnoses shown in Table A1.

Table A1: The frequency and description of the ICD-10 principal diagnoses captured July 1999-2001 when using a severity threshold of ICISS≤0.941.

<table>
<thead>
<tr>
<th>ICD-10 Principle Diagnosis</th>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0090</td>
<td>Superficial injury of head, part unspecified, unspecified</td>
<td>20</td>
</tr>
<tr>
<td>S0139</td>
<td>Open wound of other and multiple parts of ear and auditory structures</td>
<td>5</td>
</tr>
<tr>
<td>S0181</td>
<td>Open wound (of any part of head) communicating with a fracture</td>
<td>3</td>
</tr>
<tr>
<td>S020</td>
<td>Fracture of vault of skull</td>
<td>518</td>
</tr>
<tr>
<td>S021</td>
<td>Fracture of base of skull</td>
<td>716</td>
</tr>
<tr>
<td>S0260</td>
<td>Fracture of mandible, part unspecified</td>
<td>121</td>
</tr>
<tr>
<td>S027</td>
<td>Multiple fractures involving skull and facial bones</td>
<td>10</td>
</tr>
<tr>
<td>S029</td>
<td>Fracture of skull and facial bones, part unspecified</td>
<td>59</td>
</tr>
<tr>
<td>S040</td>
<td>Injury of optic nerve and pathways</td>
<td>4</td>
</tr>
<tr>
<td>S0603</td>
<td>Loss of consciousness of moderate duration (30 minutes to 24 hours)</td>
<td>85</td>
</tr>
<tr>
<td>S0605</td>
<td>Loss of consciousness of prolonged duration (more than 24 hours), without return to pre-existing conscious level</td>
<td>2</td>
</tr>
<tr>
<td>S061</td>
<td>Traumatic cerebral oedema</td>
<td>27</td>
</tr>
<tr>
<td>S0620</td>
<td>Diffuse cerebral and cerebellar brain injury, unspecified</td>
<td>20</td>
</tr>
<tr>
<td>S0621</td>
<td>Diffuse cerebral contusions</td>
<td>26</td>
</tr>
<tr>
<td>ICD-10 Principle Diagnosis</td>
<td>Description</td>
<td>Frequency</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>S0622</td>
<td>Diffuse cerebellar contusions</td>
<td>24</td>
</tr>
<tr>
<td>S0623</td>
<td>Multiple intracerebral and cerebellar haematomas</td>
<td>138</td>
</tr>
<tr>
<td>S0628</td>
<td>Other diffuse cerebral and cerebellar injury</td>
<td>10</td>
</tr>
<tr>
<td>S0630</td>
<td>Focal cerebral and cerebellar injury, unspecified</td>
<td>2</td>
</tr>
<tr>
<td>S0632</td>
<td>Focal cerebellar contusion</td>
<td>9</td>
</tr>
<tr>
<td>S0633</td>
<td>Focal cerebral haematoma</td>
<td>81</td>
</tr>
<tr>
<td>S0634</td>
<td>Focal cerebellar haematoma</td>
<td>2</td>
</tr>
<tr>
<td>S064</td>
<td>Epidural haemorrhage</td>
<td>80</td>
</tr>
<tr>
<td>S065</td>
<td>Traumatic subdural haemorrhage</td>
<td>411</td>
</tr>
<tr>
<td>S066</td>
<td>Traumatic subarachnoid haemorrhage</td>
<td>152</td>
</tr>
<tr>
<td>S068</td>
<td>Other intracranial injuries</td>
<td>73</td>
</tr>
<tr>
<td>S069</td>
<td>Intracranial injury, unspecified</td>
<td>136</td>
</tr>
<tr>
<td>S070</td>
<td>Crushing injury of face</td>
<td>1</td>
</tr>
<tr>
<td>S100</td>
<td>Contusion of throat</td>
<td>15</td>
</tr>
<tr>
<td>S1098</td>
<td>Superficial injury of neck, part unspecified, other</td>
<td>10</td>
</tr>
<tr>
<td>S1102</td>
<td>Open wound of trachea</td>
<td>4</td>
</tr>
<tr>
<td>S120</td>
<td>Fracture of first cervical vertebra</td>
<td>80</td>
</tr>
<tr>
<td>S121</td>
<td>Fracture of second cervical vertebra</td>
<td>146</td>
</tr>
<tr>
<td>S1221</td>
<td>Fracture of third cervical vertebra</td>
<td>28</td>
</tr>
<tr>
<td>S1222</td>
<td>Fracture of fourth cervical vertebra</td>
<td>37</td>
</tr>
<tr>
<td>S129</td>
<td>Fracture of neck, part unspecified</td>
<td>22</td>
</tr>
<tr>
<td>S1311</td>
<td>Dislocation of C1/C2 cervical vertebrae</td>
<td>18</td>
</tr>
<tr>
<td>S1312</td>
<td>Dislocation of C2/C3 cervical vertebrae</td>
<td>12</td>
</tr>
<tr>
<td>S1315</td>
<td>Dislocation of C5/C6 cervical vertebrae</td>
<td>27</td>
</tr>
<tr>
<td>S1317</td>
<td>Dislocation of C7/T1 cervicothoracic vertebrae</td>
<td>2</td>
</tr>
<tr>
<td>S140</td>
<td>Concussion and oedema of cervical spinal cord</td>
<td>5</td>
</tr>
<tr>
<td>S1410</td>
<td>Injury of cervical spinal cord, unspecified</td>
<td>77</td>
</tr>
<tr>
<td>S1411</td>
<td>Complete lesion of cervical spinal cord</td>
<td>11</td>
</tr>
<tr>
<td>S1412</td>
<td>Central cord syndrome (incomplete cord injury) of cervical spinal cord</td>
<td>12</td>
</tr>
<tr>
<td>S1413</td>
<td>Other incomplete cord syndrome of cervical spinal cord</td>
<td>16</td>
</tr>
<tr>
<td>S142</td>
<td>Injury of nerve root of cervical spine</td>
<td>13</td>
</tr>
<tr>
<td>S1470</td>
<td>Functional spinal cord injury, cervical level unspecified</td>
<td>5</td>
</tr>
<tr>
<td>S1471</td>
<td>Functional spinal cord injury, C1</td>
<td>1</td>
</tr>
<tr>
<td>S1472</td>
<td>Functional spinal cord injury, C2</td>
<td>1</td>
</tr>
<tr>
<td>S1474</td>
<td>Functional spinal cord injury, C4</td>
<td>1</td>
</tr>
<tr>
<td>ICD-10 Principle Diagnosis</td>
<td>Description</td>
<td>Frequency</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>S1500</td>
<td>Injury of carotid artery, unspecified</td>
<td>4</td>
</tr>
<tr>
<td>S1503</td>
<td>Injury of internal carotid artery</td>
<td>3</td>
</tr>
<tr>
<td>S151</td>
<td>Injury of vertebral artery</td>
<td>1</td>
</tr>
<tr>
<td>S153</td>
<td>Injury of internal jugular vein</td>
<td>3</td>
</tr>
<tr>
<td>S158</td>
<td>Injury of other blood vessels at neck level</td>
<td>1</td>
</tr>
<tr>
<td>S179</td>
<td>Crushing injury of neck, part unspecified</td>
<td>1</td>
</tr>
<tr>
<td>S2200</td>
<td>Fracture of thoracic vertebra, level unspecified</td>
<td>27</td>
</tr>
<tr>
<td>S2201</td>
<td>Fracture of thoracic vertebra, T1 and T2 level</td>
<td>31</td>
</tr>
<tr>
<td>S2231</td>
<td>Fracture of first rib</td>
<td>20</td>
</tr>
<tr>
<td>S2240</td>
<td>Multiple rib fractures, unspecified</td>
<td>240</td>
</tr>
<tr>
<td>S2241</td>
<td>Multiple rib fractures, involving first rib</td>
<td>4</td>
</tr>
<tr>
<td>S225</td>
<td>Flail chest</td>
<td>88</td>
</tr>
<tr>
<td>S2315</td>
<td>Dislocation of T9/T10 and T10/T11 thoracic vertebrae</td>
<td>2</td>
</tr>
<tr>
<td>S2316</td>
<td>Dislocation of T11/T12 thoracic vertebrae</td>
<td>1</td>
</tr>
<tr>
<td>S2410</td>
<td>Injury of thoracic spinal cord unspecified</td>
<td>29</td>
</tr>
<tr>
<td>S2411</td>
<td>Complete lesion of thoracic spinal cord</td>
<td>20</td>
</tr>
<tr>
<td>S2412</td>
<td>Incomplete cord syndrome of thoracic spinal cord</td>
<td>7</td>
</tr>
<tr>
<td>S243</td>
<td>Injury of peripheral nerves of thorax</td>
<td>1</td>
</tr>
<tr>
<td>S2472</td>
<td>Functional spinal cord injury, T2/T3</td>
<td>1</td>
</tr>
<tr>
<td>S2477</td>
<td>Functional spinal cord injury, T12</td>
<td>2</td>
</tr>
<tr>
<td>S250</td>
<td>Injury of thoracic aorta</td>
<td>11</td>
</tr>
<tr>
<td>S251</td>
<td>Injury of innominate or subclavian artery</td>
<td>1</td>
</tr>
<tr>
<td>S252</td>
<td>Injury of superior vena cava</td>
<td>2</td>
</tr>
<tr>
<td>S254</td>
<td>Injury of pulmonary blood vessels</td>
<td>1</td>
</tr>
<tr>
<td>S255</td>
<td>Injury of intercostal blood vessels</td>
<td>1</td>
</tr>
<tr>
<td>S257</td>
<td>Injury of multiple blood vessels of thorax</td>
<td>1</td>
</tr>
<tr>
<td>S2682</td>
<td>Laceration of heart without penetration into heart chamber</td>
<td>2</td>
</tr>
<tr>
<td>S2683</td>
<td>Laceration of heart with penetration into heart chamber</td>
<td>4</td>
</tr>
<tr>
<td>S2688</td>
<td>Other injuries of heart</td>
<td>6</td>
</tr>
<tr>
<td>S269</td>
<td>Injury of heart, unspecified</td>
<td>1</td>
</tr>
<tr>
<td>S271</td>
<td>Traumatic haemothorax</td>
<td>75</td>
</tr>
<tr>
<td>S272</td>
<td>Traumatic haemopneumothorax</td>
<td>133</td>
</tr>
<tr>
<td>S2731</td>
<td>Contusion and haematoma of lung</td>
<td>90</td>
</tr>
<tr>
<td>S2732</td>
<td>Laceration of lung</td>
<td>13</td>
</tr>
<tr>
<td>S2738</td>
<td>Other and unspecified injuries of lung</td>
<td>8</td>
</tr>
<tr>
<td>ICD-10 Principle Diagnosis</td>
<td>Description</td>
<td>Frequency</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>S2781</td>
<td>Injury of diaphragm</td>
<td>17</td>
</tr>
<tr>
<td>S2788</td>
<td>Injury of other specified intrathoracic organs and structures</td>
<td>5</td>
</tr>
<tr>
<td>S279</td>
<td>Injury of unspecified intrathoracic organ</td>
<td>7</td>
</tr>
<tr>
<td>S3181</td>
<td>Open wound (of any part of lower back and pelvis) communicating with a fracture</td>
<td>1</td>
</tr>
<tr>
<td>S3200</td>
<td>Fracture of lumbar vertebra, level unspecified</td>
<td>25</td>
</tr>
<tr>
<td>S3283</td>
<td>Fracture of pelvis, part unspecified</td>
<td>59</td>
</tr>
<tr>
<td>S3289</td>
<td>Other and multiple pelvic fractures</td>
<td>46</td>
</tr>
<tr>
<td>S332</td>
<td>Dislocation of sacroiliac and sacrococcygeal joint</td>
<td>6</td>
</tr>
<tr>
<td>S3475</td>
<td>Functional spinal cord injury, L5</td>
<td>1</td>
</tr>
<tr>
<td>S351</td>
<td>Injury of inferior vena cava</td>
<td>1</td>
</tr>
<tr>
<td>S352</td>
<td>Injury of coeliac or mesenteric artery</td>
<td>6</td>
</tr>
<tr>
<td>S354</td>
<td>Injury of renal blood vessels</td>
<td>3</td>
</tr>
<tr>
<td>S358</td>
<td>Injury of other blood vessels at abdomen, lower back and pelvis level</td>
<td>2</td>
</tr>
<tr>
<td>S359</td>
<td>Injury of unspecified blood vessel at abdomen, lower back and pelvis level</td>
<td>3</td>
</tr>
<tr>
<td>S3603</td>
<td>Laceration of spleen extending into parenchyma</td>
<td>32</td>
</tr>
<tr>
<td>S3604</td>
<td>Massive parenchymal disruption of spleen</td>
<td>82</td>
</tr>
<tr>
<td>S3608</td>
<td>Other injury of spleen</td>
<td>41</td>
</tr>
<tr>
<td>S3610</td>
<td>Injury of liver, unspecified</td>
<td>32</td>
</tr>
<tr>
<td>S3612</td>
<td>Laceration of liver, unspecified</td>
<td>55</td>
</tr>
<tr>
<td>S3615</td>
<td>Major laceration of liver</td>
<td>32</td>
</tr>
<tr>
<td>S3617</td>
<td>Injury of gallbladder</td>
<td>4</td>
</tr>
<tr>
<td>S3618</td>
<td>Injury of bile duct</td>
<td>1</td>
</tr>
<tr>
<td>S3629</td>
<td>Injury of other and multiple parts of pancreas</td>
<td>2</td>
</tr>
<tr>
<td>S3659</td>
<td>Injury of other and multiple parts of colon</td>
<td>9</td>
</tr>
<tr>
<td>S367</td>
<td>Injury of multiple intra-abdominal organs</td>
<td>1</td>
</tr>
<tr>
<td>S3683</td>
<td>Injury of retroperitoneum</td>
<td>9</td>
</tr>
<tr>
<td>S369</td>
<td>Injury of unspecified intra-abdominal organ</td>
<td>40</td>
</tr>
<tr>
<td>S3703</td>
<td>Complete disruption of kidney parenchyma</td>
<td>13</td>
</tr>
<tr>
<td>S3733</td>
<td>Injury of prostatic urethra</td>
<td>1</td>
</tr>
<tr>
<td>S379</td>
<td>Injury of unspecified pelvic organ</td>
<td>5</td>
</tr>
<tr>
<td>S427</td>
<td>Multiple fractures of clavicle, scapula and humerus</td>
<td>9</td>
</tr>
<tr>
<td>S429</td>
<td>Fracture of shoulder girdle, part unspecified</td>
<td>13</td>
</tr>
<tr>
<td>S443</td>
<td>Injury of axillary nerve</td>
<td>2</td>
</tr>
<tr>
<td>S450</td>
<td>Injury of axillary artery</td>
<td>10</td>
</tr>
<tr>
<td>S481</td>
<td>Traumatic amputation at level between shoulder and elbow</td>
<td>1</td>
</tr>
<tr>
<td>ICD-10</td>
<td>Description</td>
<td>Frequency</td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>S489</td>
<td>Traumatic amputation of shoulder and upper arm, level unspecified</td>
<td>1</td>
</tr>
<tr>
<td>S529</td>
<td>Fracture of forearm, part unspecified</td>
<td>18</td>
</tr>
<tr>
<td>S6082</td>
<td>Blister of wrist and hand</td>
<td>11</td>
</tr>
<tr>
<td>S7200</td>
<td>Fracture of neck of femur, part unspecified</td>
<td>604</td>
</tr>
<tr>
<td>S7203</td>
<td>Fracture of subcapital section of femur</td>
<td>3338</td>
</tr>
<tr>
<td>S7205</td>
<td>Fracture of base of neck of femur</td>
<td>163</td>
</tr>
<tr>
<td>S7210</td>
<td>Fracture of trochanteric section of femur, unspecified</td>
<td>395</td>
</tr>
<tr>
<td>S7211</td>
<td>Fracture of intertrochanteric section of femur</td>
<td>2883</td>
</tr>
<tr>
<td>S7243</td>
<td>Supracondylar fracture of femur</td>
<td>259</td>
</tr>
<tr>
<td>S729</td>
<td>Fracture of femur, part unspecified</td>
<td>74</td>
</tr>
<tr>
<td>S781</td>
<td>Traumatic amputation at level between hip and knee</td>
<td>2</td>
</tr>
<tr>
<td>S881</td>
<td>Traumatic amputation at level between knee and ankle</td>
<td>5</td>
</tr>
<tr>
<td>S9088</td>
<td>Other superficial injuries of ankle and foot</td>
<td>7</td>
</tr>
<tr>
<td>S9330</td>
<td>Dislocation of foot, part unspecified</td>
<td>3</td>
</tr>
<tr>
<td>S983</td>
<td>Traumatic amputation of other parts of foot</td>
<td>4</td>
</tr>
<tr>
<td>T016</td>
<td>Open wounds involving multiple regions of upper limb(s) with lower limb(s)</td>
<td>2</td>
</tr>
<tr>
<td>T018</td>
<td>Open wounds involving other combinations of body regions</td>
<td>1</td>
</tr>
<tr>
<td>T019</td>
<td>Multiple open wounds, unspecified</td>
<td>2</td>
</tr>
<tr>
<td>T042</td>
<td>Crushing injuries involving multiple regions of upper limb(s)</td>
<td>1</td>
</tr>
<tr>
<td>T063</td>
<td>Injuries of blood vessels involving multiple body regions</td>
<td>3</td>
</tr>
<tr>
<td>T0901</td>
<td>Abrasion of trunk, level unspecified</td>
<td>2</td>
</tr>
<tr>
<td>T093</td>
<td>Injury of spinal cord, level unspecified</td>
<td>26</td>
</tr>
<tr>
<td>T100</td>
<td>Fracture of upper limb, level unspecified, closed</td>
<td>2</td>
</tr>
<tr>
<td>T1101</td>
<td>Abrasion of upper limb, level unspecified</td>
<td>5</td>
</tr>
<tr>
<td>T111</td>
<td>Open wound of upper limb, level unspecified</td>
<td>32</td>
</tr>
<tr>
<td>T1305</td>
<td>Contusion of lower limb, level unspecified</td>
<td>12</td>
</tr>
<tr>
<td>T133</td>
<td>Injury of unspecified nerve of lower limb, level unspecified</td>
<td>5</td>
</tr>
<tr>
<td>T139</td>
<td>Unspecified injury of lower limb, level unspecified</td>
<td>4</td>
</tr>
<tr>
<td>T1401</td>
<td>Abrasion of unspecified body region</td>
<td>1</td>
</tr>
<tr>
<td>T1420</td>
<td>Fracture of unspecified body region, closed</td>
<td>1</td>
</tr>
<tr>
<td>T173</td>
<td>Foreign body in larynx</td>
<td>39</td>
</tr>
<tr>
<td>T203</td>
<td>Full thickness burn of head and neck</td>
<td>49</td>
</tr>
<tr>
<td>T2104</td>
<td>Burn of unspecified thickness of trunk, back</td>
<td>7</td>
</tr>
<tr>
<td>T2119</td>
<td>Erythema of trunk, other</td>
<td>2</td>
</tr>
<tr>
<td>T2131</td>
<td>Full thickness burn of trunk, breast</td>
<td>4</td>
</tr>
<tr>
<td>ICD-10 Principle Diagnosis</td>
<td>Description</td>
<td>Frequency</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>T2132</td>
<td>Full thickness burn of trunk, chest wall</td>
<td>31</td>
</tr>
<tr>
<td>T2133</td>
<td>Full thickness burn of trunk, abdominal wall</td>
<td>23</td>
</tr>
<tr>
<td>T2134</td>
<td>Full thickness burn of trunk, back</td>
<td>40</td>
</tr>
<tr>
<td>T2135</td>
<td>Full thickness burn of trunk, genitalia</td>
<td>3</td>
</tr>
<tr>
<td>T2139</td>
<td>Full thickness burn of trunk, other</td>
<td>11</td>
</tr>
<tr>
<td>T2231</td>
<td>Full thickness burn of shoulder and upper limb, except wrist and hand, forearm and elbow</td>
<td>71</td>
</tr>
<tr>
<td>T2232</td>
<td>Full thickness burn of shoulder and upper limb, except wrist and hand, upper arm and shoulder region</td>
<td>37</td>
</tr>
<tr>
<td>T264</td>
<td>Burn of eye and adnexa, part unspecified</td>
<td>17</td>
</tr>
<tr>
<td>T270</td>
<td>Burn of larynx and trachea</td>
<td>8</td>
</tr>
<tr>
<td>T271</td>
<td>Burn involving larynx and trachea with lung</td>
<td>1</td>
</tr>
<tr>
<td>T280</td>
<td>Burn of mouth and pharynx</td>
<td>20</td>
</tr>
<tr>
<td>T281</td>
<td>Burn of oesophagus</td>
<td>11</td>
</tr>
<tr>
<td>T290</td>
<td>Burns of multiple regions, unspecified thickness</td>
<td>1</td>
</tr>
<tr>
<td>T293</td>
<td>Burns of multiple regions, at least one burn of full thickness mentioned</td>
<td>5</td>
</tr>
<tr>
<td>T3110</td>
<td>Burns involving 10–19% of body surface, less than 10% full thickness or unspecified</td>
<td>1</td>
</tr>
<tr>
<td>T337</td>
<td>Superficial frostbite of knee and lower leg</td>
<td>1</td>
</tr>
<tr>
<td>T462</td>
<td>Poisoning by other antidysrhythmic drugs, not elsewhere classified</td>
<td>14</td>
</tr>
<tr>
<td>T467</td>
<td>Poisoning by peripheral vasodilators</td>
<td>2</td>
</tr>
<tr>
<td>T493</td>
<td>Poisoning by emollients, demulcents and protectants</td>
<td>17</td>
</tr>
<tr>
<td>T504</td>
<td>Poisoning by drugs affecting uric acid metabolism</td>
<td>23</td>
</tr>
<tr>
<td>T603</td>
<td>Toxic effect of herbicides and fungicides</td>
<td>20</td>
</tr>
<tr>
<td>T68</td>
<td>Hypothermia</td>
<td>150</td>
</tr>
<tr>
<td>T71</td>
<td>Asphyxiation</td>
<td>164</td>
</tr>
</tbody>
</table>
Appendix 2: Indicator specifications

ID I01

Name ICISS-based All Serious Non-Fatal Injury Frequency

Concept of Interest  Societal burden of serious non-fatal injury.

Scope

<table>
<thead>
<tr>
<th>Area</th>
<th>Gender</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Injury</td>
<td>Both genders</td>
<td>All ages</td>
</tr>
</tbody>
</table>

Source Organisation Developed by IPRU for this project.

Numerator

Description  Injury hospitalisations in a calendar year who did not die in hospital with an ICISS score of 0.941 or less.

Details  Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and external cause code are coded using the ICD-10-AM classification. (10) Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al. (12)

ICISS scores have been calculated using the methods described elsewhere.(14, 59)

In order to compare to earlier years the definition of an injury hospitalisation has been translated into equivalent ICD-9-CM-A codes. (60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E800-E869, E880-E928 or E950-E999. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

Source  NZHIS NMDS (62)

Denominator N/A
Calculation N/A
ID I02

Name ICISS-based All Serious Non Fatal Injury Rate

Concept of Interest Individuals’ average annual risk of serious non-fatal injury.

Scope

- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

Source Organisation Developed by IPRU for this project.

Numerator

Description Injury hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

Details Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and external cause codes are coded using the ICD-10-AM classification. (10) Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al (12)

ICISS scores have been calculated using the methods described elsewhere.(14, 59)

In order to compare to earlier years the definition of an injury hospitalisation has been translated into equivalent ICD-9-CM-A codes. (60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E800-E869, E880-E928 or E950-E999. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

Source NZHIS NMDS (62)

Denominator Estimated total New Zealand population as at 30 June of the relevant year.

Description The estimates used have been published by Statistics New Zealand, They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmlDocs/National+Population+Estimates+Tables accessed April 2004)

Source Statistics New Zealand

Calculation Age standardised rates. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical Research, 2nd ed., pp 399-403.
**ID** I11

**Name** All Fatal Injury Frequency

**Concept of Interest** Societal burden of fatal injury.

**Scope**
- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation** Developed by IPRU for this project.

**Numerator**

**Description**
Injury fatalities registered in a calendar year.

**Details**
All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification (10).

In order to compare with earlier years the definition of an injury fatality has been translated into equivalent ICD-9-CM-A codes (60). These are an underlying cause of death e-code in the range E800-E869, E880-E928 or E950-E999.

**Source** NZHIS Mortality Data (61)

**Denominator** N/A

**Calculation** N/A
<table>
<thead>
<tr>
<th>ID</th>
<th>I12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>All Fatal Injury Rate</td>
</tr>
<tr>
<td><strong>Concept of Interest</strong></td>
<td>Individuals’ average annual risk of fatal injury.</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>All Injury</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>Both genders</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>All ages</td>
</tr>
<tr>
<td><strong>Source Organisation</strong></td>
<td>Developed by IPRU for this project.</td>
</tr>
<tr>
<td><strong>Numerator</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Injury fatalities registered in a calendar year.</td>
</tr>
<tr>
<td><strong>Details</strong></td>
<td>All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. (10) In order to compare to earlier years the definition of an injury fatality has been translated into equivalent ICD-9-CM-A codes. (60) These are an underlying cause of death e-code in the range E800-E869, E880-E928 or E950-E999.</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>NZHIS Mortality Data (61)</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>NZHIS NMDS (62)</td>
</tr>
<tr>
<td><strong>Denominator</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Estimated total New Zealand population as at 30 June of the relevant year.</td>
</tr>
<tr>
<td><strong>Details</strong></td>
<td>The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref <a href="http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables">http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables</a> accessed April 2004)</td>
</tr>
<tr>
<td><strong>Source</strong></td>
<td>Statistics New Zealand</td>
</tr>
<tr>
<td><strong>Calculation</strong></td>
<td>Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.</td>
</tr>
</tbody>
</table>
ID A01

**Name**  Provisional ICISS-based Assault Serious Non-Fatal Injury Frequency

**Concept of Interest**  Societal burden of serious non-fatal injury from assault.

**Scope**
- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation**  Developed by IPRU for this project.

**Numerator Description**  Assault hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

**Details**  Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and e-codes are coded using the ICD-10-AM classification(10). Assault hospitalisations are injury hospitalisations with a first external cause code in the range X85-Y09. Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al (35)

ICISS scores have been calculated using the methods described elsewhere. (14, 59)

In order to compare to earlier years the definition of an assault hospitalisation has been translated into equivalent ICD-9-CM-A codes,(60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E960-E969. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

**Source**  NZHIS NMDS (62)

**Denominator**  N/A

**Calculation**  N/A
ID A02

Name  Provisional ICISS-based Assault Serious Non Fatal Injury Rate

Concept of Interest  Individuals’ average annual risk of serious non-fatal injury from assault.

Scope
Area  All Injury
Gender  Both genders
Age  All ages

Source Organisation  Developed by IPRU for this project.

Numerator  Assault hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

Details  Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first e-code in the range V01-Y36, where diagnoses and external cause codes are coded using the ICD-10-AM classification. (10) Assault hospitalisations are injury hospitalisations with a first external cause code in the range X85-Y09. Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al (35). ICISS scores have been calculated using the methods described in elsewhere.(14, 59)

In order to compare to earlier years the definition of an assault hospitalisation has been translated into equivalent ICD-9-CM-A codes (ref ICD-9-CM-A). These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E960-E969. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

Source  NZHIS NMDS (62)

Denominator  Estimated total New Zealand population as at 30 June of the relevant year.

Description  The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmlDocs/National+Population+Estimates+Tables accessed April 2004)

Source  Statistics New Zealand

Calculation  Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
ID A11

Name Assault Fatal Injury Frequency

Concept of Interest Societal burden of fatal injury from assault.

Scope

Area All Injury
Gender Both genders
Age All ages

Source Organisation Developed by IPRU for this project.

Numerator

Description Assault fatalities registered in a calendar year.
Details All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. (10) Assault fatalities are injury fatalities with a underlying cause of death e-code in the range X85-Y09.

In order to compare to earlier years the definition of an assault fatality has been translated into equivalent ICD-9-CM-A codes (60). These are an underlying cause of death e-code in the range E960-E969.

Source NZHIS Mortality Data (61)

Denominator N/A

Calculation N/A
ID A12

Name Assault Fatal Injury Rate

Concept of Interest Individuals’ average annual risk of fatal injury from assault.

Scope
Area All Injury
Gender Both genders
Age All ages

Source Organisation Developed by IPRU for this project.

Numerator
Description Assault fatalities registered in a calendar year.

Details All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. (10). Assault fatalities are injury fatalities with a underlying cause of death e-code in the range X85-Y09.

In order to compare to earlier years the definition of an assault fatality has been translated into equivalent ICD-9-CM-A codes. (60) These are an underlying cause of death e-code in the range E960-E969.

Source NZHIS Mortality Data (61)

Source NZHIS NMDS (62)

Denominator
Description Estimated total New Zealand population as at 30 June of the relevant year.

Details The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmlDocs/National+Population+Estimates+Tables accessed April 2004)

Source Statistics New Zealand

Calculation Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
ID W01

**Name** ICISS-based Work-Related Serious Non-Fatal Injury Frequency

**Concept of Interest**  Societal burden of serious non-fatal work-related injury.

**Scope**

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>15 years and older</td>
</tr>
</tbody>
</table>

**Source Organisation** Developed by IPRU for this project.

**Numerator Description** Work-related hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

**Details** Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and e-codes are coded using the ICD-10-AM classification(8). Work-related hospitalisations are injury hospitalisations with an associated work-related ACC claim. The process of linking hospitalisations and ACC claims has been described elsewhere.(63) Work-related ACC claims are those made to the Residual Claims, Self-Employed Work and Employers’ ACC accounts. Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al (35)

ICISS scores have been calculated using the methods described elsewhere (14) (59)

In order to compare to earlier years the definition of an assault hospitalisation has been translated into equivalent ICD-9-CM-A codes.(50) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E960-E969. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

**Source** NZHIS NMDS (62)

**Denominator** N/A

**Calculation** N/A
ID W02

Name ICISS-based Work-Related Serious Non-Fatal Injury Rate

Concept of Interest Individuals’ average annual risk of serious non-fatal work-related injury.

Scope

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>15 years and older</td>
</tr>
</tbody>
</table>

Source Organisation Developed by IPRU for this project.

Numerator Work-related hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

Description Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and e-codes are coded using the ICD-10-AM classification.(10) Work-related hospitalisations are injury hospitalisations with an associated work-related ACC claim. The process of linking hospitalisations and ACC claims has been described elsewhere.(63) Work-related ACC claims are those made to the Residual Claims, Self-Employed Work and Employers’ ACC accounts. Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al. (35)

ICISS scores have been calculated using the methods described elsewhere. (14) (59)

In order to compare to earlier years the definition of an assault hospitalisation has been translated into equivalent ICD-9-CM-A codes.(50) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E960-E969. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

Source NZHIS NMDS (62)

Denominator Estimated total New Zealand working population as at 30 June of the relevant year.

Details The estimates have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey. (ref http://xtabs.stats.govt.nz/eng/TableViewer/Wdsvview/dispviewwp.asp?ReportId=206 (Accessed August 2004)

Source Statistics New Zealand

Calculation Age standardised rate. Age standardisation was via the direct method with age groups of 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the
process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical Research, 2nd ed., pp 399-403.
ID W11

**Name** Provisional Work-Related Fatal Injury Frequency

**Concept of Interest** Societal burden of work-related fatal injury.

**Scope**

Area: All Injury  
Gender: Both genders  
Age: 15 years and older

**Source Organisation** Developed by IPRU for this project.

**Numerator**

**Description** Work-related injury fatalities registered in a calendar year.

**Details** All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. Work-related fatalities are those with an ICD-10-AM activity code of 2. (10)

**Source** NZHIS mortality data (61)

**Denominator** N/A

**Calculation** N/A
Name Provisional Work-Related Fatal Injury Frequency - ACC

Concept of Interest Societal burden of work-related fatal injury.

Scope
Area All Injury
Gender Both genders
Age 15 years and older

Source Organisation ACC

Numerator Description New work-related injury fatalities ACC claims registered in a calendar year.

Details ACC claims include a field indicating whether or not the claim is for a fatal injury. Work-related fatalities are those made to the Residual Claims, Self-Employed Work and Employers’ ACC accounts.


Denominator N/A

Calculation N/A
**Name** Provisional Work-Related Fatal Injury Rate

**Concept of Interest** Individuals’ average annual risk of work-related fatal injury.

**Scope**
- **Area**: All Injury
- **Gender**: Both genders
- **Age**: 15 years and older

**Source Organisation** Developed by IPRU for this project.

**Numerator**
**Description** Work-related injury fatalities registered in a calendar year.

**Details** All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. Work-related fatalities are those with an ICD-10-AM activity code of 2. (10)

**Source** NZHIS mortality data (61)

**Denominator**
**Description** Estimated total New Zealand working population as at 30 June of the relevant year.

**Details** The estimates have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey. (ref http://xtabs.stats.govt.nz/eng/TableViewer/Wdsviewdispviewp.asp?ReportId=206 (Accessed August 2004)

**Source** Statistics New Zealand

**Calculation** Age standardised rate. Age standardisation was via the direct method with age groups of 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical Research, 2nd ed., pp 399-403.
**ID** W14

**Name** Provisional Work-Related Fatal Injury Rate - ACC

**Concept of Interest** Individuals’ average annual risk of work-related fatal injury.

**Scope**

- **Area**: All Injury
- **Gender**: Both genders
- **Age**: 15 years and older

**Source Organisation** ACC

**Numerator**

**Description** New work-related injury fatalities ACC claims registered in a calendar year.

**Details** ACC claims include a field indicating whether or not the claim is for a fatal injury. Work-related fatalities are those made to the Residual Claims, Self-Employed Work and Employers’ ACC accounts.


**Denominator**

**Description** Estimated total New Zealand working population as at 30 June of the relevant year.


**Source** Statistics New Zealand

**Calculation**

Age standardised rate. Age standardisation was via the direct method with age groups of 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical Research, 2nd ed., pp 399-403.
ID S01

Name Provisional ICISS-based Self-Harm Serious Non-Fatal Injury Frequency

Concept of Interest Societal burden of serious non-fatal injury from self-harm.

Scope

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>All ages</td>
</tr>
</tbody>
</table>

Source Organisation Developed by IPRU for this project.

Numerator

Description Self-harm hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

Details Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and e-codes are coded using the ICD-10-AM classification (10). Self-harm hospitalisations are injury hospitalisations with a first external cause code in the range X60-X84. Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al (35).

ICISS scores have been calculated using the methods described elsewhere.(14, 59)

In order to compare to earlier years the definition of an self-harm hospitalisation has been translated into equivalent ICD-9-CM-A codes. (60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E950-E959. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

Source NZHIS NMDS (62)

Denominator N/A

Calculation N/A
**ID** S02

**Name** Provisional ICISS-based Self-Harm Serious Non Fatal Injury Rate

**Concept of Interest** Individuals’ average annual risk of serious non-fatal injury from self-harm.

**Scope**
- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation** Developed by IPRU for this project.

**Numerator** Self-harm hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

**Description**
Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and external cause codes are coded using the ICD-10-AM classification. (10) Self-harm hospitalisations are injury hospitalisations with a first e-code in the range X60-X84. Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al (35)

ICISS scores have been calculated using the methods described elsewhere.(14, 59)

In order to compare to earlier years the definition of an self-harm hospitalisation has been translated into equivalent ICD-9-CM-A codes. (60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E950-E959. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

**Source** NZHIS NMDS (62)

**Denominator** Estimated total New Zealand population as at 30 June of the relevant year.

**Description**
The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables accessed April 2004)

**Source** Statistics New Zealand
Calculation  Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
**ID** S11

**Name** Self-Harm Fatal Injury Frequency

**Concept of Interest** Societal burden of fatal injury from self-harm.

**Scope**
- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation** Developed by IPRU for this project.

**Numerator**

**Description** Self-harm fatalities registered in a calendar year.

**Details** All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification (10). Self-harm fatalities are injury fatalities with an underlying cause of death e-code in the range X60-X84.

In order to compare to earlier years the definition of a self-harm fatality has been translated into equivalent ICD-9-CM-A codes. (60) These are an underlying cause of death e-code in the range E950-E959.

**Source** NZHIS Mortality Data (61)

**Denominator** N/A

**Calculation** N/A
Name: Self-Harm Fatal Injury Rate

Concept of Interest: Individuals’ average annual risk of fatal injury from self-harm.

Scope:
- Area: All Injury
- Gender: Both genders
- Age: All ages

Source Organisation: Developed by IPRU for this project.

Numerator:
- Description: Self-harm fatalities registered in a calendar year.
- Details: All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. (10) Self-harm fatalities are injury fatalities with an underlying cause of death external cause code in the range X60-X84.

In order to compare to earlier years the definition of a self-harm fatality has been translated into equivalent ICD-9-CM-A codes. (60) These are an underlying cause of death e-code in the range E950-E959.

Source:
- NZHIS Mortality Data (61)
- NZHIS NMDS (62)

Denominator:
- Description: Estimated total New Zealand population as at 30 June of the relevant year.
- Details: The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables accessed April 2004)

Source: Statistics New Zealand

Calculation:
- Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
ID F01

Name ICISS-based Falls Serious Non-Fatal Injury Frequency

Concept of Interest Societal burden of serious non-fatal injury from falls.

Scope
   Area All Injury
   Gender Both genders
   Age All ages

Source Organisation Developed by IPRU for this project.

Numerator
   Description Falls hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

Details Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and external cause codes are coded using the ICD-10-AM classification. (10) Falls hospitalisations are injury hospitalisations with a first external cause code in the range W00-W19. Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al. (35)

ICISS scores have been calculated using the methods described elsewhere. (14, 59)

In order to compare to earlier years the definition of a falls hospitalisation has been translated into equivalent ICD-9-CM-A codes. (60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E880-E886 or E888. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

Source NZHIS NMDS (62)

Denominator N/A

Calculation N/A
**ID** F02

**Name** ICISS-based Falls Serious Non Fatal Injury Rate

**Concept of Interest** Individuals’ average annual risk of serious non-fatal injury from falls.

**Scope**
- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation** Developed by IPRU for this project.

**Numerator**

**Description** Falls hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

**Details**

Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and external cause codes are coded using the ICD-10-AM classification. (10) Falls hospitalisations are injury hospitalisations with a first e-code in the range W00-W19. Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al (35)

ICISS scores have been calculated using the methods described in elsewhere. (14) (59)

In order to compare to earlier years the definition of a falls hospitalisation has been translated into equivalent ICD-9-CM-A codes (60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E880-E886 or E888. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

**Source** NZHIS NMDS (62)

**Denominator**

**Description** Estimated total New Zealand population as at 30 June of the relevant year.

**Details**

The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables accessed April 2004)

**Source** Statistics New Zealand
Calculation

Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
ID F11

Name Fatal Falls Injury Frequency

Concept of Interest  Societal burden of fatal injury from falls.

Scope
  Area  All Injury
  Gender  Both genders
  Age  All ages

Source Organisation Developed by IPRU for this project.

Numerator Description  Fatalities falls registered in a calendar year.

Details  All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification (10). Falls fatalities are injury fatalities with an underlying cause of death external cause code in the range W00-W19.

In order to compare to earlier years the definition of a fatal fall has been translated into equivalent ICD-9-CM-A codes. (60) These are an underlying cause of death e-code in the range E880-E886 or E888.

Source  NZHIS Mortality Data (61)

Denominator N/A

Calculation N/A
**ID** F12

**Name** Fatal Falls Injury Rate

**Concept of Interest** Individuals’ average annual risk of fatal injury from falls.

**Scope**

- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation** Developed by IPRU for this project.

**Numerator Description** Fatal falls registered in a calendar year.

**Details**

All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification (10). Falls fatalities are injury fatalities with an underlying cause of death external cause code in the range W00-W19.

In order to compare to earlier years the definition of a fatal fall has been translated into equivalent ICD-9-CM-A codes. (60) These are an underlying cause of death e-code in the range E880-E886 or E888.

**Source** NZHIS Mortality Data (61)

**Source** NZHIS NMDS (62)

**Denominator Description** Estimated total New Zealand population as at 30 June of the relevant year.

**Details**

The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmlDocs/National+Population+Estimates+Tables accessed April 2004)

**Source** Statistics New Zealand

**Calculation**

Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
ID M01

Name ICISS-based MVTC Serious Non-Fatal Injury Frequency

Concept of Interest  Societal burden of serious non-fatal injury from MVTCs.

Scope

- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

Source Organisation  Developed by IPRU for this project.

Numerator Description  MVTC hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.

Details  Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and external cause codes are coded using the ICD-10-AM classification (10). MVTC hospitalisations are injury hospitalisations with a first e-code in the range V02-V04 (with a 4th digit in the range .1-.9), V09 (.2), V12-V14 (.3-.9), V19 (.4-.6), V20-V28 (.3-.9), V29-V79 (.4-.9), V80 (.3-.5), V81-V82 (.1), V83-V86 (.0-.3), V87 (.0-.8) or V89 (.2). Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al .(35)

ICISS scores have been calculated using the methods described elsewhere.(14) (59)

In order to compare to earlier years the definition of an MVTC hospitalisation has been translated into equivalent ICD-9-CM-A codes. (60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E810-E819. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

Source  NZHIS NMDS (62)

Denominator  N/A

Calculation  N/A
ID M02

Name ICISS-based MVTC Serious Non Fatal Injury Rate

Concept of Interest Individuals’ average annual risk of serious non-fatal injury from MVTCs.

Scope

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>All ages</td>
</tr>
</tbody>
</table>

Source Organisation Developed by IPRU for this project.

Numerator

<table>
<thead>
<tr>
<th>Description</th>
<th>MVTC hospitalisations in a calendar year who didn’t die in hospital with an ICISS score of 0.941 or less.</th>
</tr>
</thead>
</table>

Details

Hospitalisations have been operationally defined as all discharges from public hospitals in the relevant year. Injury hospitalisations are those hospitalisations with a principal diagnosis in the range S00-T78 and a first external cause code in the range V01-Y36, where diagnoses and external cause codes are coded using the ICD-10-AM classification. MVTC hospitalisations are injury hospitalisations with a first external cause code in the range V02-V04 (with a 4th digit in the range .1-.9), V09 (.2), V12-V14 (.3-.9), V19 (.4-.6), V20-V28 (.3-.9), V29-V79 (.4-.9), V80 (.3-.5), V81-V82 (.1), V83-V86 (.0-.3), V87 (.0-.8) or V89 (.2). Readmissions for subsequent treatment and deaths in hospital have been excluded using the methods described in Langley et al (35).

ICISS scores have been calculated using the methods described elsewhere. (14, 59)

In order to compare to earlier years the definition of an MVTC hospitalisation has been translated into equivalent ICD-9-CM-A codes.(60) These are a principal diagnosis in the range 800-904 or 910-995 and a first e-code in the range E810-E819. An equivalent ICISS threshold for the ICD-9-CM-A data is estimated as an ICISS score of 0.96 or less.

Source NZHIS NMDS (62)

Denominator

<table>
<thead>
<tr>
<th>Description</th>
<th>Estimated total New Zealand population as at 30 June of the relevant year.</th>
</tr>
</thead>
</table>

Details The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables accessed April 2004)

Source Statistics New Zealand
Calculation

Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
**ID** M11

**Name** MVTC Fatal Injury Frequency

**Concept of Interest** Societal burden of fatal injury from MVTCs.

**Scope**

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>All ages</td>
</tr>
</tbody>
</table>

**Source Organisation** Developed by IPRU for this project.

**Numerator**

**Description** MVTC fatalities registered in a calendar year.

**Details**

All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. MVTC fatalities are injury fatalities with an underlying cause of death external cause code in the range V02-V04 (with a 4th digit in the range .1-.9), V09 (.2), V12-V14 (.3-.9), V19 (.4-.6), V20-V28 (.3-.9), V29-V79 (.4-.9), V80 (.3-.5), V81-V82 (.1), V83-V86 (.0-.3), V87 (.0-.8) or V89 (.2).

In order to compare to earlier years the definition of a MVTC fatality has been translated into equivalent ICD-9-CM-A codes. (60) These are an underlying cause of death e-code in the range E810-E819.

**Source** NZHIS Mortality Data (61)

**Denominator** N/A

**Calculation** N/A
ID M12

Name MVTC Fatal Injury Rate

Concept of Interest Individuals’ average annual risk of fatal injury from MVTCs.

Scope

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>All ages</td>
</tr>
</tbody>
</table>

Source Organisation Developed by IPRU for this project.

Numerator

Description MVTC fatalities registered in a calendar year.

Details All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. (10) MVTC fatalities are injury fatalities with an underlying cause of death external cause code in the range V02-V04 (with a 4th digit in the range .1-.9), V09 (.2), V12-V14 (.3-.9), V19 (.4-.6), V20-V28 (.3-.9), V29-V79 (.4-.9), V80 (.3-.5), V81-V82 (.1), V83-V86 (.0-.3), V87 (.0-.8) or V89 (.2)

In order to compare to earlier years the definition of a MVTC fatality has been translated into equivalent ICD-9-CM-A codes. (60) These are an underlying cause of death e-code in the range E810-E819.

Source NZHIS Mortality Data (61)

Source NZHIS NMDS (62)

Denominator

Description Estimated total New Zealand population as at 30 June of the relevant year.

Details The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmlDocs/National+Population+Estimates+Tables accessed April 2004).

Source Statistics New Zealand
Calculation
Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
Name: MVTC Fatal Injury Rate Per Vehicle Kilometre

**Concept of Interest**: Individuals’ average annual risk of fatal injury from MVTCs adjusting for exposure.

**Scope**
- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation**: Developed by IPRU for this project.

**Numerator**
- **Description**: MVTC fatalities registered in a calendar year.

**Details**
- All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification (10). MVTC fatalities are injury fatalities with an underlying cause of death external cause code in the range V02-V04 (with a 4th digit in the range .1-.9), V09 (.2), V12-V14 (.3-.9), V19 (.4-.6), V20-V28 (.3-.9), V29-V79 (.4-.9), V80 (.3-.5), V81-V82 (.1), V83-V86 (.0-.3), V87 (.0-.8) or V89 (.2).

In order to compare to earlier years the definition of a MVTC fatality has been translated into equivalent ICD-9-CM-A codes. (60). These are an underlying cause of death e-code in the range E810-E819.

**Source**: NZHIS Mortality Data (61)

**Denominator**
- **Description**: Estimated total kilometres travelled by motor vehicles in New Zealand in the relevant year.

**Details**: Unknown

**Source**: Land Transport Safety Authority (LTSA)

**Calculation**: Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
Name  MVTC Fatal Injury Rate Per Vehicle

Concept of Interest  Drivers’ average annual risk of fatal injury from MVTCs.

Scope
Area  All Injury
Gender  Both genders
Age  All ages

Source Organisation  Developed by IPRU for this project.

Numerator
Description  MVTC fatalities registered in a calendar year.

Details  All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification (10). MVTC fatalities are injury fatalities with an underlying cause of death external cause code in the range V02-V04 (with a 4th digit in the range .1-.9), V09 (.2), V12-V14 (.3-.9), V19 (.4-.6), V20-V28 (.3-.9), V29-V79 (.4-.9), V80 (.3-.5), V81-V82 (.1), V83-V86 (.0-.3), V87 (.0-.8) or V89 (.2)

In order to compare to earlier years the definition of a MVTC fatality has been translated into equivalent ICD-9-CM-A codes. (60). These are an underlying cause of death e-code in the range E810-E819.

Source  NZHIS NMDS (62)

Denominator
Description  Total motor vehicles registered in New Zealand as at 30 June of the relevant year.

Details  Vehicle numbers include registered Cars, Vans, Trucks, Buses, Motor Caravans, Motor Cycles and Mopeds, but excludes those with an exempt or restoration licence.

Source  Motor vehicle register, Land Transport Safety Authority (LTSA)

Calculation  Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
**ID** M15
**Name** Provisional MVTC Fatal Injury Frequency

**Concept of Interest**  Societal burden of fatal injury from MVTCs.

**Scope**

- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation**  LTSA

**Numerator**

**Description**  MVTC fatalities recorded in the Traffic Crash Report (TCR) database in a calendar year.

**Details**  All motor vehicle crashes resulting in injury or death that occur on a public road are required to be reported within 24 hours. Reported crashes are attended by a police officer who completes a TCR. People injured in a crash are coded as fatalities if they die within 30 days of the crash. Deaths that did not result from injuries sustained in the crash or result from suicide or murder are excluded.

**Source**  Land Transport Safety Authority TCR database (64)

**Denominator**  N/A

**Calculation**  N/A
ID M16

Name Provisional MVTC Fatal Injury Rate

Concept of Interest Individuals’ average annual risk of fatal injury from MVTCs.

Scope
- Area: All Injury
- Gender: Both genders
- Age: All ages

Source Organisation LTSA

Numerator
- Description: MVTC fatalities recorded in the Traffic Crash Report (TCR) database in a calendar year.

Details: All motor vehicle crashes resulting in injury or death that occur on a public road are required to be reported within 24 hours. Reported crashes are attended by a police officer who completes a TCR. People injured in a crash are coded as fatalities if they die within 30 days of the crash. Deaths that did not result from injuries sustained in the crash or result from suicide or murder are excluded. (64)

Source: LTSA TCR database (64)

Denominator
- Description: Estimated total New Zealand population as at 30 June of the relevant year.

Details: The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables accessed April 2004).

Source: Statistics New Zealand

Calculation
- Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
ID M17

**Name** Provisional MVTC Fatal Injury Rate Per Vehicle Kilometre

**Concept of Interest** Individuals’ average annual risk of fatal injury from MVTCs adjusting for exposure.

**Scope**
- **Area**: All Injury
- **Gender**: Both genders
- **Age**: All ages

**Source Organisation** LTSA.

**Numerator**

**Description** MVTC fatalities recorded in the Traffic Crash Report (TCR) database in a calendar year.

**Details** All motor vehicle crashes resulting in injury or death that occur on a public road are required to be reported within 24 hours. Reported crashes are attended by a police officer who completes a TCR. People injured in a crash are coded as fatalities if they die within 30 days of the crash. Deaths that did not result from injuries sustained in the crash or result from suicide or murder are excluded.

**Source** LTSA TCR database (64)

**Denominator**

**Description** Estimated total kilometres travelled by motor vehicles in New Zealand in the relevant year.

**Details** Unknown

**Source** LTSA

**Calculation**

Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
ID M18

Name  Provisional MVTC Fatal Injury Rate Per Vehicle

Concept of Interest  Drivers’ average annual risk of fatal injury from MVTCs.

Scope

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>All ages</td>
</tr>
</tbody>
</table>

Source Organisation  LTSA.

Numerator

<table>
<thead>
<tr>
<th>Description</th>
<th>MVTC fatalities recorded in the Traffic Crash Report (TCR) database in a calendar year.</th>
</tr>
</thead>
</table>

Details  All motor vehicle crashes resulting in injury or death that occur on a public road are required to be reported within 24 hours. Reported crashes are attended by a police officer who completes a TCR. People injured in a crash are coded as fatalities if they die within 30 days of the crash. Deaths that did not result from injuries sustained in the crash or result from suicide or murder are excluded.

Source  LTSA TCR database (64)

Denominator

<table>
<thead>
<tr>
<th>Description</th>
<th>Total motor vehicles registered in New Zealand as at 30 June of the relevant year.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Details</td>
<td>Vehicle numbers include registered Cars, Vans, Trucks, Buses, Motor Caravans, Motor Cycles and Mopeds, but excludes those with an exempt or restoration licence.</td>
</tr>
</tbody>
</table>

Source  Motor vehicle register, LTSA

Calculation  Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical Research, 2nd ed., pp 399-403.
ID D11

Name Drowning Fatal Injury Frequency

Concept of Interest Societal burden of fatal injury from drowning.

Scope

Area All Injury
Gender Both genders
Age All ages

Source Organisation Developed by IPRU for this project.

Numerator

Description Drowning fatalities registered in a calendar year.

Details All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. Drowning fatalities are injury fatalities with any diagnosis of T75.1 and an underlying cause of death external cause code that is not in the range X60-Y09 or Y35-Y36.

There are no available equivalent ICD-9-CM-A codes (60) to identify drowning fatalities.

Source NZHIS Mortality Data (61)

Denominator N/A

Calculation N/A
**ID** D12

**Name** Drowning Fatal Injury Rate

**Concept of Interest** Individuals’ average annual risk of fatal injury from drowning.

**Scope**

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>All ages</td>
</tr>
</tbody>
</table>

**Source Organisation** Developed by IPRU for this project.

**Numerator**

**Description** Drowning fatalities registered in a calendar year.

**Details**

All fatalities are required to be registered. Injury fatalities are those fatalities where the underlying cause of death is an external cause code in the range V01-Y36, where external cause codes are coded using the ICD-10-AM classification. Drowning fatalities are injury fatalities with any diagnosis of T75.1 and an underlying cause of death external cause code that is not in the range X60-Y09 or Y35-Y36.

There are no available equivalent ICD-9-CM-A codes (60) to identify drowning fatalities.

**Source** NZHIS Mortality Data (61)

**Source** NZHIS NMDS (62)

**Denominator**

**Description** Estimated total New Zealand population as at 30 June of the relevant year.

**Details** The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables accessed April 2004)

**Source** Statistics New Zealand

**Calculation**

Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
ID D13

**Name** Provisional Drowning Fatal Injury Frequency

**Concept of Interest** Societal burden of fatal injury from drowning.

**Scope**
- **Area** All Injury
- **Gender** Both genders
- **Age** All ages

**Source Organisation** WaterSafety New Zealand

**Numerator**

**Description** Drowning fatalities recorded in the DrownBase database in a calendar year.

**Details** Fatalities are recorded in DrownBase if:

1. Drowning is the primary cause of death; or
2. Drowning is a contributing cause of death and the primary cause was potentially survivable in the absence of the drowning.

Multiple sources are used to identify potential drowning-related fatalities including police reports, media and coroner’s files (46).

**Source** DrownBase

**Denominator** N/A

**Calculation** N/A
**Name** Provisional Drowning Fatal Injury Rate

**Concept of Interest** Individuals’ average annual risk of fatal injury from drowning.

**Scope**

<table>
<thead>
<tr>
<th>Area</th>
<th>All Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Both genders</td>
</tr>
<tr>
<td>Age</td>
<td>All ages</td>
</tr>
</tbody>
</table>

**Source Organisation** WaterSafety New Zealand

**Numerator**

**Description** Drowning fatalities recorded in the DrownBase database in a calendar year.

**Details** Fatalities are recorded in DrownBase if:

1. Drowning is the primary cause of death; or
2. Drowning is a contributing cause of death and the primary cause was potentially survivable in the absence of the drowning.
3. Multiple sources are used to identify potential drowning-related fatalities including police reports, media and coroner’s files (46).

**Source**

- NZHIS Mortality Data (61)
- NZHIS NMDS (62)

**Denominator**

**Description** Estimated total New Zealand population as at 30 June of the relevant year.

**Details** The estimates used have been published by Statistics New Zealand. They are based on the most recent New Zealand Census and post-enumeration survey adjusted for the estimated number of New Zealand residents overseas on census night, estimated natural increase in population and estimated net long term and permanent migration. (ref http://www.stats.govt.nz/domino/external/web/prod_serv.nsf/htmldocs/National+Population+Estimates+Tables accessed April 2004)

**Source** Statistics New Zealand

**Calculation**

Age standardised rate. Age standardisation was via the direct method with age groups of 0-14, 15-24, 25-64, 65-79 and 80 and above. The standard population was the estimated New Zealand population as at 30 June 2003. For details of the process of direct standardisation see, for example, Armitage and Berry (1987), Statistical Methods in Medical research, 2nd ed., pp 399-403.
Appendix 3. Selected readings


Langley JD, Cryer PC. Indicators for injury surveillance. Australasian Epidemiologist, 2000;7:1:5-9


