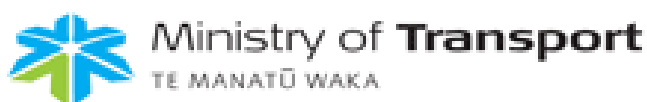


Mapping Injury Severity Scores against Hospitalisation Day Stays for the Injury Priority Areas (excluding workplace injury)

A report prepared for the Accident Compensation Corporation, Statistics New Zealand and Ministry of Transport



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MANATŪ HAUORA

Foreword

The *New Zealand Injury Prevention Strategy (2003)* sets out the Government's framework to address the burden of injury in New Zealand. Government agencies, in a co-ordinated manner under the leadership of the New Zealand Injury Prevention Secretariat in the Accident Compensation Corporation (ACC), are responsible for implementation of parts of the strategy and associated action plans. For example, the Ministry of Health is responsible for leading actions on suicide prevention, and the Ministry of Transport is responsible for leading action on road safety.

This publication is an example of joint government agency effort between the Ministry of Health, ACC, Ministry of Transport and Statistics New Zealand to progress ideas about how best to monitor at the strategic level the outcomes sought by Government from implementation of the New Zealand Injury Prevention Strategy.

The publication explores, from an agency perspective, the merits of using two statistical methods of counting the number of injuries and their associated severity: either length of stay (LOS) in hospital or an injury severity score based upon diagnostic codes (ICISS). Both methods rely upon information contained within national administrative datasets collected by the Ministry of Health.

The publication explicitly explores the relationship between length of stay and ICISS as two measures of injury severity. Recommendations are made about which of these methods are preferred, from Public Health Intelligence's perspective, for adoption by government agencies as one measure of the burden of injury at the strategic level.

Comments about this report are welcomed and should be sent to either:

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Executive Summary

Injury is an important cause of premature death and disability in New Zealand, resulting in more than 112,000 hospitalisations per year (see table A1 p.57). The New Zealand Injury Prevention Strategy sets down a strategic direction for injury prevention that included the monitoring of national injury prevention strategies for six priority areas in 2003 (Hon Ruth Dyson Minister for ACC 2003). However, a valid, reliable, easily understood and methodologically straightforward method of monitoring important injury in New Zealand has been difficult to identify. The key objective of this report is to provide further information about the use of the ICD-based Injury Severity Score (ICISS) and length of stay as measures of severity of injury, in order to aid the decision-making processes of agencies in regard to the adoption of a method for reporting the severity of injury outcomes and monitoring of trends over time.

Injury hospitalisation data from 2002 to 2006 is used in this report. For each hospitalisation the length of stay in days and ICD based Injury Severity Score (ICISS) has been determined. Data on the concordance, correlation, annual number and age-standardised rates of discharges, and types of injury diagnoses have found that:

- Length of stay is not a reliable indicator of risk of death from injury. This is demonstrated through tests of concordance and correlation between length of stay and ICISS. These findings provide evidence against the use of length of stay as an indicator of injury severity monitoring in New Zealand.
- The IPRU ICISS definition of serious injury (less than or equal to 0.941) appears to identify injuries which are generally regarded as severe and clinically important for all ages combined, and for the life cycle age groups.
- The PHI defined categories for moderate and minor injury (ICISS 0.941-0.99 and ICISS >0.99 respectively) also appear to identify injuries which are less severe than the IPRU serious injury category, and present commonly as moderate and minor injury. It appears that the (IPRU and PHI-defined) ICISS categories for serious, moderate and minor injury correctly reflect the range of injury experiences for each life cycle age group, where there are differences in injury diagnoses present for age groups.
- Length of stay does not consistently identify the same injury diagnoses as ICISS. When categorised into minor, moderate and serious length of stay categories, length of stay describes a different range of injury diagnoses to ICISS across priority areas, severity categories and age groups. Longer length of stay, in some instances, appears to identify admissions with common, serious non-injury diagnoses which are complicated by injury, rather than serious injury in terms of higher risk of death. For falls, the serious length of stay category appears to identify admissions with diagnoses requiring prolonged periods of immobility rather than higher risk of death.

Recommendations

1. Length of stay is not a reliable indicator to be used in the reporting of injury as it does not consistently identify admissions with a higher risk of death. It should therefore not be used in the monitoring of injury in New Zealand.
2. Routine monitoring should continue to use the ICD based Injury Severity Score (ICISS), with a threshold of less than or equal to 0.941.
3. Improvements to the ICISS should be considered. These include updating the training set used for the calculation of ICISS, incorporating factors such as deaths occurring outside of hospital, age and co-morbidity in the calculation, and modifying the 0.941 threshold for some priority areas.
4. Consider adopting different thresholds of ICISS for the serious category in each priority area rather than a single level of 0.941, and adopting 3 step injury severity taxonomy of serious, moderate and minor injury, as defined in this report by the IPRU (serious) and PHI (moderate and minor).

On the basis of these findings and the reviewed literature, PHI recommends against continuing to use length of stay as an indicator of severity in the monitoring of injury in New Zealand as it does not consistently identify admissions with a higher risk of death. While length of stay may be more easily understood and methodologically more simple, using length of stay would result in less valid information. Routine monitoring should move towards the use of the ICD based Injury Severity Score (ICISS), with ongoing attention to its limitations and potential improvements, in particular different thresholds for the priority groups.

Chapter 1: Introduction

Injury is an important cause of premature death and disability in New Zealand. Between 2002 and 2006 there were approximately 578,000 hospitalisations due to injury (refer to table A1 p.57). Injury can have significant social and economic costs (Ministry of Health 2001; 2006; Stephenson et al 2005). In 2003 the *New Zealand Injury Prevention Strategy* set down a vision and strategic direction for injury prevention that included the monitoring of national injury prevention strategies for six priority areas (Hon Ruth Dyson Minister for ACC 2003).

For some time there has been concern about the validity and reliability of traditional methods of reporting injury outcome indicators (Cryer et al 1999; Langley et al 2003; Langley et al 2002; McClure et al 2002). The Injury Prevention Research Unit (IPRU) of the University of Otago has made recommendations on valid and reliable outcome indicators for 'all injury' and for the six priority areas (Cryer et al 2004). In this publication an injury severity score based on International Classification of Diseases (ICD) version 10 diagnostic codes has been suggested to distinguish serious from more minor injuries. Using this ICD based Injury Severity Score (ICISS) score, trends of serious non-fatal injuries have been reported (Cryer et al 2007a; Cryer et al 2007b; Cryer et al 2007c). Previously, injury had been monitored with a variety of measures, including admissions to hospital, traffic crash reports and length of stay; each has their own limitations (Cryer et al 2004).

This report aims to provide further information about the use of the ICISS and length of stay as measures of severity of injury, in order to aid the decision-making processes of agencies in regard to the adoption of the ICISS method for reporting the severity of injury outcomes. Analyses in this report will specifically investigate whether or not length of hospital stay could be used as a valid and reliable indicator of severity, as an alternative to ICISS.

Areas to be covered include statistical tests of association between the two measures, the use of different thresholds, and describing the injury diagnosis types and experiences for lifecycle age groups. The choice of measure may have an important impact on the monitoring of injury outcomes in the *New Zealand Injury Prevention Strategy*.

Background

The *New Zealand Injury Prevention Strategy* established the Government's direction for injury prevention (Hon Ruth Dyson Minister for ACC 2003). The Strategy's goals are to achieve a positive safety culture and to create safe environments. The six priority areas are:

- motor vehicle traffic crashes (MVTC)
- suicide and deliberate self-harm (DSH)
- falls
- assault
- workplace injuries, and
- drowning

An important objective of the strategy was to develop, implement and monitor national injury prevention strategies for these priority areas.

Monitoring injury outcomes

The difficulties in monitoring injury outcomes have been demonstrated both in New Zealand and internationally (Cryer et al 2002; Cryer et al 1999; Langley 2004), and makes measuring progress towards goals problematic. Issues include incomplete case selection, changes in service provision and poor selectivity of important injuries.

A variety of monitoring methods have been used. Many countries, including New Zealand have measured their performance in reducing non-fatal injury from motor vehicle traffic crash (MVTC) using traffic crash reports (TCRs) compiled by police. However, case ascertainment is affected by several factors, including reporting patterns and service provision other than the true occurrence of injury (Langley et al 2003). Similarly with ACC data: the likelihood that a person makes a claim may be dependant on individual, employment and health service factors. It has been suggested that workers from larger firms are less likely to claim and that higher employment results in lower claim rates and more rapid return to work (Raymont et al 2003). Trends in injury claims and TCRs overtime are therefore likely to be influenced by factors other than injury occurrence.

Injuries requiring a consultation with a family doctor or a hospital attendance had been suggested as an indicator of injury in the United Kingdom (Cryer et al 1999). Health service utilisation indicators such as this are relatively easy to measure. They may however focus attention on minor injury, which causes a large number of attendances but a smaller proportion of both the burden of disability on a population. Focus may be diverted from important, more severe, injuries. Additionally, health service utilisation is affected by social factors and service provision factors (Cryer et al 1999). Consultations for injury may be less for some ethnic groups, or those living in deprived or rural areas. Changes in access to services may affect utilisation independently of the occurrence of injury. Similar problems have been described when using attendance at accident and emergency departments (Langley & Cryer 2000).

In New Zealand, admissions to hospital with a discharge diagnosis of injury have been used to monitor injury (Langley et al 2002). The current definition of an admission requires three or more hours of treatment at a hospital (New Zealand Health Information Service 2003). Therefore, many who attend accident and emergency services and all those who attend primary care services with injuries are excluded. Using only admissions is thought to select more severe injuries than all those seeking medical attention. However, service provision factors also affect hospital admissions for injury (Cryer et al 2000; Langley et al 2002). For example, the number of admissions for injury may increase because of a trend towards discharge and later readmission for treatment as an outpatient procedure, rather than due to a true increase in the number of injuries. A change in diagnostic procedure may allow prompt discharge rather than admission. For example, the increasing use of computerised tomography (CT) scanning as an

investigation for head injury has allowed early discharge rather than admission for observation (Beattie et al 1998).

Severity indicators

Using a measure of severity to define cases can overcome many of these problems. However, choosing a measure of severity, and a threshold for that measure may be more difficult. A variety of severity measures have been proposed that have been based on factors such as anatomical damage such as long bone fractures, threat to life, threat of disablement (Clark & Ahmad 2006; Cryer et al 1999; Kool et al 2007; Langley & Cryer 2000; Stephenson et al 2002; Stevenson et al 2001) or alternatively, severe injuries could be indicated by length of stay in hospital (Polinder et al 2008). If a higher threshold of severity is chosen, for example a probability of death of 6% or greater, or a length of stay of more than three days, near complete ascertainment from hospital admissions can be ensured as these injuries are important enough for all to require medical attention and admission regardless of access or service provision factors. Applying a lower threshold (for example, with a probability of death of less than 0.5%, or all admissions of more than three hours duration) may re-introduce the biases associated with access and service provision as many of the less severe injuries may not seek treatment or be admitted at all hospitals (Cryer et al 2004), or the ascertainment of cases may change over time making the indicator inappropriate for monitoring time trends. Two indicators of severity will be considered in this report: length of stay in hospital and the injury severity score (ICISS) based on ICD diagnoses proposed by Cryer et al (2004).

Length of stay

Length of stay in hospital has the advantages of being easy to measure and is easily understood, and can be used as a measure of resource utilisation. Length of stay is related to a number of factors including age and co-morbidities, which may be important indicators of disability. However, additional factors, which do not indicate threat to life or disability are related to length of hospital admission, such as transfers between hospitals and discharge destination (Bergeron et al 2005; Brasel et al 2007; Liu et al 2001). There has been a trend of declining length of stay over the last 20 years, likely related to healthcare service provision rather than because of declining severity of injury (Cryer et al 2002).

ICD-based Injury Severity Score: ICISS

A range of injury severity scores have been proposed and compared (Clark & Ahmad 2006; Senkowski & McKenney 1999; Stephenson et al 2002; Stevenson et al 2001). Some are based on ICD codes of discharge diagnoses, and therefore can be applied to administrative datasets. The severity score proposed by the IPRU for use as an indicator of serious injury in New Zealand (Cryer et al 2004) is the ICISS (ICD-based Injury Severity Score) developed by Osler et al (1996). This method involves calculating a survival risk ratio for each injury diagnosis code from the ratio of the number of patients with the injury code who have not died to the number of patients diagnosed with that code (this is further described in the methods section). This method is thought to offer a more direct and certain

route to severity than methods using statistical packages to translate ICD codes to other anatomical based severity scales. It is also not dependant on a particular version of ICD coding (Cryer et al 2004).

Using the ICISS system, an *increasing* ICISS score means a decreasing risk of death, that is a *less serious* injury, and a *decreasing* ICISS indicates a *more serious* injury. An increasing length of stay is expected to be associated with a more serious injury as depicted in the following figure.

Figure 1: Description of ICISS, risk of death and length of stay

ICISS	Risk of death	Description	Length of stay
0	100% chance of death ie. no people with an injury with this score have survived	Inevitably fatal injury	Unknown (may not be admitted to hospital)
0.5	50% chance of death with injuries with this score	Very serious injury	Unknown (expect longer length of stay)
0.941 (IPRU-defined threshold)	5.9% chance of death with injuries with this score	Serious injury	Unknown
0.96	4% chance of death with injuries with this score	Moderate injury	Unknown
0.99	1% chance of death with injuries with this score	Minor injury	Unknown (expect shorter length of stay)
1	0% chance of death ie. no people with injuries with this score have died	Always non-fatal injury	Unknown (may not be admitted to hospital)

The advantages of ICISS over other severity scoring systems have been described (Osler et al 1996; Stephenson et al 2002), however the ICISS is less easily understood than a measure such as length of stay. ICISS is a measure of threat to life and does not necessarily reflect threat of disability, with injuries such

as eye injuries and hand injuries receiving a high ICISS score but resulting in significant disability (Langley & Cryer 2000). An ICISS threshold of less than or equal to 0.941 has been proposed by the IPRU (Cryer et al 2004) (indicating a probability of death of 5.9%), to demonstrate serious injury; this threshold has been suggested for application across all priority areas.

Chapter 2: Methods

This report aimed to produce information which would inform the decision-making processes of agencies in regard to committing to the adoption of the ICISS method for reporting the severity of injury outcomes. Specifically, this report investigates the use of length of stay as a methodologically easier approach than ICISS for injury monitoring.

Primary objective:

- Can length of stay be used as a reliable indicator of severity in the monitoring of injury outcomes, as an alternative to ICISS?

Research questions

1. Does longer length of stay identify injuries with an increased risk of death? And, does a shorter length of stay identify injuries with a lesser risk of death?
2. What type of injuries are represented by differing thresholds of ICISS? Are the same injuries identified by differing thresholds of length of stay?

Background: reframing the objective

In October 2007 Public Health Intelligence, the epidemiology group of the Ministry of Health, was contracted by the Accident Compensation Corporation (ACC), in partnership with the Ministry of Transport and Statistics New Zealand to explore:

- *whether there was an alternative approach to validly and reliably report injury outcomes that would be methodologically easier for agencies to do than using the injury severity score (ICISS) method proposed by the IPRU (Cryer et al 2004), and*
- *how different thresholds for the ICISS relate to the reporting of injury outcomes by hospitalisations by 1+ days as a measure of severity, for different types of injury events.*

The originally specified objectives were to:

1. *Map the ICISS indicator against 1 to 5+ day hospitalisations for 'all injuries' and for each of the six injury priority areas.*
2. *Benchmark different threshold levels for the ICISS against 1 to 5+ day stays.*
3. *Describe the broad characteristics of the types of injuries represented in the ICISS thresholds for each of the six priority areas.*
4. *Explore whether the broad injury characteristics for each priority area can be disaggregated by lifecycle age groups to reflect the typical injury experience for those age groups.*

Initial analyses to meet these objectives gathered data on the annual number of admissions over the period 2002-2006, age standardised admission rates and injury diagnosis types for the injury priority areas. In carrying out these analyses, it became apparent that alternative statistical tests (namely concordance and correlation coefficients) would aid in the investigation of length of stay as an

alternative to ICISS. Concordance and correlation analyses can be carried out on data at the *individual* admission level, rather than comparisons using the *number* of admissions per year or within specific severity or age groups, and potentially provided more useful information to aid decision-making than analyses proposed to meet the original objectives.

The overall objective and research questions were therefore reframed as above. Firstly, in order to answer the revised overall objective, statistical analyses were performed to investigate whether or not length of stay indicates risk of death as ICISS does, that is, if injury admissions with a longer length of stay have an increased risk of death and if admissions with a shorter length of stay have a lesser risk of death. This is investigated in Chapter 3 using tests of concordance and correlation.

Secondly, information on injury diagnosis types is presented in Chapter 4 and further information in the appendices. These additional findings in the appendices help to describe the populations affected, the differing injury experiences and possible influences on length of stay.

Workplace injury

In the 12 months up to 30 June 2007, the Accident Compensation Corporation (ACC) received claims for 225,898 work related injuries, equating to roughly one in ten people being injured at work (Accident Compensation Corporation 2008). Workplace injury is therefore an important priority area identified in the Injury Prevention Strategy (Hon Ruth Dyson Minister for ACC 2005).

Hospitalisation data is used for this report as length of hospital stay and the ICISS (calculated from hospitalisation diagnosis codes and outcomes) are the primary areas of interest. The physical location where the injury occurred is not able to be reliably determined from hospitalisation data, making the identification of workplace injuries difficult. Workplace injuries are better identified using ACC data, however this does not include information regarding length of stay or data for the calculation of ICISS. Linking ACC and hospitalisation data was beyond the scope of this report, therefore workplace injuries were unable to be included in these analyses. The findings of this report may be generalisable to workplace injuries in some instances, for example workplace falls or MVTCS.

Data sources

The injury hospitalisation data was sourced from the National Minimum Dataset (NMDS) maintained by the New Zealand Health Information Service (NZHIS).

Coding of injury hospitalisation data

The NMDS is a national collection of public and private hospital discharge information, including clinical information, for inpatients and day patients. This data includes information about the patient (including a unique identifier, age,

ethnic group) and the admission (such as type, date, source, destination on discharge and duration). The principal and additional diagnoses, and external cause in the case of injury, are recorded and coded according to ICD protocols. Following these protocols, there may be more than one diagnosis for an admission. The principal diagnosis is the disease or condition thought to be chiefly responsible for the hospitalization, additional diagnoses may be complications arising during the hospital stay or co-existing conditions affecting the admission. External causes are classified with 'e-codes', from Chapter XX of the ICD-10-AM and describe the circumstances of the injury such as place of occurrence, activity and in some cases, the intent. Where appropriate, there may be more than one e-code for an admission. In Figure 2, example 1 demonstrates how injuries resulting from a fall may be coded, and example two describes an intentional overdose of two drug types associated with a depressive episode.

Figure 2: Examples of ICD-10AM hospitalisation diagnosis and e-codes

Example 1	
Principal diagnosis	
S72.03	Fracture of subcapital section of left femur
Additional diagnoses	
S51.0	Laceration of left elbow
S00.05	Contusion of scalp
M81.9	Postmenopausal osteoporosis
External cause code	
W01.03	Tripped over hose while gardening at home
Example 2	
Principal diagnosis	
F32.20	Severe depressive episode without psychotic symptoms
Additional diagnoses	
T43.0	Poisoning by psychotropic drugs - Tricyclic and tetracyclic antidepressants
T39.1	Poisoning by nonopioid analgesics, antipyretics and antirheumatics - 4-Aminophenol derivatives
External cause codes	
X60.0	Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics
X61.0	Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs, not elsewhere classified

In this report, admissions are included if they have an external cause code (e-code) recorded which falls in the range specified by PHI, and in the priority areas using the e-codes described in figure 3 below. The all injury category includes all the priority areas, and other areas such as burns and accidental poisoning. Injuries resulting from medical care, including those associated with surgery, medical devices and drugs are also included in the all injury category.

Figure 3: ICD-10-AM codes for priority areas

Falls	W00-W19
MVTC	V01-V09, V10-V19, V20-V29, V30-V39, V40-V49, V50-V59, V60-V69, V70-V79, V80-V89
DSH	X60-X84
Assault	X85-Y09
Drowning	W65-W74

Inclusion criteria

The dataset of publicly funded admissions (received from NZHIS) has been filtered by PHI to exclude deaths in hospital, re-admissions and transfers between hospitals that occur for the same injury.

Those who are admitted to hospital as a result of their injury are included in the results, however, there has previously been inconsistency across District Health Boards (DHBs) in the definition of an admission. The current definition for admission to hospital is those who receive three or more hours of treatment (excluding waiting time) (New Zealand Health Information Service 2003). This report therefore includes many hospitalisations with zero days stay (that is, less than 24hours). During the time period covered by this report (2002-2006) inconsistency in definition is likely to have affected the numbers of injury admissions included, as some DHBs may have included hospital events (such as short emergency department visits) that other DHBs have excluded.

Period of data

Hospitalisation data from the years 2002 to 2006 were included in this report. Admissions were assigned to years based on their date of discharge.

Measures of severity

ICD-based Injury Severity Score (ICISS)

The Injury Prevention Research Unit (IPRU) of the University of Otago have proposed using ICISS as an indicator of severity to allow injury to be monitored in a reliable and valid manner (Cryer et al 2004; Cryer et al 2002). The method (as described in Figure 4 below) involves estimating the probability of survival from ICD-10 injury diagnoses by examining a large set of cases for which the survival status is known. The Survival Risk Ratio (SRR) is the ratio of the number of patients with a given ICD injury diagnosis code who have not died, to the total number of patients with that diagnosis. Thus a SRR of 0.92 indicates that of 100 people with the same injury (as defined by an ICD injury diagnosis), 92 people survived. In the case of multiple injuries for the same person during one admission, the ICISS is the product of the SRRs. For example, if a person is admitted with a shaft of femur fracture and a scalp wound following a motor vehicle traffic crash, the SRRs for shaft of femur fracture and scalp wound are multiplied to give the ICISS for the admission. The ICISS is a summary of the

‘risk of survival’ for the injury event; one minus the ICISS gives the probability of death.

Figure 4: Summary of ICISS calculation

1. Dataset of all injury hospitalisations (fatal and non-fatal) compiled
Outcomes: fatal or non-fatal and ICD diagnoses
2. Survival Risk Ratio (SRR) calculated for each ICD diagnosis

SRR for injury diagnosis A = $\frac{\text{number of people with injury diagnosis A who survived}}{\text{total number of people with injury diagnosis A}}$

3. ICISS for each non-fatal admission calculated by multiplying diagnosis SRRs for admissions with multiple injuries

ICISS = SRR(injury diagnosis A) x SRR(injury diagnosis B) x SRR(injury diagnosis C)

The *New Zealand Injury Prevention Strategy* serious injury outcome indicators 1994-2004 chartbook regarded non-fatal hospitalised injuries as serious if they have an ICISS score of less than or equal to 0.941 (Cryer et al 2006; Cryer et al 2004). This threshold selects patients who had a risk of death from their injuries of 5.9% or more. The threshold is subsequently referred to as the ‘IPRU-defined serious ICISS’ threshold.

For analyses in this report, PHI has calculated SRRs and the resulting ICISS from the same hospitalisation data as is used for all results, that is injury hospitalisation data from the period 2002-2006. SRRs were calculated using both fatal and non-fatal admissions, where fatal admissions were identified by the ‘discharged deceased’ code for discharge destination. SRRs therefore do not include deaths that have occurred outside of hospital in their calculation. For the purposes of this report, ICISS is calculated only for the (chronologically) first injury event for an admission. Where multiple injury events have been recorded for a single admission, only the first event has an ICISS, other injury events are not included in the analysis.

Length of stay

Length of stay in hospital is measured by the number of days that a patient spends in hospital. Where an admission lasts for less than 24 hours, the length of stay is recorded as zero days stay, many emergency department visits for injury are included in this category. Some admissions of zero days are ‘day cases’, where patients are admitted for surgery or minor procedures and discharged the same day.

Analyses and potential limitations

Proposing minor, moderate and serious injury categories

A process was carried out to propose serious, moderate and minor categories as defined by length of stay. For the serious category, a range of differing lengths of stay were compared with the threshold of ICISS that has been proposed by the IPRU to indicate serious injury: less than or equal to 0.941 (Cryer et al 2004). Where a particular length of stay (for example greater than three days hospital stay) was found to have a similar number of discharges per year (and age-standardised discharge rate) as the number of IPRU-defined ICISS serious injuries over the time period it may have been appropriate to use this length of stay as a proxy measure for serious injury, as demonstrated in Figure 5.

Figure 5: Proposing minor, moderate and serious categories

ICISS	Risk of death	Description	Length of stay
IPRU defined ≤0.941	More than 5.9% risk of death	Serious injury	PHI defined eg. more than 5 days stay
PHI defined Between 0.941 and 0.99	Risk of death between 5.9% and 1%	Moderate injury	PHI defined eg. 1-5 days stay
PHI defined ≥0.99	Less than 1% risk of death	Minor injury	PHI defined eg. 0 days stay (less than 24 hours)

A number of different length of stay categories were compared to find the length of stay which most closely approximated the number of admissions with ICISS less than or equal to 0.941. Length of stay categories ranging from zero days stay to greater than twenty days were compared as the originally suggested range from 1 day to greater than five days was not found to be suitable for some priority areas. For example, for all injury admissions between and 2002 and 2006, 29,838 admissions had an ICISS of less than or equal to 0.941 (see Table A1 p.43). The length of stay threshold that identified the most similar number of admissions was greater than 20 days duration, with 23,559 admissions having this length of stay (see Table A1 p.43).

As the appropriate length of stay may be different for each priority area, each priority area was analysed individually. The *absolute* length of stay, for example length of stay equals three days, as well as *greater than* three days stay were analysed when producing this report. Lengths of stay greater than specified levels were found to be the most appropriate, and are presented here.

Similar processes were followed for moderate and minor injury. After comparing several thresholds, PHI has proposed thresholds for ICISS for all priority areas: for moderate injury an ICISS of between 0.941 and 0.99 indicating injuries with a risk of death between 1% and 5.9%, and greater than 0.99 for minor injury indicating injuries which have a risk of death of less than 1%. These thresholds have for simplicity at this stage, been applied to all priority areas. Keeping these ICISS categories constant for each injury area means that a differing proportion of injury admissions are categorised as serious (and moderate or minor) for each injury area (see figures in Chapter 4 for proportion of admissions in each ICISS category).

In the same manner as for serious injury, length of stay thresholds have been proposed for minor and moderate injury, by finding the length of stay which identifies the most similar number of admissions during the time period as the corresponding ICISS threshold. The following table shows the resulting length of stay categories. The data on numbers of admissions in each of these categories is presented in Appendix 1.

Table 1: PHI proposed ICISS and length of stay categories for minor, moderate and serious injuries, for each injury priority area.

	Minor ICISS >0.99	Moderate 0.941<ICISS≤0.941	Serious ICISS ≤0.941
All injury	0-2 days	3-20 days	>20 days
Falls	0-1 days	2-15 days	>15 days
MVTC	0 days	1-5 days	>5 days
DSH	0-1 days	2-14 days	>14 days
Assault	0 days	1-2 days	>2 days
Drowning	0 days	1-2 days	>2 days

Limitations of proposed categories

Categories were able to be proposed which identified similar numbers of comparable severity admissions in some areas, shown by the closeness of admission numbers in each of the figures. For assault and drowning admissions, while the number of admissions with PHI defined length of stay was the most similar to the stated ICISS thresholds, there was still a large difference between the numbers. 6941 assault admissions had an ICISS >0.99 and 10368 assault admissions were for less than 24 hours. 10541 admissions had an ICISS between 0.941 and 0.99, and 6894 admissions lasted between 1 and 2 days. For drowning, 37 admissions had an ICISS >0.99 and 124 admissions lasted were for less than 24 hours. No other length of stay categories had a more similar number of admissions. Despite these thresholds being less precise in some cases, they have been used for subsequent analyses as they are the best possible length of stay categories.

It is important to note that while a similar number of admissions may be seen for admissions with, for example, an ICISS less than or equal to 0.941 and admissions with a particular length of stay, this does not mean that the same admissions are identified by each category. In fact, very different injury admissions may be identified by each category, despite numbers being similar. These analyses cannot determine the differences nor similarities between

admission ICISS and length of stay at the individual level. Therefore, these findings have limited use in providing evidence either for or against the use of length of stay as a severity indicator.

Research question 1: Concordance and Correlation

Concordance and discordance

Using the PHI defined minor, moderate and serious severity categories, individual admissions can be categorised as having a length of stay which is concordant or discordant with the corresponding ICISS category. For example, where a MVTC admission has both an IPRU-defined serious ICISS (that is less than or equal to 0.941) and PHI defined serious length of stay (that is greater than five days) the admission is categorised as concordant. Where an admission with a serious ICISS does not have a serious length of stay (either zero days or between one and five days) the admission is categorised as discordant.

The percentage of admissions with a particular length of stay that have an ICISS concordant with the admissions length of stay can then be determined. Where the percentage is closer to 100%, the length of stay category better identifies admissions with the corresponding ICISS. A lower percentage indicates that the length of stay category does not identify many admissions with the corresponding ICISS.

The percentages can be affected by the number of admissions in each category, and consequently higher concordance may be due to chance. The Kappa statistic provides a measure of the agreement between the ICISS and length of stay categories correcting for chance effects. A weighted Kappa, assigns less weight to agreement as categories move further apart. It has a maximum of 1 when agreement between the two scorers is perfect; whereas a value of zero indicates no agreement better than chance. The Kappa value can be interpreted as follows (Altman 1991).

Table X Kappa statistic values and levels of agreement

Kappa value	Strength of agreement
< 0.20	Poor
0.21 - 0.40	Fair
0.41 - 0.60	Moderate
0.61 - 0.80	Good
0.81 - 1.00	Very good

Statistical correlation

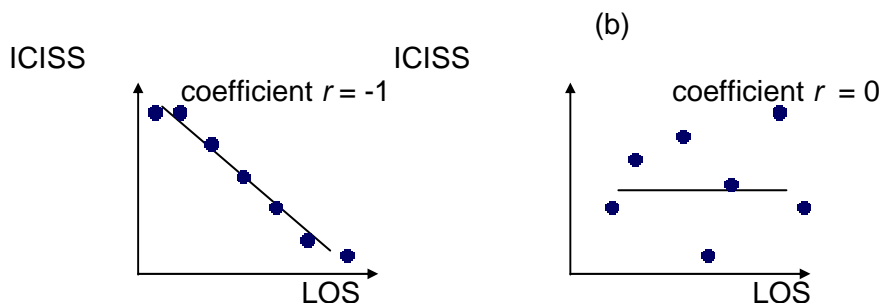
The strength of a relationship between length of stay and ICISS was examined using a Spearman's rank correlation coefficient which was estimated using SAS version 9.1 software.

To establish whether there is a statistical association between ICISS and length of stay for individual injury admissions, the ICISS and length of stay for each hospital admission were ranked and a correlation coefficient calculated. In contrast to the previous category analyses the individual rankings for ICISS were analysed.

If there is a close correlation of increasing length of stay with declining ICISS (that is, increasing risk of death), the correlation coefficient will be close to -1 . If r is close to -1 , and the ICISS and length of stay for each admission were plotted on a scatter plot, the points would be closely clustered around a line with a slope of negative one, as shown figure 6(a) in the diagram below. This would indicate that as length of stay increases, ICISS consistently decreases.

If there is no correlation between ICISS and length of stay (LOS), the correlation coefficient will be zero. On a scatter plot, points would be widely distributed, with a line of best fit having a slope of zero (figure 6(b)), indicating that there is no relationship of increasing length of stay and decreasing ICISS.

Figure 6: Examples of negative correlation (a) and no correlation (b)



Limitations of concordance and correlation analyses

The analyses of concordance and discordance are based on the PHI defined categories for minor, moderate and serious injury. For some priority areas, these categories are less than ideal: the trends seen rather than the absolute percentages are more important. Despite aggregating several years of data, small numbers are seen for drowning, and some severity categories (such as greater than 14 days stay and ICISS less than or equal to 0.941 for deliberate self harm). Concordance percentages are therefore limited by smaller numbers in these categories.

Research question 2: Injury diagnosis comparisons

A key hypothesis for the original query was that different injury diagnosis types are characterised by the different injury priority areas. For example are drowning events characterised mainly by brain injuries compared to motor vehicle traffic events that are characterised by a range of trauma injuries, and were these differences seen in the ICISS indicator? Furthermore, does the characterisation change as the severity threshold changes.

To investigate this query, the twenty most common diagnoses (as described by four digit ICD-10 diagnosis codes) in each injury priority area, for admissions between 2002 and 2006 were listed using the proposed ICISS and then length of stay thresholds. An example of the injury diagnoses in each priority area is given by Table 2 overleaf which lists the ten most common injury diagnoses for each priority area (these are not subdivided by severity).

Age groups

This report uses life cycle stage age groups. That is, early childhood (0-4 years), childhood (5-14 years), youth (15-24 years), young adults (25-44 years), middle aged adults (45-64 years), older adults (65-74 years) and the very old (75 years or more – sometimes sub-divided into 75-84 years and 85 years or more). It is noted that these groups include varying numbers of years; they are not of equal sizes.

For these analyses, the diagnoses in the IPRU-defined ICISS serious category (for each priority area) were broadly evaluated as to whether they correspond to what would usually be considered as common and clinically serious for that priority area. Similarly, the diagnoses in the PHI-defined moderate and minor ICISS categories were evaluated as to whether they respectively identify injury diagnoses which are generally regarded as moderate and minor.

Secondly, comparisons of the diagnoses in the ICISS and length of stay categories were made by counting the number of shared diagnoses within comparable severity categories. These comparisons considered whether or not the injury diagnoses identified by the IPRU-defined serious ICISS category were similar or different to those identified by the PHI-defined serious length of stay category, and if the diagnoses identified by the (PHI-defined) moderate and minor ICISS categories were similar or different to those identified by the (PHI-defined) moderate and minor length of stay categories. The diagnoses were described as ‘having different’ diagnoses, having ‘some similar’ diagnoses, or having ‘many similar’ diagnoses according to the following criteria.

Table 3 Describing similarities between ICISS and length of stay diagnoses

Number of ICD-10 diagnoses shared by corresponding ICISS and length of stay categories	Description
7 or less out of 20 diagnoses are shared	Have different diagnoses
8 to 14 out of 20 diagnoses are shared	Have some similar diagnoses
15 or more diagnoses out of 20 are shared	Have many similar diagnoses

If similar injury diagnoses were identified for serious injury as defined by corresponding ICISS and length of stay thresholds (for example for MVTC: ICISS less than or equal to 0.941 and greater than 5 days stay), this could support using a length of stay indicator for serious injury. This is because the PHI-defined serious length of stay threshold accurately describes injury diagnoses that are known to have an important threat to life. Conversely, if longer length of stay identifies different injury diagnoses to those identified by serious ICISS, it can be argued that length of stay does not identify diagnoses with a serious risk of death. Similarly for minor and moderate injuries; if the length of stay categories identify different injury diagnoses to those with moderate and lower threats to life, this could provide evidence against using length of stay categories for monitoring.

Table 2: Ten most common injury diagnoses for each of the injury priority areas 2002-2006 (by fourth digit ICD-10 code)

All injury	Falls	MVTC	DSH	Assault	Drowning
Infection following a procedure	Fracture of hip (subcapital)	Loss of consciousness for less than 30 min	Paracetamol poisoning	Open wound of scalp	Drowning and non-fatal submersion
Bleeding or bruising following a procedure	Fracture of lower wrist (both bones)	Head injury (unspecified)	Benzodiazepine poisoning	Head injury (unspecified)	Hypothermia
Head injury (unspecified)	Fracture of hip (intertrochanteric)	Bruising of chest	Antidepressant poisoning (unspecified)	Loss of consciousness for less than 30 min	Loss of consciousness for less than 30 min
Fracture of lower wrist	Fracture of lower wrist with angulation	Concussion	Other sedative poisoning	Fracture of nose	Seizures (unspecified)
Loss of consciousness for less than 30 min	Fracture of upper elbow	Open wound of head	Tricyclic antidepressant poisoning	Fracture of angle of jaw	Concussion
Fracture of hip (subcapital)	Head injury (unspecified)	Open wound of scalp	Unspecified antipsychotics poisoning	Superficial injury of head	Head injury (unspecified)
Skin infection of leg	Fracture of forearm	Fracture of lower wrist (both bones)	Non-steroidal anti-inflammatory drugs poisoning	Fracture of jaw bones	Observation following an accident
Fracture of hip (intertrochanteric)	Fracture of ankle	Sprain and strain of neck	Other opioids poisoning	Open wound of head	Heart attack
Admission for rehabilitation	Fracture of wrist (unspecified)	Fracture of shaft of femur	Toxic effects of carbon monoxide	Loss of consciousness for unknown duration	Pneumonitis (lung inflammation following inhalation of liquid)
Fracture of lower wrist with angulation	Admission for rehabilitation	Loss of consciousness for unknown duration	Open wound of wrist and hand	Fracture of eye socket	Adult respiratory distress syndrome

Table 4: Comparing serious MVTC diagnoses – ICISS \leq 0.941 and length of stay greater than five days

ICISS \leq 0.941		
1	S021	Fracture of base of skull
2	S723	Fracture of shaft of femur
3	S065	Traumatic subdural haemorrhage
4	S0601	Loss of consciousness of unspecified duration
5	S020	Fracture of vault of skull
6	S325	Fracture of pubis
7	S270	Traumatic pneumothorax
8	Z509	Care involving use of rehabilitation procedure, unspecified
9	S066	Traumatic subarachnoid haemorrhage
10	S2244	Multiple rib fractures involving four or more ribs
11	S0602	Loss of consciousness of less than 30 minutes duration
12	S010	Open wound of scalp
13	S272	Traumatic haemopneumothorax
14	S324	Fracture of acetabulum
15	S0623	Multiple intracerebral and cerebellar haematomas
16	S0631	Focal cerebral contusion
17	S121	Fracture of second cervical vertebra
18	S024	Fracture of malar and maxillary bones
19	S0188	(S018) Open wound of other part of head
20	S2731	Contusion and haematoma of lung

Length of stay > 5 days		
1	S723	Fracture of shaft of femur
2	S8218	Other fracture of upper end of tibia
3	S8221	Fracture of shaft of tibia with fracture of fibula (any part)
4	Z509	Care involving use of rehabilitation procedure, unspecified
5	S325	Fracture of pubis
6	S8231	Fracture of lower end of tibia with fracture of fibula (any part)
7	S324	Fracture of acetabulum
8	S8281	Other fracture of upper end of tibia
9	S3201	Fracture of lumbar vertebra, L1 level
10	S7203	Fracture of subcapital section of femur
11	S222	Fracture of sternum
12	S8228	Other fracture of shaft of tibia
13	S825	Fracture of medial malleolus
14	S8188	(S818) Open wound of other parts of lower leg
15	S065	Traumatic subdural haemorrhage
16	S270	Traumatic pneumothorax
17	S021	Fracture of base of skull
18	S7211	Fracture of intertrochanteric region of femur
19	S2244	Multiple rib fractures involving four or more ribs
20	S272	Traumatic haemopneumothorax

The lists of the twenty most common diagnoses used in comparisons are included in appendix two. Table 4 shows an example of the comparisons performed; diagnoses are compared for MVTC admissions that meet the IPRU serious ICISS definition (left column) and serious as defined by PHI's serious length of stay category of greater than five days stay (right column). The shaded diagnoses are shared by both categories; 9 of 20 are common to both categories indicating some similar diagnoses.

The twenty most common diagnoses was chosen for this analysis (compared to a higher or lower number of diagnoses) as a balance of a number large enough to incorporate a reasonable percentage of injury diagnoses in each category (ranging from 40-81% for the five priority areas), and a number small enough to allow relative ease of comparison.

Injury diagnoses by life cycle age groups

Age groups obviously have differing experiences of injury. For example, older adults are more likely to suffer hip fractures as a result of a fall, where younger adults may perform activities more likely to result in ankle fractures or chest injuries associated with MVTCs. A query related to the previous section was to explore whether the broad injury characteristics for each priority area could be disaggregated by lifecycle age groups, to reflect the typical injury experience for those age groups. For example, do the injury characteristics described by the IPRU-defined serious ICISS injury category, reflect differences between the severity experience by children, people aged over 75 years, and other lifecycle age groups? Additionally, are these same injury characteristics for age groups reflected in the hospitalisation length.

To investigate these questions, the same analyses were performed for the life cycle age groups. The broad characteristics of injuries were observed for life cycle age groups in each of the priority areas, and ICISS and length of stay severity categories (minor, moderate and serious) within each age group were compared, again to demonstrate whether or not the two severity indicators identified similar diagnoses. Given the large amount of data and comparisons made, a summary of the important findings and relevant examples are described in Chapter 4.

Limitations of injury diagnosis analyses

The injury diagnosis analyses are subject to some limitations. Firstly, it is important to recognise that the injury diagnoses used in these analyses include second and subsequent diagnoses, and that only one ICISS is reported for each admission (that is the ICISS for the primary e-coded event). Therefore, secondary diagnoses – which may be related to more minor injuries – may be included in the serious category because they occur alongside primary diagnoses which have a higher threat to life. This occurs because while not appearing serious (for example, an open wound of the scalp) they occur in combination with more serious injury (such as a fracture of the base of the skull). Where these less serious injury diagnoses also occur alone, the same injury diagnoses may also be seen in the moderate or minor categories. Also, diagnoses not obviously injury-related are included in the analyses such as psychiatric disorders and medical conditions. These conditions may be identified during an injury admission, or injury may complicate hospitalisations which are primarily for these conditions. A list of the ICD-10 principal diagnoses captured between 1999-2001 using the severity threshold of ICISS ≤ 0.941 developed by the IPRU (Cryer et al 2004) is provided in the appendix of that publication. Compared with the IPRU publication, this report includes a

broader range of injury diagnoses in the serious category as diagnoses other than the principal are included.

Another limitation to the study is that only a broad assessment of whether the injury diagnoses were common and clinically important (or otherwise) for each age group was undertaken. As this approach did not apply a strict clinical methodology, if the categories (moderate and minor) are considered for monitoring purposes, then the diagnoses identified by each threshold should be reviewed by experienced injury clinicians.

The inclusion of secondary and non-injury diagnoses may overestimate the differences seen between ICISS and length of stay categories compared to similar analyses where these diagnoses were not included. However, excluding these diagnoses was thought to overly restrict the analyses, because a large number of injury related admissions would have been excluded by only using the primary diagnosis.

Also, the range of diagnoses seen in that priority area affects the number of similarities in injury diagnoses observed. Where there are truly only a small number of diagnoses (for example, a limited range of diagnoses associated with drowning) a high percentage of all admissions are included in the twenty most common, and both ICISS and length of stay categories will have a greater chance of detecting all twenty diagnoses, and similarities in these analyses will be high. By contrast, if there are 100 different injury diagnoses for MVTC admissions, only a small proportion will be included in the twenty most common and the chance of the two variables detecting similar injuries diagnoses will be lower.

In these analyses fourth digit ICD diagnosis codes have been used, increasing the specificity and range of injury diagnoses compared. Compared to using lower order diagnosis codes, fourth digit codes may underestimate similarities seen between the two variables. This level of specificity was felt necessary in order to distinguish serious from less serious injuries in order to meet the overall objectives of the report.

Despite aggregating data from 2002 to 2006, the small number of admissions in some priority areas (particularly drowning) prevented comparisons of injury types. Similarly, when subdividing by life cycle age group closer analysis was not possible because the number of admissions in each age group was not large enough to allow valid comparisons.

Appendices: Describing characteristics of all injury and injury priority areas

Annual admissions and age-standardised rates

The number of discharges per year, for 2002-2006 combined and the age-standardised discharge rates for all injury admissions and for each of the priority areas have been included in the appendices. These counts and rates can be subdivided by ICISS and length of stay, for example, ICISS less than or equal to 0.941 or length of stay of greater than three days. A trend over time for each priority area by ICISS and length of stay category has also been described in some areas.

Age standardisation

Age-standardised hospitalisation rates are reported for the years 2002-2006 for the priority areas. Direct standardisation is performed using the World Health Organisation standard population as the reference. Standardisation allows the comparison of injury admission rates for populations with differing age distributions.

Population denominator

Hospitalisation rates for the years 2002 to 2006, for all injury and the priority areas are calculated in this report. The population denominator used to calculate these rates is the 2006 Census population, adjusted for undercount using 1991-2011 projection data.

Ethnicity classification

Data is described for two ethnic groups: Māori and non-Māori. A prioritised concept has been used, meaning that any person who has reported their ethnicity as Māori is included in the Māori group, and all other people are included in the non-Māori group. People who report Māori ethnicity and one or more other ethnic groups (such as European or Pacific ethnic groups) are included in the Māori group, but not in the non-Māori group.

Difference in methods compared to those reported in other PHI and IPRU publications

Different data sources and methods have been used in other PHI reports on injury hospitalisations; annual number of admissions and age standardised admission rates are therefore not directly comparable between reports.

As described, this study includes admissions between 2002 and 2006 which had an e-code within the range specified by PHI. Admissions were allocated to particular priority areas on the basis of e-codes as per Figure 3. Only the first e-coded event for an admission was included. Re-admissions and transfers were excluded by only keeping the (chronologically) first admission where more than one admission has the same injury event and date. Deaths occurring in hospital are also excluded. These admissions have been used to calculate ICISS in this report. They have also been used in all analyses: concordance and correlation, injury diagnosis comparisons, annual counts of admissions, age-standardised rates.

Importantly, PHI has included admissions with any primary diagnoses (that may or may not be injury related) and admissions of zero days stay. These are significant methodological differences in the PHI method of both calculating ICISS and reporting of admission numbers and rates compared to the method used by the IPRU in the production of the NZIPS chartbooks (Cryer et al 2006; Cryer et al 2007a). The IPRU method includes cases with a first e-code in the ICD-10 range V01-Y36 (similar to PHI's specification) and where the principal diagnosis is within the range of S00-T78 (Cryer et al 2006). Previously, the IPRU has also recommended excluding admissions of zero days stay (Langley et al 2002), although this exclusion has not occurred in the current chartbooks.

These differences will result in a different number of admissions reported by PHI and IPRU in each priority area, and differences in the age standardised admission rates. As

the survival risk ratios used to calculate the ICISS are determined from injury admissions, the number of events included within the respective PHI and IPRU ICISS scores will differ considerably.

The PHI method deliberately takes a broader approach to the definition of an injury admission than the IPRU method, which IPRU describes as 'conservative' (Cryer et al 2006, p.9). For example, the PHI approach includes injuries which may occur during an admission which was not primarily due to injury, such as a fall during an admission for heart failure, complications of medical procedures, and other admissions where the primary diagnosis is not an injury (see example 2 in Figure 2). It is recognised that some of these injuries may not have resulted in admission had they occurred without the other (non-injury) diagnoses. However as adverse events in hospital including injuries are common and have important implications (Davis et al 2002) and that less life threatening injuries are later excluded from the serious category, inclusion of these admissions was considered valid by PHI.

Methods different to those described here have been used in previous PHI publications and may be used in future publications and data releases, in part due to the differing objectives of various reports. Work is currently being carried out to consider a standard methodological approach between PHI and the IPRU in the calculation of injury severity scores and rates.

Chapter 3: Length of stay and ICISS – is there a relationship?

Research question 2: Does longer length of stay identify injuries with an increased risk of death? And, does a shorter length of stay identify injuries with a lesser risk of death?

Key findings

Length of stay is not a reliable indicator of risk of death from injury, for admissions between 2002 and 2006.

This is demonstrated through tests of concordance and correlation between length of stay and ICISS.

- There is not great concordance between admissions with longer length of stay and those with IPRU defined serious injury ($ICISS \leq 0.941$) for the priority areas.
- Overall analysis shows poor concordance between the ICISS and length of stay for all injury and each of the priority areas except falls, where concordance is slightly greater.
- For all injury and the five priority areas, tests of statistical correlation show that there is not evidence for a close association of increasing length of stay and decreasing ICISS.

These findings provide evidence against the use of length of stay as a valid and reliable indicator of severity in injury monitoring in New Zealand.

As discussed, an ICISS threshold has been proposed by the IPRU as a valid method of defining serious injury (Cryer et al 2004). A threshold based on length of stay may be an easier method of distinguishing serious from less serious injury. It is currently unknown whether increasing length of stay (for hospital admissions with non-fatal injury) is associated with injuries which have a higher risk of death.

Figure 7: ICISS and length of stay

ICISS	Risk of death	Description	Length of stay
Decreasing score	Increasing chance of death	More severe injury	<i>Increasing length of stay</i>
Increasing score	Decreasing chance of death	More minor injury	<i>Decreasing length of stay</i>

If there is an association between ICISS and length of stay, it can be assumed that increasing length of stay is also associated with an increased risk of death. If this

association is present, length of stay may be an appropriate severity indicator, as an alternative to ICISS.

In order to assess this, two analyses may be useful. Firstly, by assessing concordance and discordance between proposed categories of severity for length of stay and ICISS and secondly, using a statistical test of correlation between length of stay and ICISS. Both these tests are described in more detail in the methods section, and assess whether there is a consistent association between length of stay and ICISS, and hence an association between length of stay and risk of death.

Results

Table 5 shows that for all injury admissions, there is not good concordance between IPRU-defined serious ICISS injury and PHI-defined serious length of stay, as only 16% of admissions of greater than 20 days have an ICISS of greater than or equal to 0.941. 85% (35% and 50%) of admissions lasting more than 20 days have a risk of death of less than 5.9%. Similarly, only 16% of deliberate self harm admissions lasting more than 14 days, and 16% of falls admissions lasting more than 15 days had a risk of death of greater than 5.9%, that is, an ICISS concordant with the length of stay.

Greater proportions of MVTC admissions lasting more than five days (47%), assault admissions lasting more than two days (31%), and drowning admissions lasting more than two days (30%) had an ICISS of greater than or equal to 0.941. For these priority areas, there is greater, but not large, concordance between the IPRU-defined serious ICISS category and the PHI-defined serious length of stay categories.

When comparing the concordance of (PHI-defined) minor ICISS and (PHI-defined) minor length of stay admissions, concordance is greater in all categories except for drowning. For all injury admissions, 62% of admissions of zero to two days duration have an ICISS of greater than 0.99, that is a risk of death of less than 1%. Deliberate self harm and falls admissions have higher concordance for minor injuries with 70% of DSH admissions of zero days duration and 63% of falls admissions of zero or one day duration having an ICISS greater than 0.99. Of MVTC admissions lasting less than 24 hours, 42% have an ICISS greater than 0.99. For assault and drowning admissions, 33% and 13% respectively of admissions lasting less than 24 hours have a risk of death of less than 1%; there is lower concordance in these areas.

For moderate injuries (according to PHI-defined length of stay and ICISS thresholds), concordance is intermediate, ranging from 46% to 54% for all priority areas except for drowning, where concordance is 84%. For drowning, a very large proportion of admissions have a same ICD diagnosis (T75.1 - drowning and non-fatal submersion, (see Table A23 p.59) and drowning admissions are commonly for one day (see Figure A12 p.72). These factors contribute to the high level of concordance seen for moderate injury in this priority area.

Table 5: Number and percentage of concordant admissions by length of stay and ICISS, and Kappa statistic for all injury and priority areas, 2002-2006

Length of stay			
Minor	Moderate	Serious	Total

All Injury

	0-2 days		3-20 days		>20 days		
ICISS >0.99	210085	62%	100812	47%	8184	35%	319081
0.941 <ICISS ≤0.99	119043	35%	98798	46%	11666	50%	229507
ICISS ≤0.941	10842	3%	15287	7%	3709	16%	29838
Total	339970	100%	214897	100%	23559	100%	578426

Kappa statistic for all injury : 0.150

Falls

	0-1 days		2-15 days		>15 days		
ICISS >0.99	43468	63%	23282	38%	1580	20%	68330
0.941 <ICISS ≤0.99	23662	34%	33576	54%	5175	64%	62413
ICISS ≤0.941	2056	3%	4958	8%	1316	16%	8330
Total	69186	100%	61816	100%	8071	100%	139073

Kappa statistic for falls : 0.243

MVTC

	0 days		1-5 days		>5 days		
ICISS >0.99	7532	42%	10614	38%	1105	13%	19251
0.941 <ICISS ≤0.99	9220	51%	13665	49%	3446	40%	26331
ICISS ≤0.941	1307	7%	3594	13%	4051	47%	8952
Total	18059	100%	27873	100%	8602	100%	54534

Kappa statistic for MVTC : 0.193

Deliberate self-harm

	0-1 days		2-14 days		>14 days		
ICISS >0.99	12248	71%	3475	62%	380	46%	16103
0.941 <ICISS ≤0.99	4741	27%	1790	32%	306	37%	6837
ICISS ≤0.941	383	2%	358	6%	133	16%	874
Total	17372	100%	5623	100%	819	100%	

Kappa statistic for deliberate self-harm : 0.104

Assault

	0 days		1-2 days		>2 days		
ICISS >0.99	3407	33%	2683	39%	851	29%	6941
0.941 <ICISS ≤0.99	5943	57%	3429	50%	1169	40%	10541
ICISS ≤0.941	1018	10%	782	11%	917	31%	2717
Total	10368	100%	6894	100%	2937	100%	20199

Kappa statistic for assault : 0.049

Drowning

	0 days		1-2 days		>2 days		
ICISS >0.99	16	13%	15	5%	6	11%	37
0.941 <ICISS ≤0.99	91	73%	231	84%	31	58%	353
ICISS ≤0.941	17	14%	30	11%	16	30%	63
Total	124	100%	276	100%	53	100%	453

Kappa statistic for drowning : 0.120

The Kappa statistic provides an overall assessment of agreement between the length of stay and ICISS categories. Concordance is poor for all injury, MVTC, deliberate self-harm, assault and drowning. Concordance is fair for falls.

Tests of an association between length of stay and ICISS using correlation show similar findings. For all injury admissions there is not evidence of a strong negative association between ICISS and length of stay because the coefficient is -0.112 , which is not close to -1 . This indicates that there is not a close association between increasing length of stay and declining ICISS for all injury admissions.

Table 6: Correlation coefficients for injury admissions, 2002-2006, by priority area

Injury Area	Spearman's rank correlation coefficient
All injury	-0.112
Falls	-0.350
MVTC	-0.310
DSH	-0.099
Assault	-0.040
Drowning	-0.106

There is also no close association between ICISS and length of stay for the individual priority areas, as the correlation coefficients for the priority areas are all far from negative one, although falls and MVTC are somewhat closer.

Summary

These analyses have been performed to answer the questions: does longer length of stay identify injuries with an increased risk of death, and does a shorter length of stay identify injuries with a lesser risk of death?

The analyses suggest that longer length of stay does not identify IPRU-defined serious injuries as there is poor concordance for all injury and most of the priority areas, and only fair concordance for falls. Overall tests of statistical correlation show that there is not a close relationship between increasing length of stay and decreasing ICISS (that is greater risk of death), for any of the priority areas.

In conclusion these analyses indicate that it is not appropriate to use length of stay as a severity indicator in the monitoring of injury in New Zealand. As length of stay is not a reliable indicator of risk of death from injury, it cannot be recommended as a valid alternative to ICISS.

Chapter 4: Comparisons of injury diagnoses

Research question 2: What type of injuries are represented by differing thresholds of ICISS? Are the same injuries identified by differing thresholds of length of stay?

Key findings

- The IPRU ICISS definition of serious injury (less than or equal to 0.941) appears to identify injuries which are generally regarded as severe and clinically important for all ages combined, and for the life cycle age groups.
- The PHI defined categories for moderate and minor injury (ICISS 0.941-0.99 and ICISS >0.99 respectively) also appear to identify injuries which are less severe than the IPRU serious injury category, and present commonly as moderate and minor injury. It appears that the (IPRU and PHI-defined) ICISS categories for serious, moderate and minor injury correctly reflect the range of injury experiences for each life cycle age group, where there are differences in injury diagnoses present for age groups.
- Length of stay does not consistently identify the same injury diagnoses as ICISS. When categorised into minor, moderate and serious length of stay categories, length of stay describes a different range of injury diagnoses to ICISS across priority areas, severity categories and age groups. Longer length of stay, in some instances, appears to identify admissions with common, serious non-injury diagnoses which are complicated by injury, rather than serious injury in terms of higher risk of death. For falls, the serious length of stay category appears to identify admissions with diagnoses requiring prolonged periods of immobility rather than higher risk of death.

Results

All injury diagnoses

A wide variety of injuries are described in this category, and it includes many of the diagnoses common in the other priority areas such as hip and wrist fractures. Using the IPRU definition of serious injury common injuries with an important threat to life including serious head injuries, hip and leg fractures are identified. Similarly, PHI-defined minor ICISS injuries (with a lower risk of death) include wrist fractures and hand injuries (refer to Tables A13 and A14 in Appendix 2 for the lists of twenty most common injury diagnoses).

Admissions with a duration longer than 20 days (PHI-defined serious length of stay) have different diagnoses to the admissions identified as serious by an ICISS of less than or equal to 0.941, only three of the top twenty diagnoses are the same. Long

injury admissions commonly have non-injury diagnoses such as heart attack, schizophrenia and congestive heart failure.

Table 7: Comparison of all injury diagnoses

ICISS			Length of stay
≤0.941	Serious admissions	have different diagnoses to (3/20)	admissions greater than 20 days
between 0.941 and 0.990	Moderate admissions	have different diagnoses to (7/20)	admissions of 3-20 days
≥0.990	Minor admissions	have many similar diagnoses to (16/20)	0-2 days

Moderate ICISS injuries have different diagnoses to those with a length of stay between 3 and 20 days, 7 out of 20 diagnoses are shared including infection and bleeding following a procedure, hip fractures and admissions for rehabilitation.

Minor ICISS injuries and admissions with a length of stay of 0 to 2 days share most common diagnoses (16 of 20), including wrist fractures, minor head injuries and hand injuries. Analyses of all injury admissions by life cycle age groups found similar findings: a useful spectrum of diagnoses were identified by the ICISS categories and different diagnoses were identified by length of stay categories at most age groups.

Falls diagnoses

The most common injuries following a fall which require hospital admission involve fractures, hence different types of hip and wrist fractures feature highly on the list of common fall diagnoses. Hip fractures often occur in the elderly population and require a period of rehabilitation, therefore rehabilitation is also in the most common twenty injury diagnoses (refer to Tables A15 and A16 in Appendix 2 for the list of twenty most common injury diagnoses).

Falls resulting in injuries with a serious risk of death include a range of hip fractures and serious head injuries. These are included in the list of the IPRU-defined serious ICISS injuries. Some diagnoses which seem less serious (such as open wounds of the scalp and nose) are featured among the common serious injuries. This may be because they can occur alongside more serious injuries as secondary diagnoses and are therefore included in this list of serious injuries.

The PHI-defined moderate ICISS category identifies some injuries which are expected to have a lower risk of death, such as contusions of the back and hip, but other diagnoses are included in both the serious and moderate ICISS lists. This indicates that other diagnoses for these admissions may distinguish the admissions in terms of risk of death.

The diagnoses included in the PHI-defined moderate (2-15 days) and serious (greater than 15 days) length of stay categories also show considerable overlap. This may suggest that factors other than the injury diagnosis influence the length of stay for falls injuries, These factors may include the age of the person, and factors such as co-

morbid illnesses and available follow-up care services. Common minor-ICISS injuries include many wrist and ankle fractures.

Table 8: Comparison of falls diagnoses

ICISS			Length of stay
≤0.941	Serious admissions	have different diagnoses to (7/20)	admissions greater than 15 days
between 0.941 and 0.990	Moderate admissions	have some similar diagnoses to (9/20)	admissions of 2-15 days
≥0.990	Minor admissions	have some similar diagnoses to (10/20)	admissions of 0-1 days

Falls show a similar pattern to all injury admissions with different diagnoses identified by the serious categories, and greater similarity in the moderate and minor categories with 9 of 20 and 10 of 20 diagnoses are shared by the moderate and minor categories respectively.

Age groups show both similarities and differences in injury experience for falls. For example, serious head injuries are seen in the serious categories for all age groups, and neck of femur fractures are identified for specifically for older adults. A spectrum of injuries is seen within age groups, as an example, in the 45-64 year old age group, the serious category identifies important head injuries, fractures of the neck of femur and chest injuries; the moderate category includes less serious head injuries; and the minor category ankle and wrist fractures and minor head injuries.

Different diagnoses are seen for the ICISS and length of stay categories particularly for the 65-74 year old and 75 years and over groups. Injuries requiring longer length of stay include those which require prolonged periods of treatment, immobility and/or rehabilitation (such as tibia and ankle fractures) rather diagnoses which have a high threat to life.

Motor vehicle traffic crash (MVTC) diagnoses

A range of injuries can require admission following MVTC, these include injuries to the head and neck, chest and limbs. The range and varying severity of these injuries is likely related to factors such as pedestrian or occupant status, type of vehicle and use of restraints (refer to Tables A17 and A18 in Appendix 2 for the lists of twenty most common injury diagnoses).

Head injuries feature highly in the list of common, (IPRU-defined) serious ICISS MVTC injuries. These include skull fractures, chest injuries and a variety of brain injuries, all of which carry a significant threat to life. In the moderate ICISS category are a range of less life threatening injuries such as chest and clavicle injuries, and less serious head injuries. Minor ICISS injuries include lower leg and wrist fractures. These categories appear to appropriately define the serious, moderate and more minor injuries which commonly occur following MVTC.

The PHI-defined serious length of stay category (greater than 5 days) identifies a range of leg and hip fractures, but less of the life threatening head injuries identified by the ICISS category. This may reflect factors such as the length of time required for people with common (but less life threatening) leg injuries to become mobile enough to be able to be discharged from hospital, rather than injuries which are serious because of an important risk of death. Nine of 20 diagnoses are shared by the serious length of stay and ICISS categories.

Table 9: Comparison of MVTC diagnoses

ICISS			Length of stay
≤0.941	Serious admissions	have some similar diagnoses to (9/20)	admissions greater than 5 days
between 0.941 and 0.990	Moderate admissions	have some diagnoses similar to (13/20)	admissions of 1-5 days
≥0.990	Minor admissions	have some similar diagnoses to (12/20)	admissions of 0 days

MVTC injuries which require an admission of 1 to 5 days duration include some of those which were identified as being of moderate severity by the ICISS thresholds (13 of 20 are shared). A similar number of diagnoses (12 of 20) are shared in the minor category indicating that some injury diagnoses which have a low risk of death are discharged in less than five days. These injuries include minor head injuries, where people may be able to be discharged after a computerised tomography (CT) scan and brief period of observation, or a fracture where people are able to be discharged without surgery or can continue their usual activities without a prolonged period of hospital rehabilitation, such as wrist fractures.

Other injuries have a low risk of death (under 1%), but were not included in those commonly discharged in under 24 hours. Many fractures of the tibia (shin bone) are included in this category, as they may require surgery or immobilisation requiring a stay in hospital.

There is considerable overlap in the type of injury diagnoses that stay for 1-5 days and those that stay for less than 24 hours. A variety of factors are likely to influence length of stay for these less serious injuries, such as the availability of services which may allow shorter admissions. There is less overlap in diagnoses identified by the ICISS defined minor, moderate and serious injury categories.

The age group analyses for MVTC admissions show similar findings. Differences in the injury experiences for age groups include the serious category where life threatening head and chest injuries are seen commonly in adults, but chest injuries are less common in children and head injuries predominate.

Deliberate self-harm (DSH) diagnoses

Deliberate self harm (DSH) admissions commonly include intentional overdose with paracetamol, benzodiazepines and other sedative drugs, and tricyclic and other antidepressants. These can vary in their risk of death, due to factors including the

amount of a drug which is taken, the combination of drugs and underlying illnesses. Other injury events include wrist wounds, carbon monoxide poisoning and asphyxiation. As these analyses include only non-fatal admissions, completed suicides are not included. Suicides will undoubtedly have a different range of injury events to admissions with deliberate self harm (refer to Tables A19 and A20 in Appendix 2 for the lists of twenty most common injury diagnoses).

People admitted with DSH injuries may related have mental health diagnoses which are recorded for the admission and therefore feature in the lists of common diagnoses. A self harm event may be the precipitating event for an admission for an underlying mental health disorder such as depression, schizophrenia, bipolar affective disorder or borderline personality disorder.

The number of the IPRU-defined serious ICISS injury admissions is relatively small, and the most common serious diagnosis is asphyxiation. These deliberate self harm events are likely to be those with serious suicidal intent. A smaller number of paracetamol and benzodiazepine overdoses, and burns of the arm, are included in the serious risk of death category.

A much larger number of admissions are of lower risk of death (moderate ICISS and minor ICISS). Many of the diagnoses at these levels of severity are shared perhaps indicating that the amount of drug taken, rather than the type of drug taken influences severity, information which is not available from the diagnosis codes. The most common minor and moderate injury diagnoses are paracetamol, benzodiazepine and other overdoses. Carbon monoxide poisoning events are common in the moderate category but not in the minor.

Table 10: Comparison of deliberate self harm diagnoses

ICISS			Length of stay
≤0.941	Serious admissions	have different diagnoses to (7/20)	admissions greater than 14 days
between 0.941 and 0.990	Moderate admissions	have some similar diagnoses to (14/20)	admissions of 2-14 days
≥0.990	Minor admissions	have some similar diagnoses to (14/20)	admissions of 0-1 days

The diagnoses identified by the PHI-defined serious length of stay category (greater than 14 days stay) were mostly mental health diagnoses such as severe depression and paranoid schizophrenia. This indicates that for the small number of longer admissions, a formal diagnosis of a mental health disorder was more common than in the serious ICISS category. The serious ICISS category and the serious length of stay category identified different diagnoses. As seen for the minor and moderate ICISS categories, there was again considerable overlap in the diagnoses for the minor and moderate length of stay categories. Some similar diagnoses were detected in the minor and moderate categories.

Deliberate self harm admissions show little variation in the injury diagnoses that occur across the age groups; there appears to be only a limited range of injury diagnoses

occurring for DSH. For example, for DSH, while open wounds of the wrist and forearm more commonly occurring younger adults (15-24 and 25-44 year olds), overdoses of medications (of varying types) occur with little variation across all the age groups. The same overdoses occur at both minor and moderate ICISS severity levels for many age groups.

Assault diagnoses

The injury diagnoses which commonly require admission following assault include facial fractures, head injuries and hand fractures. Those injuries with a high risk of death (IPRU-defined serious) include the more serious head injuries such as skull fractures, subdural and intracerebral haemorrhages. Injuries of moderate ICISS severity are more common, and include the more superficial head and facial injuries, and jaw fractures. Minor ICISS injuries include hand injuries and superficial head and facial injuries. There is overlap between the categories with some diagnoses being included in both the serious and moderate categories, and other included in both the moderate and minor categories. This overlap may be explained by the combination of various injuries increasing the severity (the lower ICISS being the product of multiple SRRs); minor injuries may be those which occur in isolation (refer to Tables A21 and A22 in Appendix 2 for the lists of twenty most common injury diagnoses)

Compared with other injury priority areas, there is little difference in the duration of stay between the severity categories with the serious length of stay category including all admissions of greater than two days and the minor category being admissions of less than 24 hours. Therefore, it could be expected that the categories are less distinct in terms of injury diagnoses; a range of injuries is seen across all length of stay categories. However, as few admissions with assault are for longer than 2 days, (see figure X) a category with a greater length of stay would not have been useful.

Table 11: Comparison of assault diagnoses

ICISS			Length of stay
≤0.941	Serious admissions	have some similar diagnoses to (12/20)	admissions greater than 2 days
between 0.941 and 0.990	Moderate admissions	have some similar diagnoses to (13/20)	admissions of 1-2 days
≥0.990	Minor admissions	have some similar diagnoses to (10/20)	admissions of 0 days

In comparing the diagnoses identified as serious by the ICISS and length of stay categories, 12 of 20 injury diagnoses are shared, similar numbers are shared by the moderate and minor categories. These length of stay categories identify some but not all of the diagnoses with corresponding risks of death.

Age group analyses for assault admissions occur mostly in the 15-24 and 25-44 year old age groups, with little difference in the types of injuries seen for these two age groups. Age group comparisons also show the overlap between the ICISS categories.

Drowning diagnoses

Drowning events may or may not be admitted to hospital, with many fatal events occurring in the community and not involving hospital services, and many non-fatal events not requiring hospital treatment.

The number of admissions with drowning was small. The majority of admissions had the diagnosis coded as 'drowning and non-fatal submersion' (T75.1) (see Table A23 in appendix). Only a small number of other diagnoses were recorded, and included hypothermia, seizures and head injury. The drowning diagnosis was seen in all of the ICISS and length of stay categories. Drowning injuries can therefore be of varying risk to life and of varying duration, but have the same diagnosis recorded. In each severity category for length of stay and ICISS, the number of admissions and range of injury diagnoses is very small. Further analyses (including those by life cycle age groups) were therefore not appropriate for this priority area.

Summary of findings

The IPRU definition of serious injury (ICISS less than or equal to 0.941) appears to identify injury diagnoses which are generally regarded as severe and clinically important.

The most common injury diagnosis types identified by the IPRU definition of serious injury include fractures of the neck of femur, traumatic subdural haemorrhage and fractures of the base and vault of the skull for falls; fractures of the base and vault of skull, shaft of femur fractures, traumatic subdural and subarachnoid haemorrhages and pelvic fractures for MVTTC admissions; asphyxiation, paracetamol poisoning, burns of the upper arm and benzodiazepine poisoning for deliberate self harm; and fractures of base and vault of skull, traumatic subdural haemorrhage and fractures of jaw bones for assault.

The PHI defined categories for moderate and minor injury (ICISS 0.941-0.99 and ICISS >0.99 respectively) appear to identify injury diagnoses which are less severe than the IPRU serious injury category, and present commonly as moderate and minor injury.

These findings provide some evidence in support of the use of the IPRU defined category for serious ICISS injury, and the PHI defined categories for moderate and minor ICISS injury as the categories as a whole, describe a spectrum of severity for injury diagnoses. However, the diagnoses identified in each of these ICISS severity categories do overlap in some priority areas.

In comparing the types of injury diagnoses identified by the IPRU-defined serious ICISS category and the PHI-defined serious length of stay category, some priority areas show similarities in injury diagnoses, others show differences. For all injury, falls and DSH admissions there are differences in the types of injury diagnoses detected by the ICISS and length of stay categories. DSH and assault admissions with an ICISS of less than or equal to 0.941 have some similar diagnoses to admissions with a length of stay of greater than 14 and 2 days respectively. Longer length of stay, in some instances, appears to identify admissions with common, serious non-injury diagnoses which are complicated by injury, rather than admissions for injury which is serious in terms of

higher risk of death. For falls and MVTC, the serious length of stay category appears to identify admissions with diagnoses requiring prolonged periods of immobility, inpatient treatment or rehabilitation rather than higher risk of death. These may be some of the factors which influence length of stay independently of the injury severity.

Longer length of stay does not appear to consistently identify diagnoses with higher threat to life, therefore not supporting the use of length of stay in preference to ICISS for serious injury.

When comparing the diagnosis types identified by the moderate ICISS and moderate length of stay categories (both PHI defined) there are some similarities and some differences in diagnoses in all five priority areas. When comparing the types of injury diagnoses identified by the minor ICISS and minor length of stay categories (both PHI defined) there are some similarities in all priority areas. While differences exist, shorter length of stay, using thresholds such as those proposed by PHI for minor and moderate injury appears to better identify admissions with a lower risk of death than longer length of stay does for serious injury. With the exception of some specific examples, such as transfers to tertiary hospitals for specialist acute care, it appears logical that the majority of injury admissions with a short length of stay will be for less life threatening injuries (where the same may not be said for longer length of stay and more life threatening injuries). This is consistent with the concordance results in part one. However, overall, shorter length cannot be said to consistently identify diagnoses with a lower risk of death.

When analyses were performed for the life cycle age groups there were similar findings. The (IPRU and PHI-defined) ICISS categories for serious, moderate and minor injury appear to correctly reflect the range of injury experiences for each life cycle age group. Length of stay categories identified a different range of injury diagnoses for age groups compared to the range identified by ICISS categories. The variety of injury diagnoses identified by the length of stay categories may again reflect other influences such as immobility and rehabilitation requirements.

These findings reinforce the finding that longer length of stay cannot reliably be used to identify injuries which have an important risk of death for each of the injury priority areas.

Overall, there is not consistent evidence supporting the use of length of stay as an alternative to ICISS for serious injury as defined by the IPRU for any of the priority areas. Similarly, the findings also do not support the use of length of stay categories for moderate or minor injury as defined by PHI. These findings are consistent with those in Chapter 3 of this report.

Chapter 5: Summary and Conclusions

This report aimed to produce information which would inform the decision-making processes of agencies in regard to committing to the adoption of the ICISS method for reporting the severity of injury outcomes. Specifically, this report investigates the use of length of stay as a methodologically easier approach than ICISS for injury monitoring.

Underlying these findings is an understanding that injury monitoring should measure (if not necessarily exclusively) ‘important’ injury. Implicit in this understanding is that the impact of interventions that aim to reduce important injuries will be measured by the chosen indicators, and the impact of changes in factors unrelated to important injury will be minimal. What constitutes ‘important’ injury is somewhat debated (Cryer et al 1999; Langley 2004); in this report we have used a measure of threat to life. It is recognised that some injuries have an important threat of disablement without a significant threat to life but in the absence of an appropriate measure of disablement, we have chosen to use threat to life. Other measures may include financial costs to the health system or society when considering ‘important’ injuries; however this is not the focus of this report.

Key findings

For all injury admissions and in each of the five priority areas, there were not high levels of concordance, and no evidence of a meaningful correlation between length of stay and ICISS. This suggests that there is not a close association between ICISS and length of stay: more serious injuries do not appear to consistently have a longer length of stay, and more minor injuries do not appear to have a consistently shorter length of stay.

Figure 8: Association between ICISS and length of stay

ICISS	Risk of death	Description		Length of stay
Decreasing score	Increasing chance of death	More severe injury	does not show a close association with	longer length of stay
Increasing score	Decreasing chance of death	More minor injury	does not show a close association with	shorter length of stay

ICISS of less than or equal to 0.941 identifies injury diagnoses with an important risk of death for each priority area, and for each age group. A higher ICISS also recognises less serious injuries which are common in each group.

Comparisons of the common diagnoses recorded for injury admissions showed that longer length of stay did not consistently identify the same diagnoses as identified by

lower ICISS (that is, higher severity). After the priority areas were disaggregated by age, longer length of stay continued to identify different diagnoses to lower ICISS.

It was possible to define length of stay thresholds that identified a similar number of admissions per year as a serious injury category, and for moderate and minor categories (included in Appendix). However, individual level analyses confirm that there is no close relationship between length of stay and ICISS.

Limitations

These findings are subject to a number of limitations. Where specific to the particular analyses, these have been discussed in the methods section. The limitations discussed here therefore apply to the general methods, and therefore all analyses.

Firstly, transfers and readmissions have been excluded from these analyses. Using only the first admission for an injury may reduce the true length of stay required for the injury which may have occurred over more than one admission. However, the longest length of stay categories for the priority areas range from more than two days for assault and drowning to greater than 15 days for falls. Most injury events, where transfers and re-admissions occur, would be included in these longest length of stay categories based on their first admission. For the correlation calculations length of stay was not limited to particular categories, excluding readmissions and transfers may therefore have affected these analyses. It is difficult to predict how this exclusion may have affected the absolute results of the correlation analyses as the severity scores and lengths of stay of the excluded admissions were not determined. However as a small proportion of all admissions were transfers or readmissions, even in the unlikely situation of all transfers and readmissions having a serious ICISS it is unlikely to have affected the overall conclusion of the study, that is of no close association between length of stay and ICISS.

This report includes those admissions where the injury diagnosis may not be the primary diagnosis. This methodological approach will include a wider range of admissions than approaches which include only admissions where only the primary diagnosis is that included in a specified range of injury ICD codes (see examples in methods section, p.8). It is possible that if these non-primary injuries occurred alone (that is, without the primary diagnoses) they would not have resulted in admission to hospital. The PHI approach is different to the method used by other agencies and this, along with other differences in methods, mean the results in terms of admission counts and admission rates are not directly comparable between reports.

Small numbers of admissions for the priority area of drowning limit analyses. Despite using data from 2002 to 2006, there were only 453 admissions with injury due to drowning. These small numbers make comparisons problematic: when comparing annual numbers or rates there was large variability, and only a small number of injury diagnoses for each severity category to use for comparisons. The findings for drowning are therefore significantly limited.

It is again important to note that analyses other than the correlation coefficient and concordance have been performed on population level data: proportions of admissions with particular ICISS or lengths of stay, comparisons of common injury diagnoses, and

the annual number of admissions and age-standardised rates in appendix 1. While any similarities seen in this population level information may provide some supporting evidence for similarities between length of stay and ICISS, findings from these analyses cannot confirm that individual admissions with more severe injuries also have a longer length of stay (or the converse) as individual level information is not being assessed. Similarities in this data may be a chance finding, limiting the conclusions able to be drawn from these analyses.

Interpretation

Using a severity threshold to define cases of injury that are worthwhile monitoring has several advantages including focussing monitoring on serious rather than minor injury, monitoring is less likely to be affected by factors not related to incidence such as health service provision and access factors and case ascertainment is more likely to be complete (Cryer et al 2004). Observed trends may therefore be more likely to reflect true changes in the incidence of injury. The choice of the measure of severity has been the subject of several studies (Lavoie et al 2005; Stephenson et al 2004; Stephenson et al 2002); in this report using length of stay as the severity measure has been investigated through annual numbers of discharges, age standardised rates, common injury diagnoses and statistical correlation.

In summary, the results of this report do not support the use of length of stay as an indicator of severity (in terms of threat to life) for the monitoring of injury outcomes in New Zealand, as there is little evidence that length of stay is closely associated with risk of death. Length of stay may be a valid measure for other purposes, including as part of the financial cost of injury; it has been included in comparisons of efficiency and cost-effectiveness of care in some settings and a proposed quality improvement measure (Brasel et al 2007), it may also be useful as a measure of disability. Length of stay is a routinely collected, easily available and importantly, an easily interpreted measure. However, it does not appear to be suitable as a measure of threat to life from an injury.

Why length of stay is not a good measure of threat to life

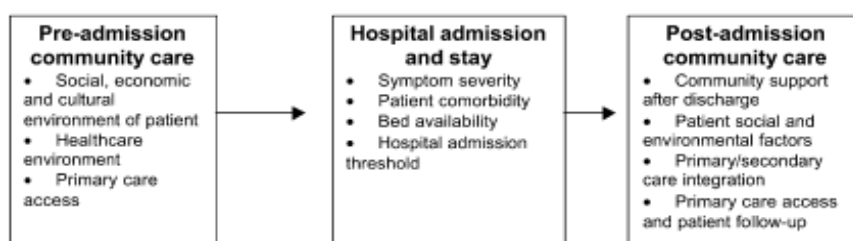
The most likely reason is that length of hospital stay is affected by many factors. These factors include severity of injury and threat to life, but also multiple other influences unrelated to severity.

There is some published research focussing on factors influencing the length of stay in New Zealand, but little specific to injury. In a Christchurch study of admissions with hip fractures in people aged over 65 years, authors found that a change to shared care between geriatricians and orthopaedic surgeons resulted in low in-hospital mortality and the majority returning to their previous residence, but a longer duration of stay (Thwaites et al 2005). Two important points are noted by Cryer, firstly that total injury admissions (of all levels of severity and length of stay) will be affected by age, social and service provision factors, with minor injury admissions being affected the most, and secondly that the average length of stay for all admissions has reduced over time, primarily due to changes in clinical practice (Cryer et al 2002). A study of trauma admissions to ICU in Auckland showed that elderly patients had similar severity scores and length of stay on ICU to other trauma patients, but higher mortality (Safih et al 1999), another study of all trauma patients found longer length of stay in those with co-morbidities (Mittal et al 2001).

Studies of length of stay for general medical, heart failure, pneumonia and psychiatric admissions (Abas et al 2006; Laing et al 2004; Rae et al 2007; Thwaites et al 2005; Wright et al 2003) describe a variety of influences on length of hospital stay in New Zealand. Lower socio-economic position, as measured by small area deprivation, bed availability, clinician practices, and factors outside of the control of health services are noted.

A conceptual model of factors influencing length of stay has been proposed by Wright et al (2003) and is shown in the figure below. Pre-admission, clinical, hospital and post-admission factors are recognised. In this study of heart failure admissions in Auckland (Wright et al 2003) multivariate analyses identified that social complications and living alone were independently associated with longer hospital stay, alongside factors related to severity.

Figure 9: Conceptual model of factors influencing length of hospital stay



Source: Wright et al 2003

Internationally, length of hospital stay is a widely researched topic, largely because of its use in resource allocation. Specific to injury hospitalisations, similar, numerous factors have been identified as influencing length of stay. Clinical factors include age, injury diagnosis, severity, location and mechanism (Brasel et al 2002; Ciesla et al 2008; Clark et al 2007; Clark & Ryan 2002), functional status and co-morbidities such as methamphetamine use and psychiatric diagnoses (Bergeron et al 2005; Clark & Ryan 2002; Tominaga et al 2004; Zatzick et al 2000). Non-clinical influences included discharge destination (Brasel et al 2007; Brasel et al 2002; Clark et al 2007), insurance type (Brasel et al 2007), and service provision factors such as case management and trauma specific services (Curtis et al 2002; Park et al 2001).

While the model in Figure 21 was not developed for injury, length of stay for injury admissions is likely influenced by similar factors. This model could be adapted for injury admissions, by including additional factors identified in this report and other published studies. Pre-admission factors for injury are similar to those in the model. Specifically, the healthcare environment may include injury prevention measures such as safe playgrounds and driving speed restrictions. Barriers to accessing primary care such as distance and cost may prevent presentation for some more minor injuries. Other injuries may be able to be managed by a general practice or emergency department visit if services or family members are available to support an injured person in their home. This support may be more difficult to access for some, resulting in admission to hospital.

A variety of patient related factors are important in injury. As identified in the analyses in part two, the length of stay for particular injury mechanisms is related to the age of the patient. In the elderly this is likely to be due to factors including frailty and reduced functional ability. Younger people may have more resilience to allow a shorter hospital stay and more recovery time after discharge. As identified in studies in New Zealand and internationally injury diagnosis, severity, location and mechanism will all influence duration of stay.

Hospital factors for injury include many service factors. Variations in admission criteria result in people with the same injury being admitted to some hospitals, but treated as outpatients or day cases in others. Clinicians may have varied practices for the same injury. Factors including acute operating theatre delays, lack of bed availability during winter, policies regarding weekend or residential care discharges and difficulty in accessing services such as radiology, physiotherapy, rehabilitation and consultations such as acute psychiatric assessment following deliberate self harm commonly affect length of stay (Brasel et al 2002; Posel & Moss 1998; Rae et al 2007; Simpson et al 2005) but are often independent of the severity of the injury. Discharge may also be dependant on the availability of residential care, support services and equipment, including those provided by ACC.

Figure 10: Additional factors likely to influence length of hospital stay for injury admissions

Pre admission	In hospital	Post admission
<ul style="list-style-type: none"> • Injury prevention environment • Access to primary care and support services 	<ul style="list-style-type: none"> • Injury specific factors: age, diagnosis, location and mechanism • Clinician practices and preferences • Theatre delays • Bed and staff availability including: <ul style="list-style-type: none"> - waiting times in emergency department - staffing levels including allied health • Consultation by other specialties/services • Availability of inpatient and out patient rehabilitation services • Discharge planning and policies 	<ul style="list-style-type: none"> • Availability of ACC support services and equipment • Availability of residential care beds • Availability of family and community support

Because of the multiple influences on duration of hospital stay, length of stay reflects more than threat to life, and is influenced by factors other than those which are ideally measured by injury indicators. The criteria generally accepted for valid injury indicators are that an indicator should (Cryer et al 1999):

1. have a case definition based on diagnosis—on anatomical or physiological damage;
2. focus on serious injury;
3. have, as far as possible, unbiased case ascertainment;
4. be derived from data that are representative of the target population;
5. be based on existing data systems (or it should be practical to develop new data systems);
6. be fully specified

Length of stay would not meet the at least three of these criteria: it is not based on a diagnosis with specified anatomical or physiological damage; length of stay does not focus on serious injury (as has been demonstrated in this report) and length of stay may be biased by case ascertainment, particularly for admissions with a shorter duration.

Recommendations

From the evidence presented in this report and the reviewed in the literature, length of stay is not recommended for routine use as an indicator of severity in the monitoring of injury in New Zealand. While potentially methodologically easier, and easier to understand, using length of stay in preference to ICISS would result in less reliable information informing policy decisions.

Because of the multiple influences on length of stay, as a stand-alone measure it is unlikely to be of use in the monitoring of injury. In combination with population and cost data, length of stay may be useful in the monitoring of costs to the hospital system caused by injury.

The ICISS is recommended for continued use in preference to length of stay because its calculation is based on risk of death, and (as seen in this report) it consistently identifies important injuries across age groups and priority areas. The 2004 IPRU report has highlighted the advantages of ICISS in terms of reliability and validity (Cryer et al 2004).

However, the ICISS measure has limitations and could be improved to allow better information in injury monitoring in New Zealand. Due to the relatively complex calculations involved in producing the ICISS scores, ICISS is not easily understood, and differences in methodology may result in different numbers (and age standardised rates) being produced by different agencies, despite similar descriptions of methods. To increase understanding of the score itself, simplified explanations and diagrams (such as those used in this report) may assist in increasing knowledge about the calculation and scale used for the ICISS (with higher ICISS indicating less severe injury). Differences in methods used for calculating the ICISS also need to be made clear, and a consistent approach considered by all agencies using the score. This would include standardising the methods for the use of primary and additional diagnoses and e-codes.

Beyond these issues, the ICISS score could be improved firstly by using an updated 'training set' for the calculation of scores. In the chartbooks currently published by the NZIPS (Cryer et al 2006; Cryer et al 2007b), survival risk ratios used for calculating the ICISS are derived from hospital discharges for the period 1999 to 2001: described as the 'training set'. In this report, discharges from 2002 to 2006 were used. Because of changes in treatment and services, some injuries which were considered serious (with a threat to life of greater than 5.9%) in 1999 may no longer be considered serious in 2002: the threshold for 'serious' injury will need to be reassessed. A commitment to using an up to date training set would improve the validity of ICISS, and is therefore strongly recommended for injury monitoring in the future.

A more accurate survival risk ratio could also be achieved by including data from deaths occurring outside of hospital, and has been suggested by the IPRU (Davie et al 2007). A method for ensuring the complete ascertainment of deaths, with consistent ICD coding, and in a timely manner will need to be considered.

The findings of this report highlight that using ICISS as an indicator of severity is most useful when the diagnosis (and combination) of injuries that occur distinguish serious from less serious injury. For example, where a MVTC causes skull fractures and brain injury, compared to superficial cut to the face; serious injury is easily able to be distinguished from minor. ICISS is less useful where severity is better indicated by factors other than injury diagnosis, for example a broken wrist may have a very different threat to life for an elderly unwell person compared to a healthy adolescent, or an admission coded only as paracetamol overdose may be very minor or have a considerable threat to life. Similarly, serious and less serious drowning events may all have the same injury diagnosis, and hence ICISS. As ICISS is simply an anatomical measure of severity, it gives an average score for all those affected by a specific injury, it does not distinguish between the range of people affected.

The survival risk ratios (and hence the ICISS) may therefore be improved using age and co-morbidity information, as is discussed in a recent IPRU report (Davie et al 2007). Using the current method, the survival risk ratio for a given injury, for example a broken wrist, is the average 'risk of survival' calculated from the diverse group of people who are admitted with a broken wrist. Including age and a measure of co-morbidity in the calculation of ICISS will better distinguish the affected groups and result in an improved measure of serious injury. Including these factors will however add another level of complexity in the calculation and understanding of the score.

A further factor highlighted by this report is that the threshold of 0.941 for ICISS distinguishes a different proportion and range of injuries for the different priority areas. It may be appropriate to have different thresholds of ICISS to indicate serious injury for the priority areas, rather than a single threshold for different areas. For example, only 4% of all DSH admissions meet the IPRU definition of serious. Changes for monitoring agencies to consider include increasing the ICISS threshold to include less serious injuries, incorporating a greater proportion and range of injury diagnoses in the serious category. The 0.941 threshold was proposed in the 2004 IPRU publication (Cryer et al 2004), where a list of included diagnoses was included. Using a less restrictive ICISS threshold was noted as a potential threat to validity, stating that injuries with a lower likelihood of hospitalisation may be included in the serious category. To date, this

assumption does not appear to have been tested by formally analysing different thresholds. Considering the use of either broader serious categories for some priority areas (or the use minor and moderate categories) is recommended, using the findings of this report as a starting point. However, any categories should be considered with an understanding of the possible threats to validity, including those related to changes in length of stay over time. If the serious, moderate and minor ICISS categories are to be considered for ongoing use in monitoring, a wider group, including clinicians experienced in the injury area, should review the types of injury diagnoses included (or excluded) in a variety of category thresholds to assess whether the injury diagnoses agree with those which are considered minor, moderate and serious and seen commonly in clinical practice.

Recommendations

1. Length of stay is not a reliable indicator to be used in the reporting of injury as it does not consistently identify admissions with a higher risk of death. It should therefore not be used in the monitoring of injury in New Zealand.
2. Routine monitoring should continue to use the ICD based Injury Severity Score (ICISS), with a threshold of less than or equal to 0.941.
3. Improvements to the ICISS should be considered. These include updating the training set used for the calculation of ICISS, incorporating factors such as deaths occurring outside of hospital, age and co-morbidity in the calculation, and modifying the 0.941 threshold for some priority areas.
4. Consider adopting different thresholds of ICISS for the serious category in each priority area rather than a single level of 0.941, and adopting 3 step injury severity taxonomy of serious, moderate and minor injury, as defined in this report by the IPRU (serious) and PHI (moderate and minor).

In summary, this report does not recommend that agencies use length of stay as an indicator of severity in the monitoring of injury. While length of stay may be more easily understood and methodologically more simple, using length of stay would result in less valid information. Formal adoption of the ICISS is recommended, with ongoing attention to its limitations and potential improvements, in particular different thresholds for the priority groups.

Appendices

Appendix One: Proposing minor, moderate and serious categories

Annual number of discharges and age-standardised rates for injury admissions 2002-2006: serious, moderate and minor categories

All injury

Table A1: Number of all injury admissions per year, by length of stay and ICISS thresholds, 2002-2006

	Year					Total 2002-2006
	2002	2003	2004	2005	2006	
All admissions	112656	113924	112786	117168	121892	578426
LOS 0-2 days	66548	66773	65865	68513	72271	339970
ICISS > 0.99	62044	62647	61927	64769	67694	319081
LOS 3-20 days	41488	42554	42280	43743	44832	214897
0.941 < ICISS ≤ 0.99	45028	45440	45195	46176	47668	229507
LOS >20 days	4620	4597	4641	4912	4789	23559
ICISS ≤ 0.941	5584	5837	5664	6223	6530	29838

Table A2: Age standardised rate for all injury admissions per year, by proposed length of stay and ICISS thresholds, 2002-2006

	Year				
	2002	2003	2004	2005	2006
LOS 0-2 days	1644.3	1636.6	1600.9	1660.4	1744.0
ICISS > 0.99	1455.7	1452.6	1423.8	1482.7	1540.1
LOS 3-20 days	823.1	833.1	820.3	843.8	856.5
0.941 < ICISS ≤ 0.99	974.7	975.0	960.3	976.8	1007.2
LOS >20 days	87.8	86.6	87.4	91.1	87.9
ICISS ≤ 0.941	124.8	128.6	124.4	135.8	141.2

Falls

Table A3: Number of falls admissions per year, by length of stay and ICISS thresholds, 2002-2006

	Year					Total
	2002	2003	2004	2005	2006	
All admissions	28084	27991	27199	27453	28346	139073
LOS 0-1 days	14046	13829	13287	13641	14383	69186
ICISS > 0.99	14198	13932	13217	13346	13637	68330
LOS 2-15 days	12409	12521	12383	12128	12375	61816
0.941 < ICISS ≤ 0.99	12295	12405	12367	12397	12949	62413
LOS >15 days	1629	1641	1529	1684	1588	8071
ICISS ≤ 0.941	1591	1654	1615	1710	1760	8330

Table A4: Age standardised rate for falls admissions per year, by proposed length of stay and ICISS thresholds, 2002-2006

	Year				
	2002	2003	2004	2005	2006
LOS 0-1 days	344.1	335.7	318.9	327.7	340.6
ICISS > 0.99	346.9	338.6	318.2	321.7	326.0
LOS 2-15 days	231.2	229.7	224.4	217.2	219.4
0.941 < ICISS ≤ 0.99	224.4	222.6	220.1	218.7	227.2
LOS >15 days	24.2	24.3	22.8	24.6	22.5
ICISS ≤ 0.941	28.2	28.5	27.8	29.1	29.4

MVTC

Table A5: Number of MVTC admissions per year, by length of stay and ICISS thresholds, 2002-2006

	Year					Total
	2002	2003	2004	2005	2006	
All admissions	10592	10722	10593	11142	11485	54534
LOS 0 days	3307	3361	3329	3901	4161	18059
ICISS > 0.99	3752	3678	3765	3942	4114	19251
LOS 1-5 days	5540	5653	5603	5481	5596	27873
0.941 < ICISS ≤ 0.99	5172	5243	5160	5310	5446	26331
LOS > 5 days	1745	1708	1661	1760	1728	8602
ICISS ≤ 0.941	1668	1801	1668	1890	1925	8952

Table A6: Age standardised rate for MVTC admissions per year, by proposed length of stay and ICISS thresholds, 2002-2006

	Year				
	2002	2003	2004	2005	2006
LOS 0 days	87.1	88.9	86.8	100.9	108.8
ICISS > 0.99	98.1	96.1	98.0	102.3	107.0
LOS 1-5 days	143.1	145.7	143.8	140.9	143.2
0.941 < ICISS ≤ 0.99	132.0	133.8	129.8	133.4	137.6
LOS > 5 days	41.7	40.5	38.9	41.4	40.0
ICISS ≤ 0.941	41.8	45.2	41.7	47.5	47.4

Deliberate self harm (DSH)

Table A7: Number of DSH admissions per year, by length of stay and ICISS thresholds, 2002-2006

	Year					Total
	2002	2003	2004	2005	2006	
All admissions	4756	5001	4755	4479	4823	23814
LOS 0-1 days	3329	3495	3427	3362	3759	17372
ICISS > 0.99	3269	3358	3187	3038	3251	16103
LOS 2-14 days	1237	1326	1138	976	946	5623
0.941 < ICISS ≤ 0.99	1299	1469	1376	1291	1402	6837
LOS > 14 days	190	180	190	141	118	819

ICISS \leq 0.941 188 174 192 150 170 874

Table A8: Age standardised rate for DSH admissions per year, by proposed length of stay and ICISS thresholds, 2002-2006

	Year				
	2002	2003	2004	2005	2006
LOS 0-1 days	86.6	91.0	88.6	87.3	97.7
ICISS > 0.99	84.3	87.1	82.3	78.4	83.8
LOS 2-14 days	30.9	33.2	28.8	24.2	22.9
0.941 < ICISS \leq 0.99	32.8	37.0	34.9	32.8	35.6
LOS > 14 days	4.7	4.4	4.7	3.4	2.8
ICISS \leq 0.941	5.0	4.4	4.9	3.8	4.2

Assault

Table A9: Number of assault admissions per year, by length of stay and ICISS thresholds, 2002-2006

	Year					Total
	2002	2003	2004	2005	2006	
All admissions	3915	3872	3909	4068	4435	20199
LOS 0 days	1951	2010	1952	2154	2301	10368
ICISS > 0.99	1380	1364	1354	1376	1467	6941
LOS 1-2 days	1355	1298	1376	1342	1523	6894
0.941 < ICISS \leq 0.99	2044	2020	2031	2114	2332	10541
LOS > 2 days	609	564	581	572	611	2937
ICISS \leq 0.941	491	488	524	578	636	2717

Table A10: Age standardised rate for assault admissions per year, by proposed length of stay and ICISS thresholds, 2002-2006

	Year				
	2002	2003	2004	2005	2006
LOS 0 days	53.4	55.0	53.4	58.9	63.3
ICISS > 0.99	37.9	37.5	37.2	37.9	40.4
LOS 1-2 days	36.5	35.1	37.2	36.3	41.2
0.941 < ICISS \leq 0.99	55.0	54.4	54.7	57.0	63.2
LOS > 2 days	16.2	14.8	15.2	15.2	16.1
ICISS \leq 0.941	13.2	13.0	13.9	15.5	17.0

Drowning

Table A11: Number of drowning admissions per year, by length of stay and ICISS thresholds, 2002-2006

	Year					Total
	2002	2003	2004	2005	2006	
All admissions	106	81	91	87	88	453
LOS 0 days	23	19	24	31	27	124
ICISS > 0.99	4	10	8	8	7	37
LOS 1-2 days	69	52	59	47	49	276
0.941 < ICISS \leq 0.99	92	53	71	70	67	353
LOS > 2 days	14	10	8	9	12	53

ICISS \leq 0.941 10 18 12 9 14 63

Table A12: Age standardised rate for drowning admissions per year, by proposed length of stay and ICISS thresholds, 2002-2006

	Year				
	2002	2003	2004	2005	2006
LOS 0 days	0.7	0.5	0.7	0.8	0.8
ICISS > 0.99	0.1	0.3	0.2	0.2	0.2
LOS 1-2 days	1.9	1.5	1.7	1.4	1.4
0.941 < ICISS \leq 0.99	2.6	1.5	2.0	2.0	1.9
LOS > 2 days	0.4	0.2	0.2	0.2	0.3
ICISS \leq 0.941	0.3	0.5	0.3	0.2	0.3

Appendix Two: Lists of twenty most common ICD 10 diagnoses by priority area, ICISS and length of stay severity categories

All injury

Table A13: All injury admissions: Twenty most common ICD 10 diagnoses for ICISS categories: Serious ≤ 0.941 (IPRU-defined), Moderate 0.941- 0.99 and Minor >0.99 (PHI-defined), 2002-2006

	Minor ICISS > 0.99			Moderate ICISS 0.941-0.99			Serious ICISS ≤ 0.941		
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	S526	6183	Fracture of lower end of both ulna and radius	T8141	11894	(T814) Infection following a procedure, not elsewhere classified	S021	1107	Fracture of base of skull
2	S5251	4474	Fracture of lower end of radius with dorsal angulation	T810	7074	Haemorrhage and haematoma complicating a procedure, not elsewhere classified	S065	1089	Traumatic subdural haemorrhage
3	S099	4402	Unspecified injury of head	S7203	5922	Fracture of subcapital section of femur	S7200	1043	Fracture of neck of femur, unspecified
4	S826	4296	Fracture of lateral malleolus	S7211	5051	Fracture of intertrochanteric section of femur	S020	625	Fracture of vault of skull
5	S610	4204	Open wound of finger(s) without damage to nail	S010	4603	Open wound of scalp	Z509	619	Care involving use of rehabilitation procedure, unspecified
6	T391	4023	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - 4-Aminophenol derivatives (paracetamol)	S0188	3640	(S018) Open wound of other parts of head	S7211	600	Fracture of intertrochanteric section of femur
7	S4241	3651	Supracondylar fracture of humerus	L0311	3258	Cellulitis of lower limb	S7203	534	Fracture of subcapital section of femur
8	S0602	3438	Loss of consciousness of less than 30min	S8188	2982	(S818) open wound of other parts of lower leg	S0601	463	Loss of consciousness of unspecified duration
9	T840	3358	Mechanical complication of internal joint prosthesis	S0602	2946	Loss of consciousness of less than 30min	S066	408	Traumatic subarachnoid haemorrhage
10	S524	3318	Fracture of shafts of both radius and ulna	Z509	2853	Care involving use of rehabilitation procedure, unspecified	S325	407	Fracture of pubis
11	S5250	3318	Fracture of lower end of radius, unspecified	S0085	2513	Superficial injury of other parts of head - contusion	S270	405	Traumatic pneumothorax
12	L0311	2943	Cellulitis of lower limb	S099	2418	Unspecified injury of head	S723	402	Fracture of shaft of femur
13	S6263	2937	Fracture of distal phalanx	S325	2072	Fracture of pubis	S010	376	Open wound of scalp
14	S681	2919	Traumatic amputation of other single finger (complete)(partial)	T818	2041	Other complications of procedures, not elsewhere classified	S024	332	Fracture of malar and maxillary bones
15	S611	2777	Open wound of finger(s) with damage to nail	T828	2039	Other complications of cardiac and vascular prosthetic devices, implants and grafts	T179	324	Foreign body in respiratory tract, part unspecified
16	S022	2631	Fracture of nasal bones	S723	1903	Fracture of shaft of femur	S2244	287	Multiple rib fractures, involving four or more

									ribs
17	S860	2601	Injury of Achilles tendon	S4222	1755	Fracture of surgical neck of humerus	S0631	268	Focal cerebral contusion
18	T424	2544	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - benzodiazepines	S810	1705	Open wound of knee	T71	264	Asphyxiation
19	S0600	2470	Concussion	S7300	1690	Dislocation of hip, unspecified	S272	263	Traumatic haemopneumothorax
20	R55	2441	Syncope and collapse	R55	1661	Syncope and collapse	S0602	258	Loss of consciousness of less than 30min

Table A14: All injury admissions: Twenty most common ICD 10 diagnoses for length of stay categories (PHI-defined): Serious >20 days, Moderate 3-20 days and Minor 0-2 days, 2002-2006

	Minor LOS 0-2 days			Moderate LOS 3-20 days			Serious LOS > 20 days		
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	S099	6666	Unspecified injury of head	T8141	6706	(T814) Infection following a procedure, not elsewhere classified	Z509	2242	Care involving use of rehabilitation procedure, unspecified
2	S0602	6282	Loss of consciousness of less than 30min	S7203	5776	Fracture of subcapital section of femur	T8141	383	(T814) Infection following a procedure, not elsewhere classified
3	S526	6237	Fracture of lower end of both ulna and radius	S7211	4920	Fracture of intertrochanteric section of femur	F200	324	Paranoid schizophrenia
4	T810	5197	Haemorrhage and haematoma complicating a procedure, not elsewhere classified	L0311	3774	Cellulitis of lower limb	S723	321	Fracture of shaft of femur
5	T8141	4911	(T814) Infection following a procedure, not elsewhere classified	Z509	3057	Care involving use of rehabilitation procedure, unspecified	I214	309	Acute subendocardial myocardial infarction
6	S010	4501	Open wound of scalp	T840	2735	Mechanical complication of internal joint prosthesis	S7211	308	Fracture of intertrochanteric section of femur
7	S5251	4483	Fracture of lower end of radius with dorsal angulation	I214	2726	Acute subendocardial myocardial infarction	I500	297	Congestive heart failure
8	T391	4406	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - 4-Aminophenol derivatives (paracetamol)	J189	2262	Pneumonia, unspecified	T845	282	Infection and inflammatory reaction due to internal joint prosthesis
9	S610	3758	Open wound of finger(s) without damage to nail	S826	2222	Fracture of lateral malleolus	S7203	263	Fracture of subcapital section of femur
10	S0600	3672	Concussion	I500	2176	Congestive heart failure	C9200	256	Acute myeloid leukaemia
11	S0188	3526	(S018) Open wound of other parts of head	T810	1921	Haemorrhage and haematoma complicating a procedure, not elsewhere classified	I200	219	Unstable angina
12	S4241	3504	Supracondylar fracture of humerus	I200	1756	Unstable angina	K565	215	Intestinal adhesions [bands] with obstruction
13	S524	3371	Fracture of shafts of both radius and ulna	S8281	1730	Bimalleolar fracture, ankle	E1173	197	(E117)Non-insulin-dependent diabetes mellitus - with multiple complications
14	S5250	3322	Fracture of lower end of radius, unspecified	S723	1707	Fracture of shaft of femur	C20	182	Malignant neoplasm of rectum
15	S022	3294	Fracture of nasal bones	S325	1665	Fracture of pubis	F3220	182	Severe depressive episode without psychotic symptoms

16	R55	2836	Syncope and collapse	M161	1535	Other primary arthrosis of hip	Z508	166	Care involving use of other rehabilitation procedures
17	S6263	2824	Fracture of distal phalanx	J440	1444	Chronic obstructive pulmonary disease with acute lower respiratory infection	F311	158	Bipolar affective disorder, current episode manic without psychotic symptoms
18	S681	2795	Traumatic amputation of other single finger (complete)(partial)	S8218	1427	Other fracture of upper end of tibia	J189	158	Pneumonia, unspecified
19	T424	2793	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - benzodiazepines	S8188	1409	(S818) open wound of other parts of lower leg	T840	146	Mechanical complication of internal joint prosthesis
20	S611	2771	Open wound of finger(s) with damage to nail	M171	1392	Other primary arthrosis of knee	C187	141	Malignant neoplasm: sigmoid colon

Falls

Table A15: Falls admissions: Twenty most common ICD 10 diagnoses for ICISS categories: Serious ≤ 0.941 (IPRU-defined), Moderate 0.941- 0.99 and Minor >0.99 (PHI-defined), 2002-2006

Minor ICISS > 0.99 (49%)				Moderate ICISS 0.941-0.99 (43%)			Serious ICISS ≤ 0.941 (55%)		
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	S526	5093	Fracture of lower end of both ulna and radius	S7203	5522	Fracture of subcapital section of femur	S7200	943	Fracture of neck of femur, unspecified
2	S5251	3898	Fracture of lower end of radius with dorsal angulation	S7211	4837	Fracture of intertrochanteric region of femur	S065	583	Traumatic subdural haemorrhage
3	S4241	3291	Supracondylar fracture of humerus	S010	2127	Open wound of scalp	S7211	551	Fracture of intertrochanteric region of femur
4	S524	2866	Fracture of shafts of both radius and ulna	Z509	1724	Care involving use of rehabilitation procedure, unspecified	S7203	481	Fracture of subcapital section of femur
5	S826	2838	Fracture of lateral malleolus	S325	1714	Fracture of pubis	S021	430	Fracture of base of skull
6	S5250	2508	Fracture of lower end of radius, unspecified	S0188	1604	(S018) Open wound of other part of head	Z509	323	Care involving use of rehabilitation procedure, unspecified
7	S099	2275	Unspecified injury of head	S4222	1510	Fracture of surgical neck of humerus	S020	205	Fracture of vault of skull
8	S0602	1558	Loss of consciousness of less than 30min	R55	1292	Syncope and collapse	S325	167	Fracture of pubis
9	S8281	1509	Bimalleolar fracture, ankle	S723	1070	Fracture of shaft of femur	S066	152	Traumatic subarachnoid haemorrhage
10	S0600	1082	Concussion	S8188	1058	(S818) Open wound of other parts of lower leg	S010	92	Open wound of scalp
11	S8231	1022	Fracture of lower end of tibia with fracture of fibula (any part)	S0085	1052	Superficial injury of other parts of head - contusion	S2240	88	Multiple rib fractures, unspecified
12	S8282	942	Trimalleolar fracture, ankle	S799	1017	Unspecified injury of hip and thigh	S2244	84	Multiple rib fractures, involving four or more ribs
13	S8218	926	Other fracture of upper end of tibia	S0602	897	Loss of consciousness of less than 30min	S270	83	Traumatic pneumothorax

14	S399	886	Unspecified injury of abdomen, lower back and pelvis	S099	845	Unspecified injury of head	S0623	82	Multiple intracerebral and cerebellar haematomas
15	S5259	756	Other and multiple fractures of lower end of radius	S2232	727	Fracture of one rib, other than first rib	S4222	82	Fracture of surgical neck of humerus
16	S5211	747	Fracture of head of radius	L0311	694	Cellulitis of lower limb	R55	81	Syncope and collapse
17	S820	725	Fracture of patella	S300	679	Contusion of lower back and pelvis	S0631	79	Focal cerebral contusion
18	S8238	719	Other fracture of lower end of tibia	S700	652	Contusion of hip	S121	78	Open wound of nose, external skin
19	S8221	705	Fracture of shaft of tibia with fracture of fibula (any part)	S7210	637	Fracture of intracapsular section of femur	S120	76	Open wound of nose, unspecified type
20	S8228	699	Other fracture of shaft of tibia	S423	613	Fracture of shaft of humerus	S2242	71	Multiple rib fractures, involving two ribs

Table A16: Falls admissions: Twenty most common ICD 10 diagnoses for length of stay categories (PHI-defined): Serious >15 days, Moderate 2-15 days and Minor 0-1 days, 2002-2006

Minor LOS 0-1 days (51%)				Moderate LOS 2-15 days (49%)			Serious LOS > 15 days (57%)		
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	S526	4504	Fracture of lower end of both ulna and radius	S7203	5050	Fracture of lower end of both ulna and radius	Z509	1397	Care involving use of rehabilitation procedure, unspecified
2	S5251	3431	Fracture of lower end of radius with dorsal angulation	S7211	4342	Fracture of lower end of radius with dorsal angulation	S7211	710	Fracture of lower end of radius with dorsal angulation
3	S099	2843	Unspecified injury of head	S826	1998	Fracture of lateral malleolus	S7203	657	Fracture of lower end of both ulna and radius
4	S4241	2535	Supracondylar fracture of humerus	S325	1376	Fracture of pubis	S723	234	Fracture of shaft of femur
5	S524	2436	Fracture of shafts of both radius and ulna	S8281	1339	Bimalleolar fracture, ankle	S325	145	Fracture of pubis
6	S0602	2250	Loss of consciousness of less than 30min	Z509	1142	Care involving use of rehabilitation procedure, unspecified	Z508	121	Care involving use of other rehabilitation procedures
7	S5250	2154	Fracture of lower end of radius, unspecified	S526	1035	Fracture of lower end of both ulna and radius	S8281	118	Bimalleolar fracture, ankle
8	S010	1803	Open wound of scalp	S5251	989	Fracture of lower end of radius with dorsal angulation	S722	98	Subtrochanteric fracture of femur
9	S0600	1380	Concussion	S4222	888	Fracture of surgical neck of humerus	S324	95	Fracture of acetabulum
10	S0188	1355	(S018) - open wound of other part of head	S4241	881	Supracondylar fracture of humerus	S7243	89	Supracondylar fracture of femur
11	R55	1041	Syncope and collapse	R55	857	Syncope and collapse	I500	88	Congestive heart failure
12	S826	950	Fracture of lateral malleolus	S8282	850	Trimalleolar fracture, ankle	S8231	85	Fracture of lower end of tibia with fracture of fibula (any part)
13	S0085	859	Superficial injury of other parts of head - contusion	S723	811	Fracture of shaft of femur	I639	82	Cerebral infarction, unspecified
14	S399	679	Unspecified injury of abdomen, lower back and pelvis	S8231	799	Fracture of lower end of tibia with fracture of fibula (any part)	S8282	82	Trimalleolar fracture, ankle

15	S0151	675	Open wound of lip	S8218	736	Other fracture of upper end of tibia	S4222	76	Fracture of surgical neck of humerus
16	S4222	628	Fracture of surgical neck of humerus	L0311	723	Cellulitis of lower limb	S8218	75	Other fracture of upper end of tibia
17	S4301	623	Anterior dislocation of humerus	S8221	703	Fracture of shaft of tibia with fracture of fibula (any part)	S065	71	Traumatic subdural haemorrhage
18	S5211	526	Fracture of head of radius	S524	674	Fracture of shafts of both radius and ulna	S7200	68	Fracture of neck of femur, unspecified
19	S799	522	Unspecified injury of hip and thigh	S8188	663	(S818) Open wound of other parts of lower leg	S7210	66	Fracture of intracapsular section of femur
20	S300	513	Contusion of lower back and pelvis	S820	635	Fracture of patella	S8188	63	(S818) Open wound of other parts of lower leg

Motor vehicle traffic crash (MVTC)

Table A17: MVTC admissions: Twenty most common ICD 10 diagnoses for ICISS categories: Serious ≤ 0.941 (IPRU-defined), Moderate 0.941- 0.99 and Minor >0.99 (PHI-defined), 2002-2006

	Minor ICISS > 0.99 (47%)			Moderate ICISS 0.941-0.99 (40%)			Serious ICISS ≤ 0.941 (40%)		
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	S0602	834	Loss of consciousness of less than 30 minutes duration	S0602	1131	Loss of consciousness of less than 30 minutes duration	S021	343	Fracture of base of skull
2	S526	807	Fracture of lower end of both ulna and radius	S0188	945	(S018) Open wound of other part of head	S723	320	Fracture of shaft of femur
3	S134	776	Sprain and strain of cervical spine	S010	881	Open wound of scalp	S065	249	Traumatic subdural haemorrhage
4	S099	759	Unspecified injury of head	S099	810	Unspecified injury of head	S0601	232	Loss of consciousness of unspecified duration
5	S202	609	Contusion of thorax	S810	628	Open wound of knee	S020	219	Fracture of vault of skull
6	S5250	545	Fracture of lower end of radius, unspecified	S222	602	Fracture of sternum	S325	207	Fracture of pubis
7	S0600	536	Concussion	S723	561	Fracture of shaft of femur	S270	193	Traumatic pneumothorax
8	S399	436	Unspecified injury of abdomen, lower back and pelvis	S202	551	Contusion of thorax	Z509	172	Care involving use of rehabilitation procedure, unspecified
9	S8218	395	Other fracture of upper end of tibia	S0601	510	Loss of consciousness of unspecified duration	S066	170	Traumatic subarachnoid haemorrhage
10	Z041	340	Examination and observation following transport accident	S0600	508	Concussion	S2244	166	Multiple rib fractures involving four or more ribs
11	S199	335	Unspecified injury of neck	S0085	488	Superficial injury of other parts of head - contusion	S0602	153	Loss of consciousness of less than 30 minutes duration
12	S5251	330	Fracture of lower end of radius with dorsal angulation	S301	470	Contusion of abdominal wall	S010	150	Open wound of scalp
13	S136	328	Sprain and strain of joints and ligaments of	S8188	382	(S818) Open wound of other parts of lower	S272	141	Traumatic haemopneumothorax

			other and unspecified parts of neck			leg			
14	S826	321	Fracture of medial malleolus	S4200	321	Fracture of clavicle, unspecified part	S324	134	Fracture of acetabulum
15	S8231	317	Fracture of lower end of tibia with fracture of fibula (any part)	S3201	317	Fracture of lumbar vertebra, L1 level	S0623	121	Multiple intracerebral and cerebellar haematomas
16	S8221	300	Fracture of shaft of tibia with fracture of fibula (any part)	S4202	288	Fracture of shaft of clavicle	S0631	121	Focal cerebral contusion
17	S5252	297	Fracture of lower end of radius with volar angulation	S8221	281	Fracture of shaft of tibia with fracture of fibula (any part)	S121	119	Fracture of second cervical vertebra
18	S825	291	Fracture of medial malleolus	S2232	269	Fracture of one rib, other than first rib	S024	112	Fracture of malar and maxillary bones
19	S524	258	Fracture of shafts of both ulna and radius	S199	263	Unspecified injury of neck	S0188	101	(S018) Open wound of other part of head
20	S4202	257	Fracture of shaft of clavicle	S325	263	Fracture of pubis	S2731	100	Contusion and haematoma of lung

Table A18: MVTC admissions: Twenty most common ICD 10 diagnoses for length of stay categories (PHI-defined): Serious >5 days, Moderate 1-5 days and Minor 0 days, 2002-2006

	Minor LOS 0 days (44%)			Moderate LOS 1-5 days (41%)			Serious LOS > 5 days (40%)		
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	S0602	948	Loss of consciousness of less than 30min	S0602	1119	Loss of consciousness of less than 30min	S723	573	Fracture of shaft of femur
2	S099	867	Unspecified injury of head	S526	752	Fracture of lower end of both ulna and radius	S8218	295	Other fracture of upper end of tibia
3	S134	696	Sprain and strain of cervical spine	S099	751	Unspecified injury of head	S8221	279	Fracture of shaft of tibia with fracture of fibula (any part)
4	S202	679	Contusion of thorax	S0600	560	Concussion	Z509	259	Care involving use of rehabilitation procedure, unspecified
5	S0188	538	(S018) Open wound of other parts of head	S202	496	Contusion of thorax	S325	221	Fracture of pubis
6	S010	507	Open wound of scalp	S010	489	Open wound of scalp	S8231	189	Fracture of lower end of tibia with fracture of fibula (any part)
7	S0600	502	Concussion	S0188	489	(S018) Open wound of other parts of head	S324	182	Fracture of acetabulum
8	S0601	342	Loss of consciousness of unspecified duration	S5250	483	Fracture of lower end of radius, unspecified	S8281	146	Other fracture of upper end of tibia
9	S199	341	Unspecified injury of neck	S222	439	Fracture of sternum	S3201	128	Fracture of lumbar vertebra, L1 level
10	S0085	323	Superficial injury of other parts of head - contusion	S810	418	Open wound of knee	S7203	121	Fracture of subcapital section of femur
11	S136	323	Sprain and strain of joints and ligaments of other and unspecified parts of neck	S0601	363	Loss of consciousness of unspecified duration	S222	117	Fracture of sternum
12	S399	297	Unspecified injury of abdomen, lower back and pelvis	S8221	352	Fracture of shaft of tibia with fracture of fibula (any part)	S8228	115	Other fracture of shaft of tibia
13	S4202	240	Fracture of shaft of clavicle	S4202	328	Fracture of shaft of clavicle	S825	114	Fracture of medial malleolus

14	S5250	219	Fracture of lower end of radius, unspecified	S134	316	Sprain and strain of cervical spine	S8188	111	(S818) Open wound of other parts of lower leg
15	S810	218	Open wound of knee	S826	309	Fracture of lateral malleolus	S065	107	Traumatic subdural haemorrhage
16	S299	210	Unspecified injury of thorax	S399	298	Unspecified injury of abdomen, lower back and pelvis	S270	107	Traumatic pneumothorax
17	S526	206	Fracture of lower end of both ulna and radius	S8218	297	Other fracture of upper end of tibia	S021	106	Fracture of base of skull
18	Z041	187	Examination and observation following transport accident	S825	286	Fracture of medial malleolus	S7211	98	Fracture of intertrochanteric region of femur
19	S301	184	Contusion of abdominal wall	S301	285	Contusion of abdominal wall	S2244	93	Multiple rib fractures involving four or more ribs
20	S0151	168	Open wound of lip	S723	280	Fracture of shaft of femur	S272	89	Traumatic haemopneumothorax

Deliberate self harm (DSH)

Table A19: DSH admissions: Twenty most common ICD 10 diagnoses for ICISS categories: Serious ≤ 0.941 (IPRU-defined), Moderate 0.941- 0.99 and Minor >0.99 (PHI-defined), 2002-2006

Minor ICISS > 0.99 (81%)			Moderate ICISS 0.941-0.99 (64%)			Serious ICISS ≤ 0.941 (54%)			
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	T391	3107	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - 4-Aminophenol derivatives (paracetamol)	T391	763	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - 4-Aminophenol derivatives (paracetamol)	T71	210	Asphyxiation
2	T424	1984	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - benzodiazepines	T402	629	Poisoning by narcotics and psychodysleptics [hallucinogens] other opioids	T391	30	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - 4-Aminophenol derivatives (paracetamol)
3	T432	1696	Poisoning by psychotropic drugs, not elsewhere classified - other and unspecified antidepressants	T58	442	Toxic effects of carbon monoxide	T2231	28	Full thickness burn of shoulder and upper limb, except wrist and hand - forearm and elbow
4	T426	1549	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - other antiepileptic and sedative-hypnotic drugs	T424	402	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - benzodiazepines	T424	23	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - benzodiazepines
5	T430	1098	Poisoning by psychotropic drugs, not elsewhere classified - tricyclic and tetracyclic antidepressants	S619	291	Open wound of wrist and hand part, part unspecified	S3681	22	Injury of peritoneum
6	T435	769	Poisoning by psychotropic drugs, not elsewhere classified - other and unspecified antipsychotics and neuroleptics	T432	270	Poisoning by psychotropic drugs, not elsewhere classified - other and unspecified antidepressants	F432	20	Adjustment disorders
7	T393	583	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - other	T430	240	Poisoning by psychotropic drugs, not elsewhere classified - tricyclic and tetracyclic	F6031	20	Emotionally unstable personality disorder - borderline type

			nonsteroidal antiinflammatory drugs			antidepressants			
8	S6188	276	(S618) Open wound of other parts of wrist and hand	T426	227	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - other antiepileptic and sedative-hypnotic drugs	F3220	16	(F322) Severe depressive episode without psychotic symptoms
9	T433	276	Poisoning by psychotropic drugs, not elsewhere classified - phenothiazine antipsychotics and neuroleptics	T393	162	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - other nonsteroidal antiinflammatory drugs	T426	15	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - other antiepileptic and sedative-hypnotic drugs
10	T421	211	Poisoning by anti-epileptic, sedative-hypnotic and antiparkinsonism drugs - lminostilbenes	F6031	134	Emotionally unstable personality disorder - borderline type	T68	12	Hypothermia
11	T509	210	Poisoning by diuretics and other and unspecified drugs, medicaments and biological substances - other and unspecified	S519	126	Open wound of forearm, part unspecified	F3290	10	Depressive episode - unspecified
12	F3220	182	(F322) Severe depressive episode without psychotic symptoms	T383	116	Poisoning by hormones and their synthetic substitutes and antagonists - insulin and oral hypoglycaemic [antidiabetic] drugs	F431	10	Reaction to severe stress, and adjustment disorders - post-traumatic stress disorder
13	T510	175	Toxic effect of alcohol - ethanol	T435	106	Poisoning by psychotropic drugs, not elsewhere classified - other and unspecified antipsychotics and neuroleptics	T430	9	Poisoning by psychotropic drugs, not elsewhere classified - tricyclic and tetracyclic antidepressants
14	F432	149	Reaction to severe stress, and adjustment disorders - adjustment disorders	F3220	96	(F322) Severe depressive episode without psychotic symptoms	S020	8	Fracture of vault of skull
15	F6031	148	Emotionally unstable personality disorder - borderline type	T461	78	Poisoning by agents primarily affecting the cardiovascular system - calcium-channel blockers	S021	8	Fracture of base of skull
16	T450	136	Poisoning by primarily systemic and haematological agents, not elsewhere classified - antiallergic and antiemetic drugs	T447	67	Poisoning by drugs primarily affecting the autonomic nervous system - betaadrenoreceptor antagonists, not elsewhere specified	S270	7	Traumatic pneumothorax
17	S5188	116	(S518) Open wound of other parts of forearm	F432	65	Reaction to severe stress, and adjustment disorders - adjustment disorders	S3613	7	Minor laceration of liver
18	T390	107	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - salicylates	T404	61	Poisoning by narcotics and psychodysleptics [hallucinogens] - other synthetic narcotics	S619	7	Open wound of wrist and hand part, part unspecified
19	F3290	105	Depressive episode - unspecified	T421	60	Poisoning by anti-epileptic, sedative-hypnotic and antiparkinsonism drugs - lminostilbenes	F341	6	Persistent mood [affective] disorders - dysthymia
20	T436	105	Poisoning by psychotropic drugs, not elsewhere specified - psychostimulants with potential for use disorder	T403	57	Poisoning by narcotics and psychodysleptics [hallucinogens] - methadone	S3614	6	Moderate laceration of liver

Table A20: DSH admissions: Twenty most common ICD 10 diagnoses for length of stay categories (PHI-defined): Serious >14 days, Moderate 2-14 days and Minor 0-1 days, 2002-2006

Minor LOS 0-1 days	Moderate LOS 2-14 days	Serious LOS > 14 days
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	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	T391	1144	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - 4-Aminophenol derivatives (paracetamol)	T391	2748	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - 4-Aminophenol derivatives (paracetamol)	F3220	112	(F322) Severe depressive episode without psychotic symptoms
2	T424	964	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - benzodiazepines	T424	1430	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - benzodiazepines	F6031	48	Emotionally unstable personality disorder - borderline type
3	T432	940	Poisoning by psychotropic drugs, not elsewhere classified - other and unspecified antidepressants	T426	1053	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - other antiepileptic and sedative-hypnotic drugs	F200	43	Paranoid schizophrenia
4	T426	730	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - other antiepileptic and sedative-hypnotic drugs	T432	1031	Poisoning by psychotropic drugs, not elsewhere classified - other and unspecified antidepressants	F3290	32	Depressive episode - unspecified
5	T393	387	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - other nonsteroidal antiinflammatory drugs	T430	991	Poisoning by psychotropic drugs, not elsewhere classified - tricyclic and tetracyclic antidepressants	F3230	27	Severe depressive episode with psychotic symptoms
6	T430	349	Poisoning by psychotropic drugs, not elsewhere classified - tricyclic and tetracyclic antidepressants	T435	567	Poisoning by psychotropic drugs, not elsewhere classified - other and unspecified antipsychotics and neuroleptics	F29	21	Unspecified nonorganic psychosis
7	T435	312	Poisoning by psychotropic drugs, not elsewhere classified - other and unspecified antipsychotics and neuroleptics	T393	363	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - other nonsteroidal antiinflammatory drugs	F319	21	Bipolar affective disorder, unspecified
8	T402	280	Poisoning by narcotics and psychodysleptics [hallucinogens] other opioids	T402	355	Poisoning by narcotics and psychodysleptics [hallucinogens] other opioids	F341	21	Persistent mood [affective] disorders - dysthymia
9	S6188	198	(S618) Open wound of other parts of wrist and hand	T58	251	Toxic effects of carbon monoxide	F431	21	Reaction to severe stress, and adjustment disorders - post-traumatic stress disorder
10	S619	197	Open wound of wrist and hand part, part unspecified	T421	227	Poisoning by anti-epileptic, sedative-hypnotic and antiparkinsonism drugs - lminostilbenes	F432	21	Adjustment disorders
11	T58	187	Toxic effects of carbon monoxide	F6031	217	Emotionally unstable personality disorder - borderline type	F209	19	Schizophrenia, unspecified
12	T433	108	Poisoning by psychotropic drugs, not elsewhere classified - phenothiazine antipsychotics and neuroleptics	T433	209	Poisoning by psychotropic drugs, not elsewhere classified - phenothiazine antipsychotics and neuroleptics	F259	19	Schizoaffective disorder, unspecified
13	T510	107	Toxic effect of alcohol - ethanol	F432	190	Adjustment disorders	F332	18	Recurrent depressive disorder, current episode severe without psychotic symptoms
14	S5188	102	(S518) Open wound of other parts of forearm	F3220	167	(F322) Severe depressive episode without psychotic symptoms	F339	17	Recurrent depressive disorder, unspecified
15	T509	101	Poisoning by diuretics and other and unspecified drugs, medicaments and biological substances - other and unspecified	T509	147	Poisoning by diuretics and other and unspecified drugs, medicaments and biological substances - other and unspecified	T424	15	Poisoning by antiepileptic, sedative-hypnotic and antiparkinsonism drugs - benzodiazepines
16	T71	91	Asphyxiation	T510	128	Toxic effect of alcohol - ethanol	F311	14	Bipolar affective disorder, current episode

									manic without psychotic symptoms
17	T450	83	Poisoning by primarily systemic and haematological agents, not elsewhere classified - antiallergic and antiemetic drugs	S6188	122	(S618) Open wound of other parts of wrist and hand	F102	13	Mental and behavioural disorders due to use of alcohol - dependence syndrome
18	S519	74	Open wound of forearm, part unspecified	T447	113	Poisoning by drugs primarily affecting the autonomic nervous system - betaadrenoreceptor antagonists, not elsewhere specified	F500	12	Anorexia nervosa
19	T390	68	Poisoning by non-opioid analgesics, antipyretics and antirheumatics - salicylates	T71	112	Asphyxiation	F314	11	Bipolar affective disorder, current episode severe depression without psychotic symptoms
20	T427	60	Poisoning by antiepileptic, sedative-hypnotic drugs - unspecified	F3290	109	Depressive episode - unspecified	F3210	11	Moderate depressive episode

Assault

Table A21: Assault admissions: Twenty most common ICD 10 diagnoses for ICISS categories: Serious ≤ 0.941 (IPRU-defined), Moderate 0.941- 0.99 and Minor >0.99 (PHI-defined), 2002-2006

	Minor ICISS > 0.99 (59%)			Moderate ICISS 0.941-0.99 (61%)			Serious ICISS ≤ 0.941 (59%)		
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	S0265	664	Fracture of angle of jaw	S010	984	Open wound of scalp	S021	197	Fracture of base of skull
2	S022	634	Fracture of nasal bones	S0085	680	Superficial injury of other parts of head - contusion	S065	172	Traumatic subdural haemorrhage
3	S099	479	Unspecified injury of head	S0602	613	Loss of consciousness of brief duration (less than 30 minutes)	S0601	153	Loss of consciousness of unspecified duration
4	S0602	385	Loss of consciousness of brief duration (less than 30 minutes)	S024	602	Fracture of malar and maxillary bones	S024	123	Fracture of malar and maxillary bones
5	S0266	256	Fracture of symphysis of body of mandible	S099	550	Unspecified injury of head	S020	119	Fracture of vault of skull
6	S0600	189	Concussion	S0188	488	(S018) Open wound of other parts of head	S010	114	Open wound of scalp
7	S6232	184	Fracture of shaft of other metacarpal bone(s)	S023	389	Fracture of orbital floor	S0085	82	Superficial injury of other parts of head - contusion
8	S0151	159	Open wound of lip	S0601	344	Loss of consciousness of unspecified duration	S270	78	Traumatic pneumothorax
9	S0268	126	Fracture of mandible body, other and unspecified	S022	265	Fracture of nasal bones	S023	72	Fracture of orbital floor
10	S399	120	Unspecified injury of abdomen, lower back and pelvis	S001	240	Contusion of eyelid and periocular area	S066	59	Traumatic subarachnoid haemorrhage

11	S610	117	Open wound of finger(s) without damage to nail	S0600	224	Concussion	S028	58	Fractures of other skull and facial bones
12	O998	112	Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium	S0151	217	Open wound of lip	S0631	47	Focal cerebral contusion
13	S6233	92	Fracture of neck of other metacarpal bone(s)	S0265	133	Fracture of angle of jaw	S0188	45	(S018) Open wound of other parts of head
14	F072	85	Postconcussional syndrome	S0260	123	Fracture of mandible, unspecified site	S099	45	Unspecified injury of head
15	S6221	85	Fracture of base of first metacarpal	S028	108	Fractures of other skull and facial bones	S0602	43	Loss of consciousness of brief duration (less than 30 minutes)
16	S6261	80	Fracture of proximal phalanx	S0005	97	Superficial injury of scalp - contusion	S022	40	Fracture of nasal bones
17	S663	78	Injury of extensor muscle and tendon of other finger at wrist and hand level	S011	93	Open wound of eyelid and periocular area	S064	40	Epidural haemorrhage
18	S6231	77	Fracture of base of other metacarpal bone(s)	S0141	90	Open wound of cheek	S0603	39	Loss of consciousness of moderate duration (30 minutes to 24 hours)
19	S011	75	Open wound of eyelid and periocular area	S6188	78	(S618) Open wound of other parts of wrist and hand	S272	39	Traumatic haemopneumothorax
20	S202	65	Contusion of thorax	S2232	75	Fracture of one rib other than first rib	S0623	36	Multiple intracerebral and cerebellar haematomas

Table A22: Assault admissions: Twenty most common ICD 10 diagnoses for length of stay categories (PHI-defined): Serious >2 days, Moderate 1-2 days and Minor 0 days, 2002-2006

	Minor LOS 0 days (61%)			Moderate LOS 1-2 days (51%)			Serious LOS > 2 days (40%)		
	ICD code	n	Injury description	ICD code	n	Injury description	ICD code	n	Injury description
1	S010	816	Open wound of scalp	S0265	534	Fracture of angle of jaw	S0265	179	Fracture of angle of jaw
2	S022	797	Fracture of nasal bones	S024	374	Fracture of malar and maxillary bones	S024	126	Fracture of malar and maxillary bones
3	S0602	756	Loss of consciousness of brief duration (less than 30 minutes)	S099	309	Unspecified injury of head	S065	98	Traumatic subdural haemorrhage
4	S099	740	Unspecified injury of head	S0602	262	Loss of consciousness of brief duration (less than 30 minutes)	S0266	83	Fracture of symphysis of body of mandible
5	S0085	551	Superficial injury of other parts of head - contusion	S010	260	Open wound of scalp	S023	79	Fracture of orbital floor
6	S0188	380	(S018) Open wound of other parts of head	S0266	224	Fracture of symphysis of body of mandible	S270	69	Traumatic pneumothorax
7	S0601	338	Loss of consciousness of unspecified duration	S0085	192	Superficial injury of other parts of head - contusion	S021	62	Fracture of base of skull
8	S0600	296	Concussion	S023	189	Fracture of orbital floor	S020	43	Fracture of vault of skull
9	S0151	288	Open wound of lip	S0601	139	Loss of consciousness of unspecified duration	S826	40	Fracture of lateral malleolus

10	S024	225	Fracture of malar and maxillary bones	S0188	137	(S018) Open wound of other parts of head	S6188	35	(S618) Open wound of other parts of wrist and hand
11	S023	193	Fracture of orbital floor	S022	126	Fracture of nasal bones	S610	34	Open wound of finger(s) without damage to nail
12	S001	190	Contusion of eyelid and periocular area	S0600	125	Concussion	S0268	33	Fracture of mandible body, other and unspecified
13	S011	112	Open wound of eyelid and periocular area	S0268	104	Fracture of mandible body, other and unspecified	S066	31	Traumatic subarachnoid haemorrhage
14	S0141	100	Open wound of cheek	S6232	104	Fracture of shaft of other metacarpal bone(s)	F200	27	Paranoid schizophrenia
15	S0265	98	Fracture of angle of jaw	S0151	95	Open wound of lip	S272	27	Traumatic haemopneumothorax
16	S202	98	Contusion of thorax	O998	74	Other specified diseases and conditions complicating pregnancy, childbirth and the puerperium	S723	26	Fracture of shaft of femur
17	S6232	88	Fracture of shaft of other metacarpal bone(s)	S021	70	Fracture of base of skull	S0631	25	Focal cerebral contusion
18	S399	82	Unspecified injury of abdomen, lower back and pelvis	S399	69	Unspecified injury of abdomen, lower back and pelvis	S099	25	Unspecified injury of head
19	S0005	80	Superficial injury of scalp - contusion	S001	68	Contusion of eyelid and periocular area	S0602	23	Loss of consciousness of brief duration (less than 30 minutes)
20	S051	79	Contusion of eyeball and orbital tissues	S610	68	Open wound of finger(s) without damage to nail	S663	23	Injury of extensor muscle and tendon of other finger at wrist and hand level

Drowning

Table A23: Drowning admissions: Twenty most common ICD 10 diagnoses 2002-2006

All admissions (88%)			
	ICD code	n	Injury description
1	T751	347	Drowning and non-fatal submersion
2	T68	12	Hypothermia
3	S0602	7	Loss of consciousness of less than 30min
4	R568	4	Other and unspecified convulsions
5	S0600	4	Concussion
6	S099	3	Unspecified injury of the head
7	Z043	3	Examination and observation following other accident
8	I214	2	Acute subendocardial myocardial infarction
9	J698	2	Pneumonitis due to other solids and liquids
10	J80	2	Adult respiratory distress syndrome
11	R55	2	Syncope and collapse
12	S4301	2	Anterior dislocation of humerus
13	S701	2	Contusion of thigh
14	A279	1	Leptospirosis, unspecified
15	E1064	1	Insulin-dependent diabetes mellitus, With other specified complications
16	F100	1	Mental and behavioural disorders due to use of alcohol – acute intoxication
17	G4090	1	Epilepsy, unspecified
18	G419	1	Status epilepticus, unspecified
19	H103	1	Acute conjunctivitis, unspecified
20	I213	1	Acute transmural myocardial infarction of unspecified site

Note: the percentage at the top of each column is the percentage of all injuries in that category included by the twenty most common diagnoses.

Appendix Three: Descriptive Analyses

Characteristics of all injury and injury priority area admissions

Much of the data in this section was produced to meet the original objectives of the project, prior to the analyses in Chapter 3 being performed. This data provides information regarding possible reasons why length of stay is not a reliable indicator of risk of death, helps to explain the process of identifying the serious, moderate and minor categories used subsequently, and highlights some important issues arising from the use of ICISS and length of stay.

In this section discharges between 2002 and 2006, for all injury and the five priority areas has been analysed in the following areas as described in methods section.

Descriptive analysis by:

- Gender
- Ethnicity (Māori and non-Māori)
- Life cycle age group
- Length of stay
- ICISS

Because the risk of injury is related to exposure to the underlying hazard, comments highlighting disproportionate levels of injury between population groups should be carefully interpreted as they may reflect differing levels of exposure rather than any inherent increased level of risk for that group. For some groups and types of injuries, for example, drowning in young children or falls in older people, the number of injuries may be due to stage of life factors. In contrast, a disproportionate number of discharges for injury due to for example MVTC in 25-44 year olds may be related to increased exposure, such as distance travelled, type of vehicle driven or use of alcohol.

Note on ICISS and length of stay charts

In the charts of ICISS distribution, note that the bars do not represent equally sized categories. For the ICISS charts, the higher ICISS categories are smaller (for example 0.990-0.995, or 0.940-0.950) than the lower categories (for example 0.60-0.70). For length of stay categories, the longer categories are for 16-20 days and all durations greater than 20 days. The zero days stay includes admissions of up to 24 hours. The charts have shaded bars with the lightest grey bars indicating the PHI-defined minor categories (of length of stay or ICISS) and the darkest grey bars indicating the PHI-defined serious category for length of stay and approximating the IPRU-defined serious ICISS category at less than or equal to 0.940 (rather than less than or equal to 0.941).

Results

All injury, admissions 2002-2006

Males had more admissions with injury than females. 15% of all hospitalisations for injury (86,137) occurred in Māori; in the 2001 and 2006 Censuses Māori made up 14.6 % of the total New Zealand population. Hospitalisations for injury occur throughout the life cycle: 5% (29,033) of all hospitalised injuries occurred in under 5 year olds, 20% (117,635) occurred in those aged over 75 years.

Most hospitalisations for injury (55% or 319,081) are of minor severity, that is, they have an ICISS of greater than 0.990 (meaning a risk of death of less than 1%). A small proportion of admissions (5% or 28,998) are more serious, with an ICISS of less than 0.940. 59% (339,970) of hospitalisations were for up to 2 days duration; 23,559 (or 4%) were for more than 20 days.

Table A24: Number of non-fatal discharges for all injury, 2002-2006 by gender and ethnicity

	Māori	Non-Māori	Total
Female	35907	230498	266405
Male	50230	261775	312005
Total	86137	492273	578410

Table A25: Number of non-fatal discharges for all injury, 2002-2006 by life cycle age group

Age group (yrs)	Number of discharges (%)
0-4	29033 (5%)
5-14	53984 (9%)
15-24	76705 (13%)
25-44	125111 (22%)
45-64	113658 (20%)
65-74	62284 (11%)
75+	117635 (20%)
Total	578410

Figure A1: Number of non-fatal discharges for all injury, 2002-2006 by ICISS categories

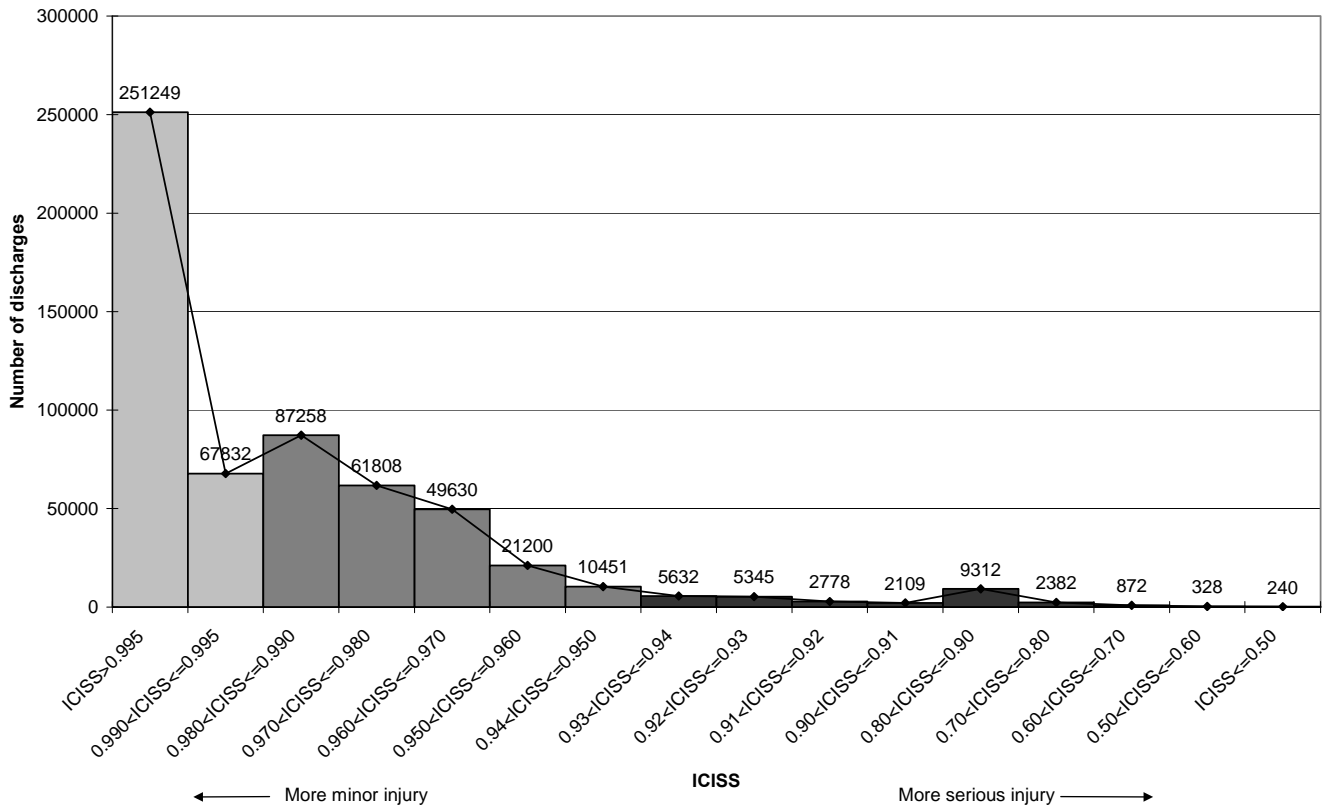
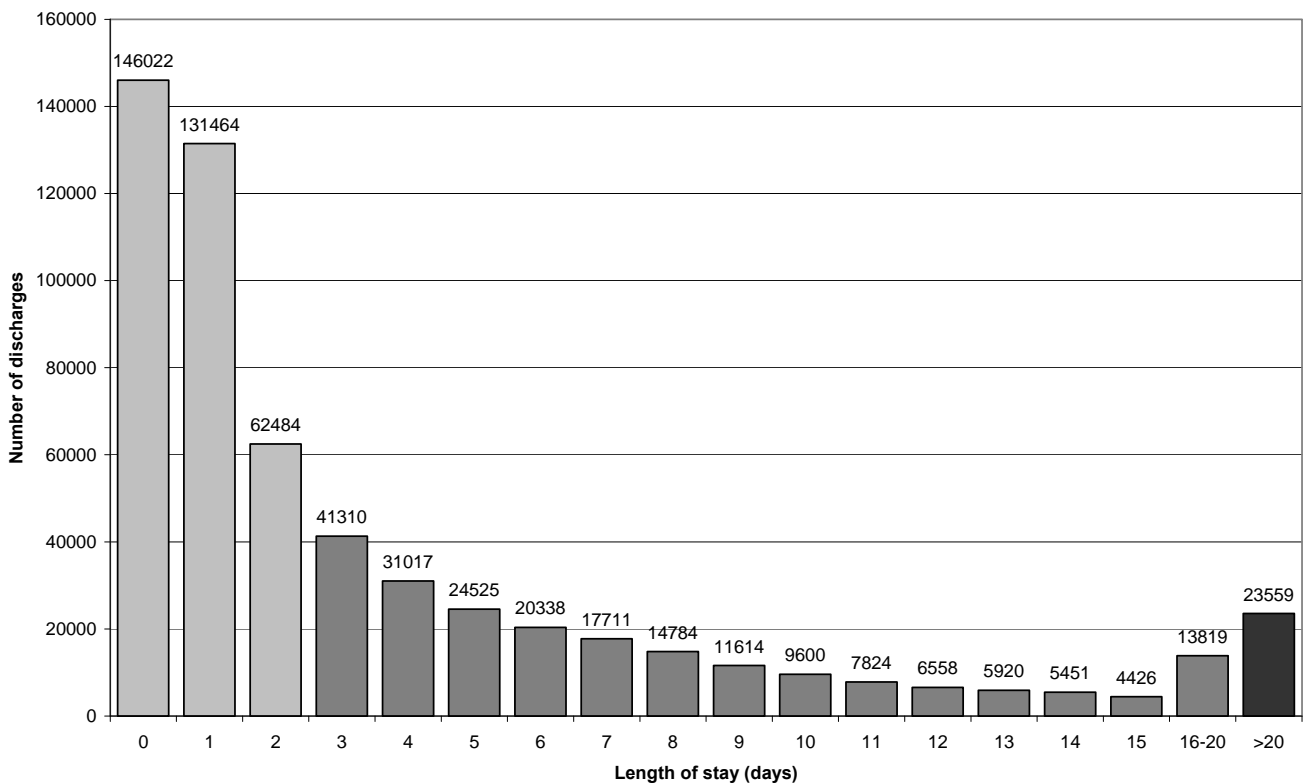


Figure A2: Number of non-fatal discharges for all injury, 2002-2006 by length of stay



Falls, admissions 2002-2006

Of the five priority areas in this report, falls were the cause of the greatest number of hospital admissions for injury. Non-Māori women have more admissions than non-Māori men, however Māori men have more admissions than Māori women. Overall, Māori are under-represented in admissions for falls, making up only 12% of admissions (16,541). Many admissions with falls occur in the younger and older age groups. Children aged 5-14 years make up 17% of admissions and over 65 years olds make up 43%.

49% of falls admissions (68330) are for (PHI-defined) minor injury with an ICISS of greater than 0.990. Only 6% (8154) are have a risk of death of greater than 6%. A large proportion (49% or 69,186) of admissions were for one day or less. 6% (8071) were for more than 15 days.

Table A26: Number of non-fatal discharges with injury due to falls, 2002-2006 by gender and ethnicity

	Māori	Non-Māori	Total
Female	6708	66550	73258
Male	9833	55977	65810
Total	16541	122527	139068

Table A27: Number of non-fatal discharges with injury due to falls, 2002-2006 by life cycle age group

Age group (yrs)	Number of discharges (%)
0-4	8278 (6%)
5-14	23090 (17%)
15-24	11842 (9%)
25-44	17450 (13%)
45-64	18882 (14%)
65-74	12571 (9%)
75+	46955 (34%)
Total	139068

Figure A3: Number of non-fatal discharges with injury due to falls, 2002-2006 by ICISS

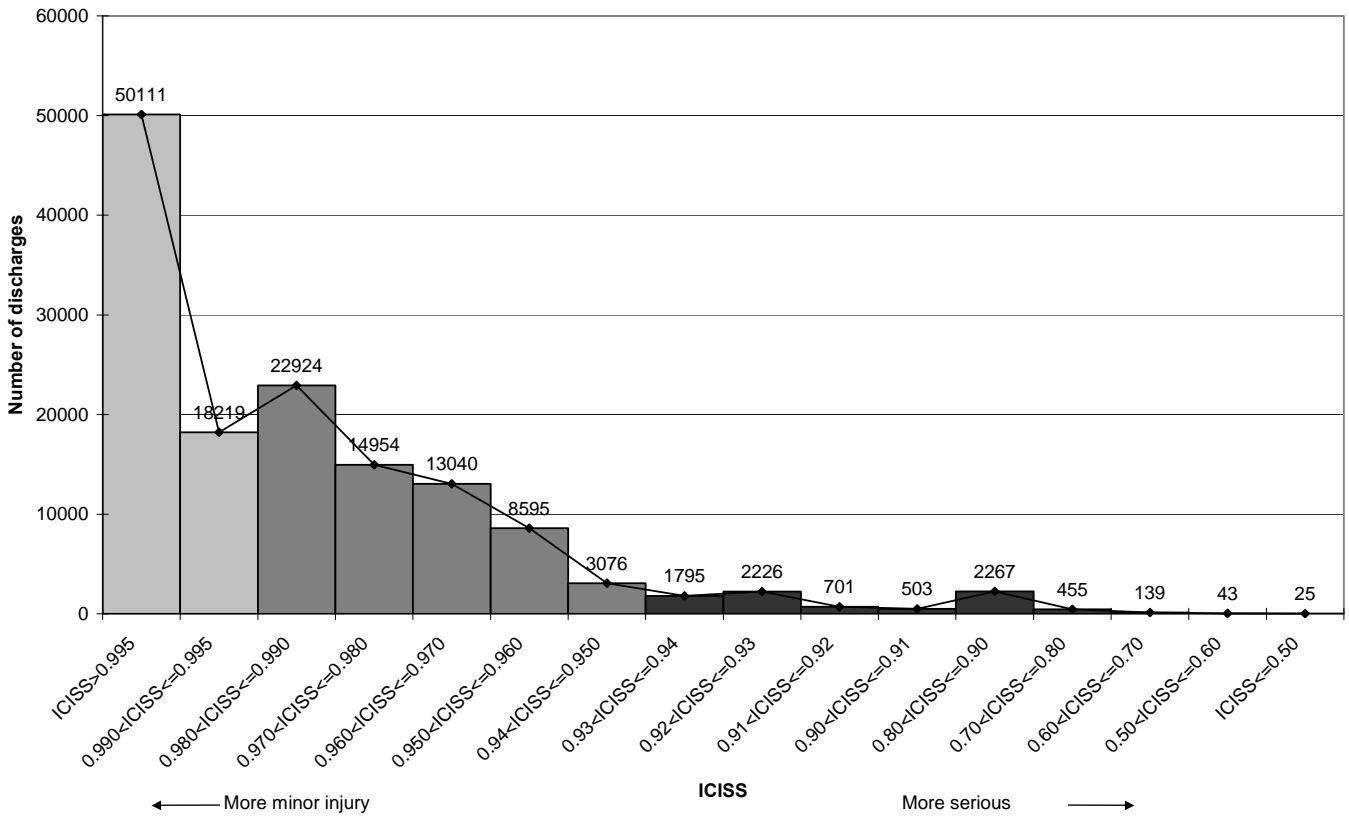
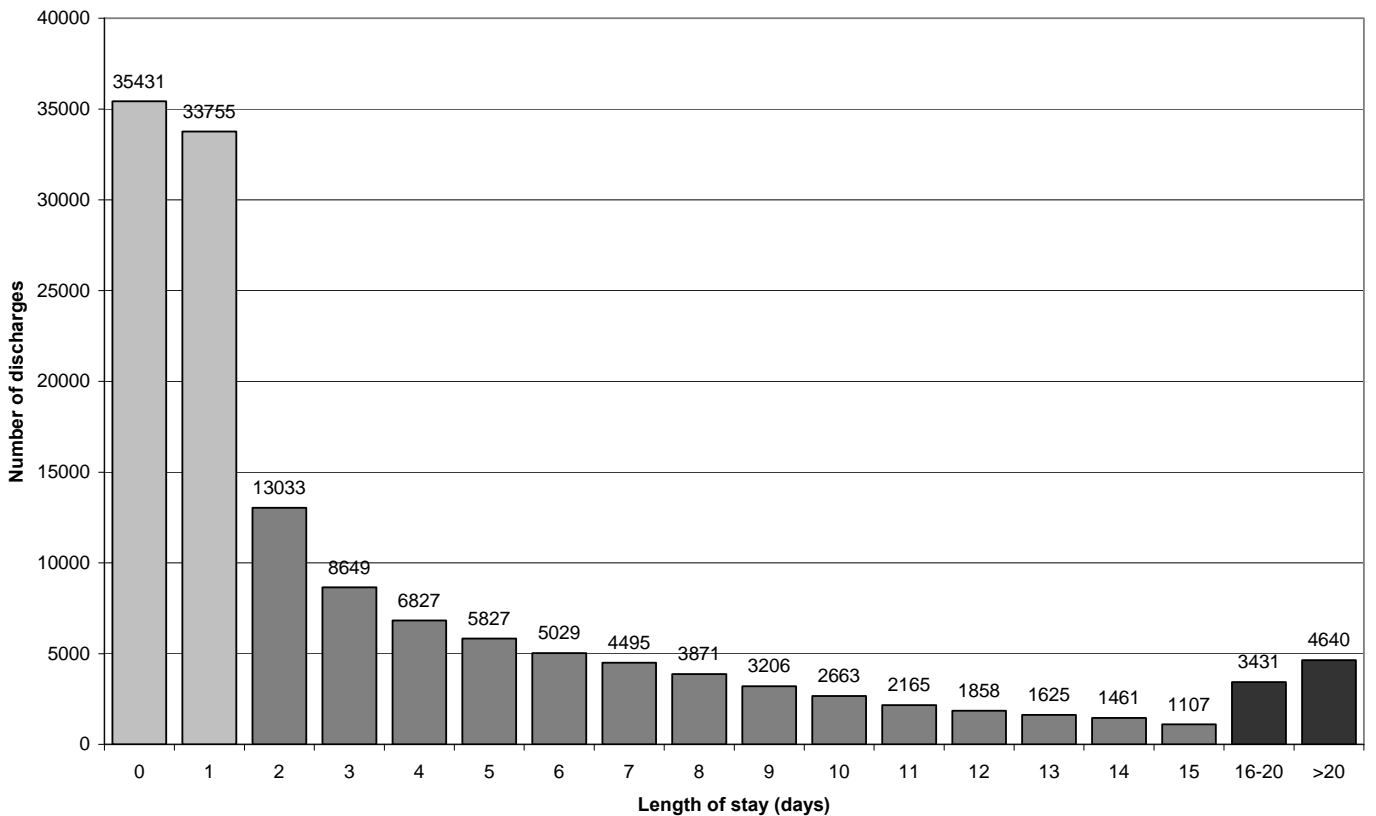


Figure A4: Number of non-fatal discharges with injury due to falls, 2002-2006 by length of stay



Motor vehicle traffic crash (MVTC), admissions 2002-2006

Admissions with injury following MVTC are more common in males, and in Māori. Most admissions (57% or 31,334) occur in the combined 15-24 and 25-44 year old age groups. 16% of MVTC admissions (8807) were more serious with an ICISS of less than or equal to 0.940, 35% (19,251) had an ICISS of greater than 0.990. 16% of admissions (8602) are for more than five days, many (33%) stay for less than one day.

Table A28: Number of non-fatal discharges with injury due to MVTC, 2002-2006 by gender and ethnicity

	Māori	Non-Māori	Total
Female	3545	16271	19816
Male	6224	28491	34715
Total	9769	44762	54531

Table A29: Number of non-fatal discharges with injury due to MVTC, 2002-2006 by life cycle age group

Age group (yrs)	Number of discharges (%)
0-4	1369 (3%)
5-14	7693 (14%)
15-24	14814 (27%)
25-44	16520 (30%)
45-64	9272 (17%)
65-74	2274 (4%)
75+	2589 (5%)
Total	54531

Figure A5: Number of non-fatal discharges with injury due to MVTC, 2002-2006 by ICISS

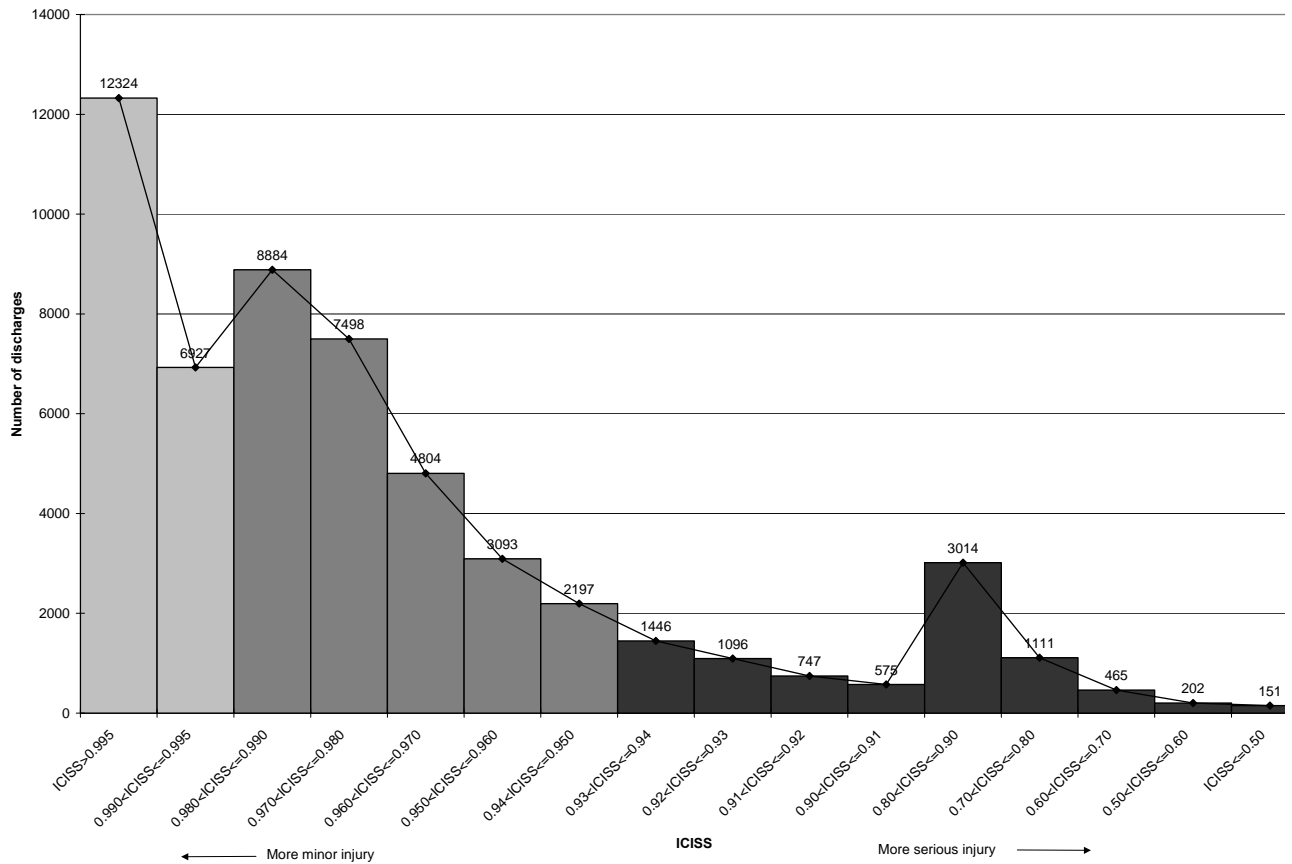
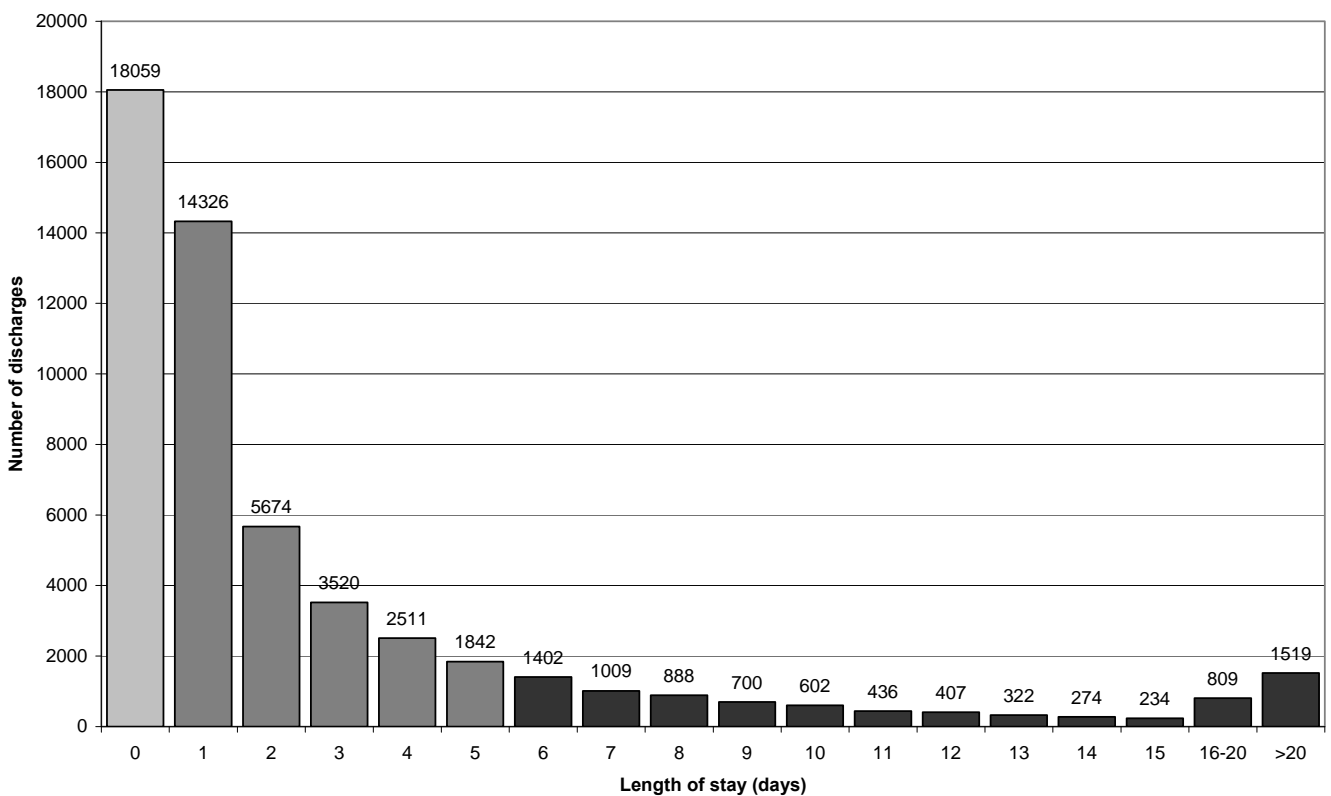


Figure A6: Number of non-fatal discharges with injury due to MVTC, 2002-2006 by length of stay



Deliberate self-harm (DSH), admissions 2002-2006

Unlike other priority areas, more women are admitted with DSH injuries than men, 69% of all DSH admissions (16,330) were for women. Women outnumber men in both Māori and non-Māori populations. Most admissions occurred in the adolescent and early adulthood age groups, with 31% (7269) in the 15-24 year old and 47% (11,129) in the 25-44 year old age groups.

Few admissions have a serious threat to life; only 4% of all admissions for DSH (837) had a ICISS of less than 0.940. 68% (16,103) have a threat to life of less than 1%. Most (73% or 17,372) admissions are for one day or less, few (3% or 819) are for longer than 14 days.

Table A30: Number of non-fatal discharges with injury due to DSH, 2002-2006 by gender and ethnicity

	Māori	Non-Māori	Total
Female	2231	14099	16330
Male	1253	6230	7483
Total	3484	20329	23813

Table A31: Number of non-fatal discharges with injury due to DSH, 2002-2006 by life cycle age group

Age group (yrs)	Number of discharges (%)
0-4	0 (0%)
5-14	487 (2%)
15-24	7269 (31%)
25-44	11129 (47%)
45-64	4257 (18%)
65-74	345 (1%)
75+	326 (1%)
Total	23813

Figure A7: Number of non-fatal discharges with injury due to DSH, 2002-2006 by ICISS

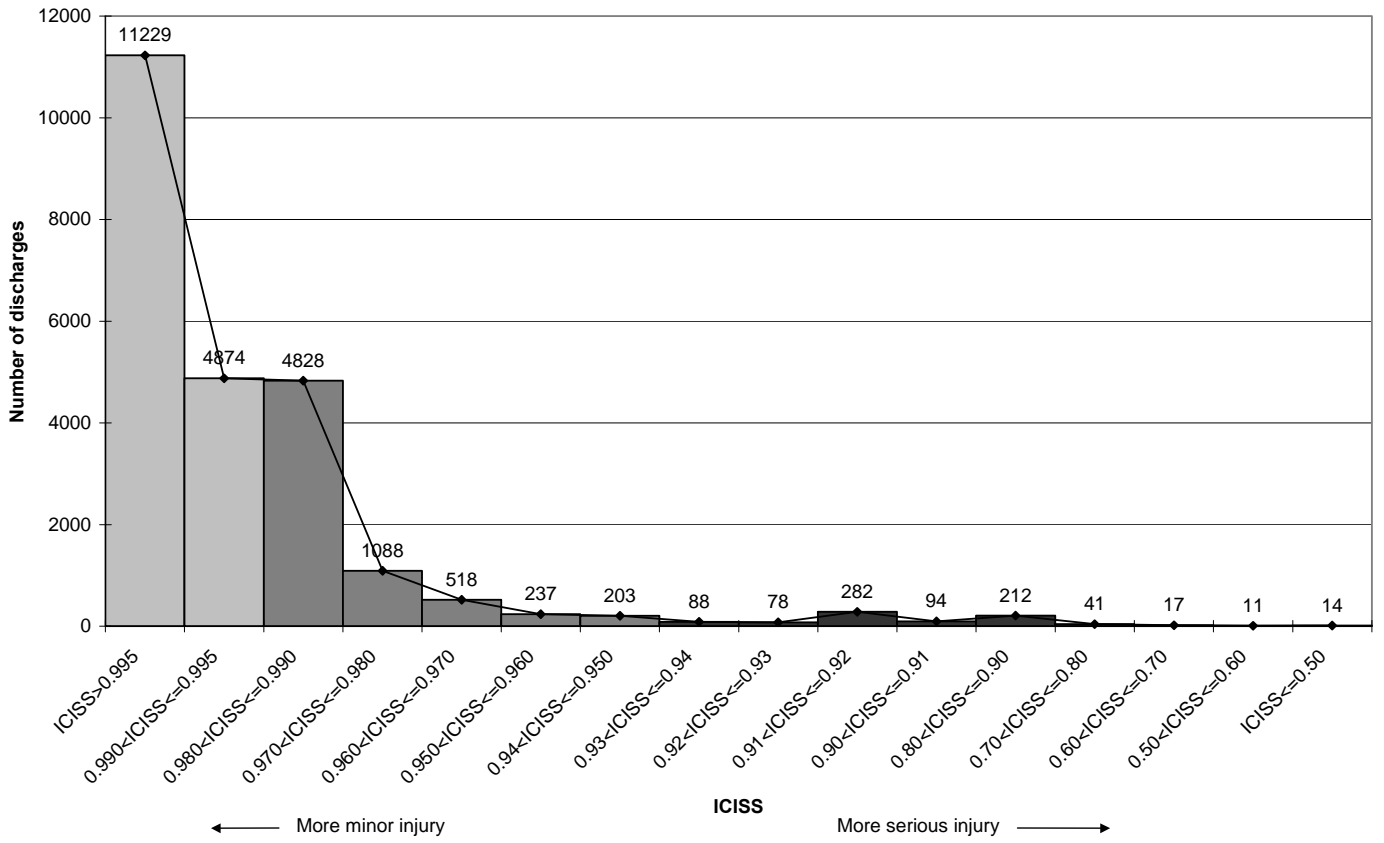
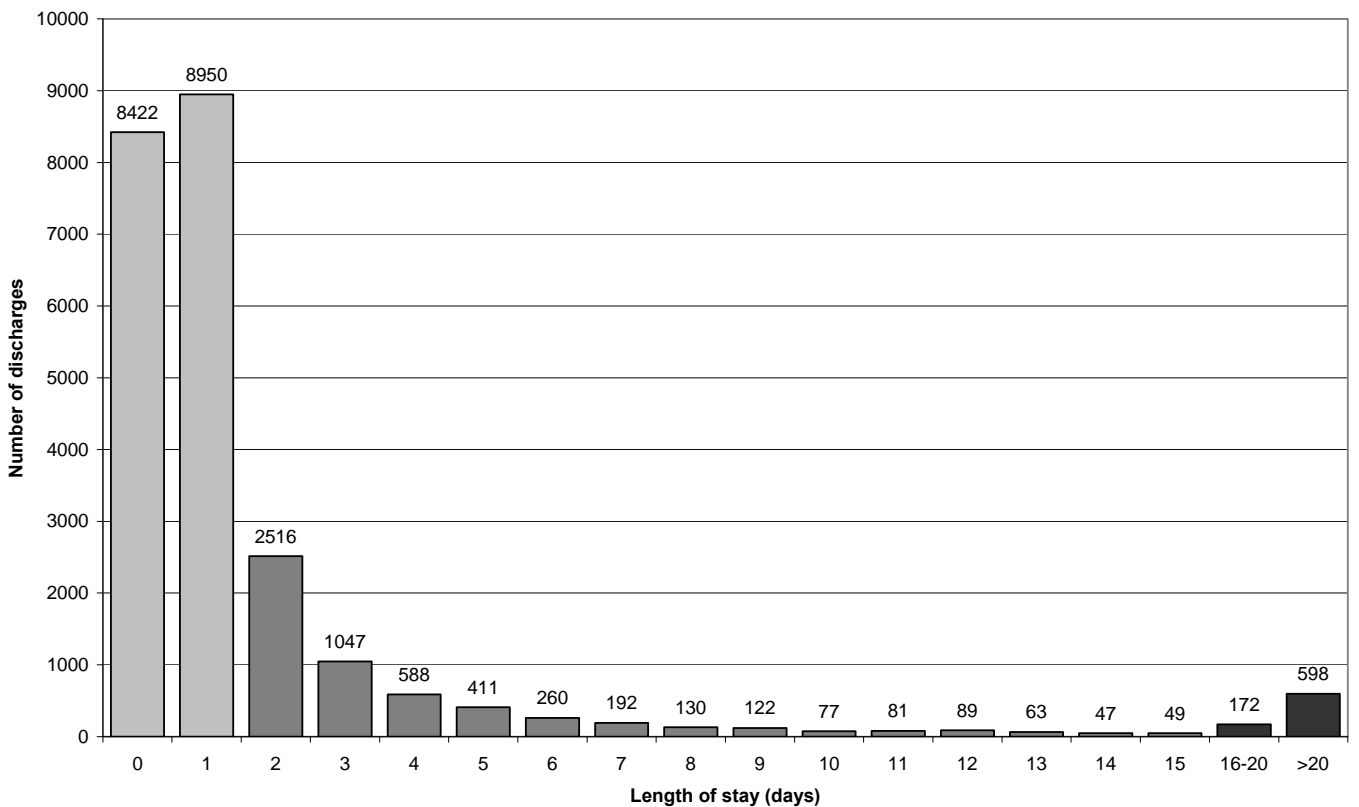


Figure A8: Number of non-fatal discharges with injury due to DSH, 2002-2006 by length of stay



Assault, admissions 2002-2006

More men than women are admitted to hospital with injuries due to assault. Māori are over-represented with 34% (6904) of all hospitalisations with injuries assault being Māori. Māori women make up 47% of all women hospitalised with injuries due to assault. Admissions for assault occur mostly in the 15-24 and 25-44 year old age groups. These two groups combined make up 83% of all admissions (16,807).

There is a broad range of severity scores for assault. Unlike other categories, a greater proportion of admissions are in the moderate and serious categories. 13% of admissions (2660) have a threat to life of greater than 6%. Most admissions are for zero days stay, with only 15% (2937) being for longer than two days duration.

Table A32: Number of non-fatal discharges with injury due to assault, 2002-2006 by gender and ethnicity

	Māori	Non-Māori	Total
Female	2390	2643	5033
Male	4514	10651	15165
Total	6904	13294	20198

Table A33: Number of non-fatal discharges with injury due to assault, 2002-2006 by life cycle age group

Age group (yrs)	Number of discharges (%)
0-4	331 (2%)
5-14	608 (3%)
15-24	8024 (40%)
25-44	8783 (43%)
45-64	2144 (11%)
65-74	185 (1%)
75+	123 (1%)
Total	20198

Figure A9: Number of non-fatal discharges with injury due to assault, 2002-2006 by ICISS

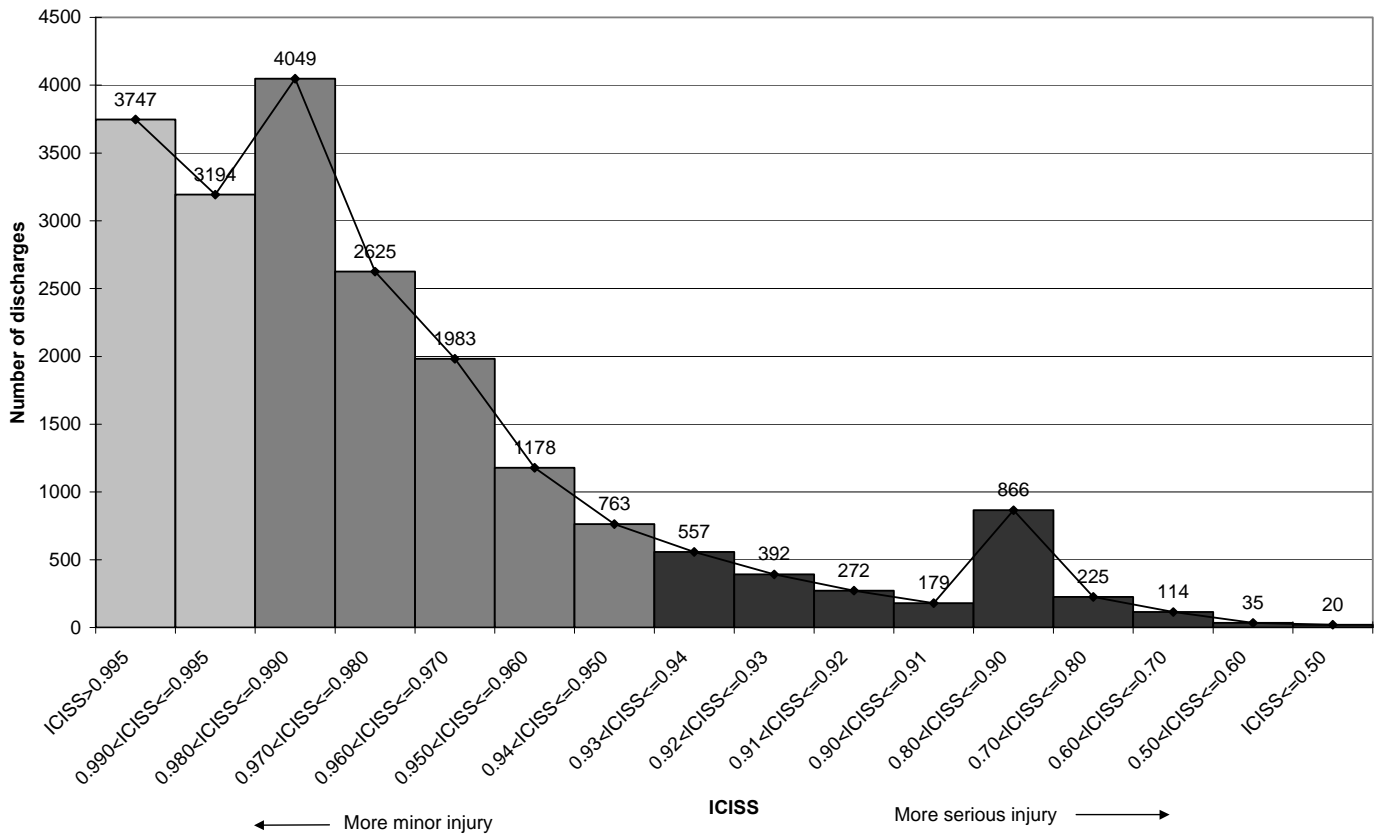
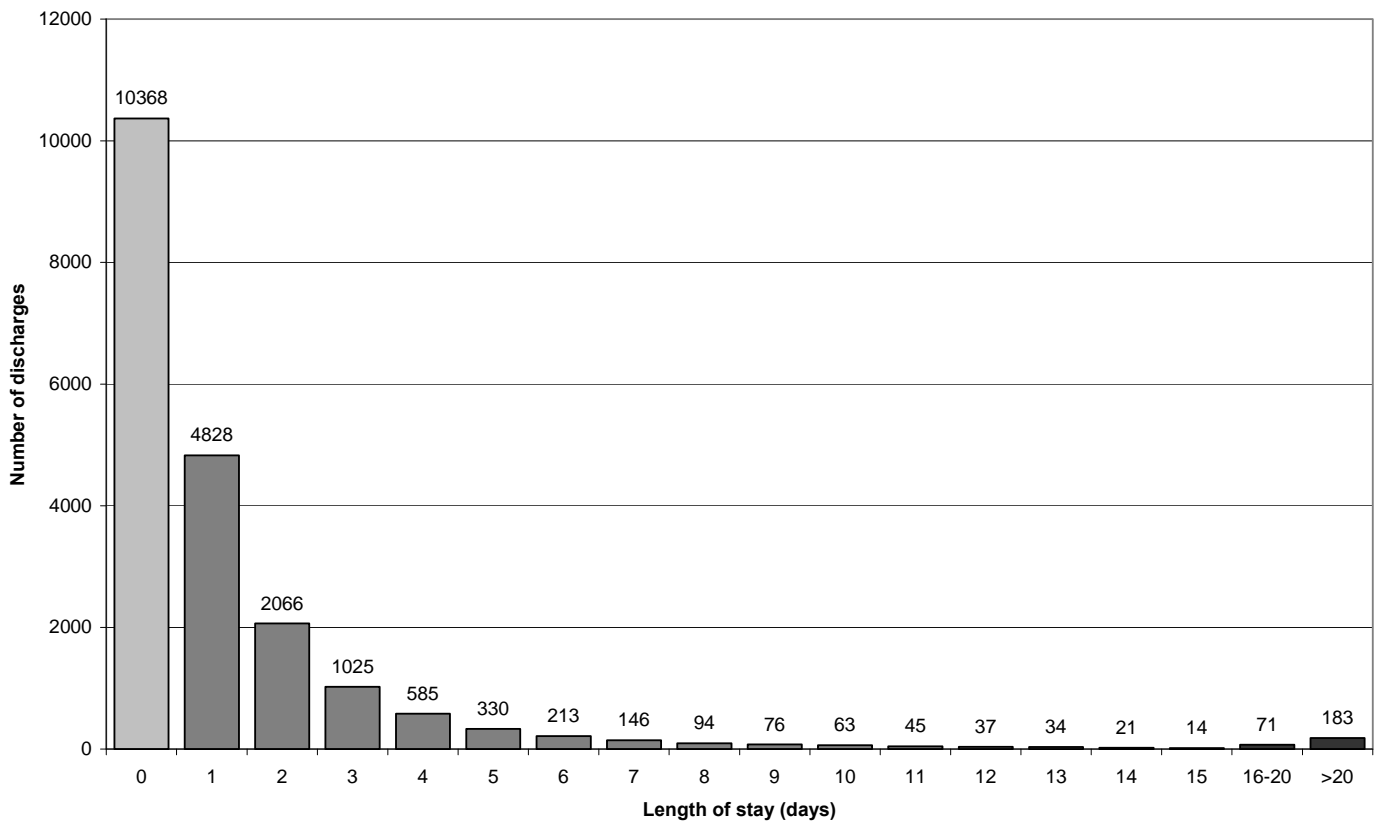


Figure A10: Number of non-fatal discharges with injury due to assault, 2002-2006 by length of stay



Drowning, admissions 2002-2006

The number of admissions with drowning was very low in comparison to the other priority areas, with a total of 453 between 2002 and 2006. More men were admitted than women, and Māori were over-represented. Most admissions occur in the younger age groups, with 71% (321) occurring in people under 24 year olds.

As almost all admissions have the same injury event code, and therefore have the same severity score. This score falls in the 0.961-0.970 category, creating the unusual distribution of severity scores seen in figure 18. 124 admissions are in the PHI-defined minor length of stay category of zero days stay; most (363) admissions are for one day or less.

Table A34: Number of non-fatal discharges with injury due to drowning, 2002-2006 by gender and ethnicity

	Māori	Non-Māori	Total
Female	39	118	157
Male	70	226	296
Total	109	344	453

Table A35: Number of non-fatal discharges with injury due to drowning, 2002-2006 by life cycle age group

Age group (yrs)	Number of discharges (%)
0-4	135 (30%)
5-14	99 (22%)
15-24	87 (19%)
25-44	68 (15%)
45-64	40 (9%)
65-74	15 (3%)
75+	9 (2%)
Total	453

Figure A11: Number of non-fatal discharges with injury due to drowning, 2002-2006 by ICISS

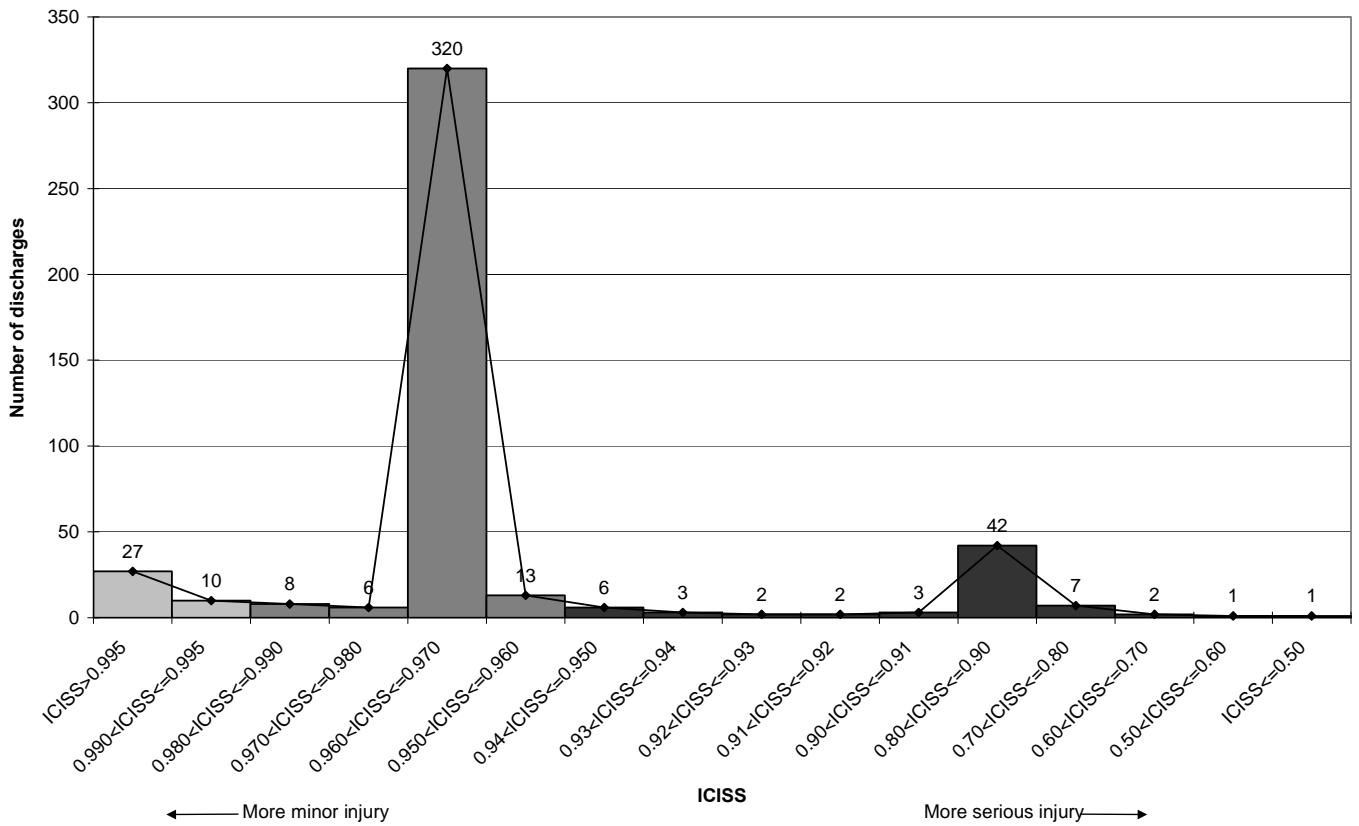
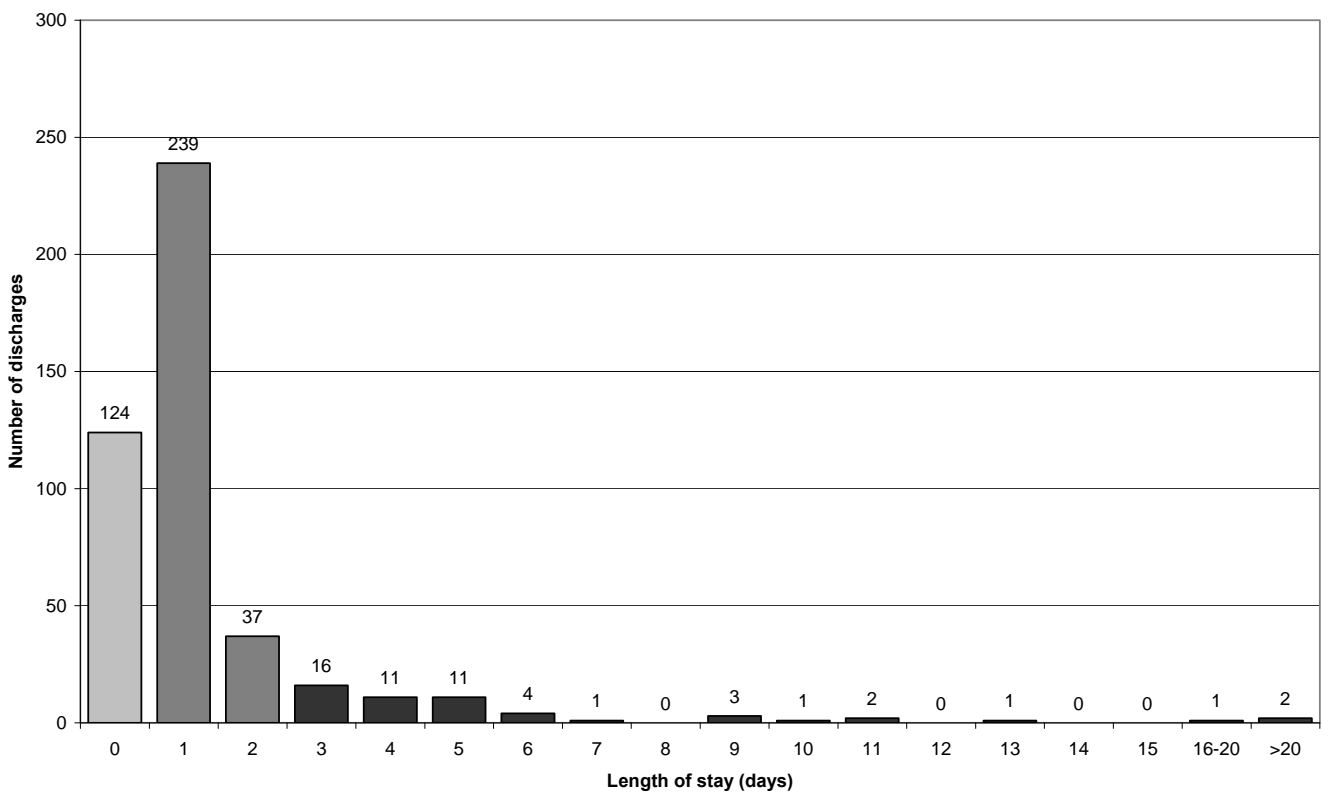


Figure A12: Number of non-fatal discharges with injury due to drowning, 2002-2006 by length of stay



Summary of descriptive analyses

The different injury priority areas affect different population groups. Children and older adults are frequently admitted with falls, where adolescents and young adults are admitted with MVTC, DSH and assault injuries. More men than women are admitted with injuries due to MVTC, assault and drowning. Maori are over represented in admissions with MVTC and assault. These population groups may have underlying differences, such as other illnesses (co-morbidities), pre-injury functioning, socio-economic circumstances and availability of support services, all of which may affect length of stay.

Length of stay and ICISS have different distributions for all injury and within priority areas. 55% of all hospital admissions with injury were of (PHI-defined) minor severity, meaning that the injuries had a risk of death of less than 1%. However only 25% of all hospital admissions with injury are for less than 24 hours stay. Only 5% of all injury admissions are due to more serious injuries, that is, those with an ICISS less than or equal to 0.940. A larger percentage (29%) of all injury admissions had a duration of 5 days or more.

Falls and DSH admissions can be long, but a small proportion of the total are serious. While only 6% of admissions for falls, and 4% for DSH have an ICISS of less than or equal to 0.940, 30% of falls admissions are for 5 days or more, and 10% of DSH admissions. Assault admissions are often short, but many have an important risk of death. 51% of admissions are for less than one day, 13% have an ICISS of less than or equal to 0.940. If length of stay and ICISS were identifying similar admissions, the two variables would be expected to have more similar distributions for each of the priority areas. The type of injuries, population affected and treatment required, varies widely amongst the areas, and consequently the range of length of stay may vary. For example, although many assault injuries have a moderate threat to life, they may be experienced by a mostly healthy, young adult population. Treatments for serious injuries may not require lengthy periods of hospitalisation or immobilisation, resulting in shorter length of stay.

The different population groups affected by injury priority areas, and the differing distributions of ICISS and length of stay provide some, but not strong evidence supporting the finding that length of stay is not a reliable indicator of risk of death.

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