Obtaining Routine Estimates of the Lifetime Cost of Hospitalised Injury

Description of a Method to Estimate the Cost of Inpatient Hospital Care

A Report prepared for the Labour Market Policy Group
Department of Labour

Shaun Stephenson
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Executive Summary

Aims
The aims of this report are to:

1. Describe in detail a method to apply hospital inpatient costs to the population of injury events resulting in inpatient treatment;

2. Discuss methods to apply ACC costs to the population of injury events resulting in inpatient treatment.

Source of Data
The source of the hospital inpatient information will be the National Minimum Data Set (NMDS) which includes information about all day patients and inpatients discharged from public hospitals throughout New Zealand. IPRU obtains data on injury discharges from the NMDS yearly. The data set includes a range of variables useful in describing an injury event.

Diagnostic Related Groups (DRGs)
DRGs are intended to classify hospital discharges into groups that receive similar treatment and hence incur similar cost. Costs can be estimated for DRGs using a three stage process.

1. Assign a DRG to each discharge using so-called 'Grouper' software.

2. Determine a cost weight for each discharge using the Weighted Inlier Equivalent Separations (WIES) methodology. This is an Australian system, which has subsequently been amended to reflect New Zealand health care practice.

3. Multiply the cost weight derived in stage 2 by the price of a cost weight with a value of 1.0 to produce a dollar estimate of the cost of the discharge.

Format/specifications and quality issues with the data
Relevant variables able to be derived from the NMDS are activity, cause/mechanism, intent, injury type, severity, setting, age, gender, prioritised ethnicity, geographic region, and socio-economic status. The quality of the data for these variables varies.

Case Selection
The report highlights the importance of case selection. Paramount is a clear theoretical and operational definition of injury.

Determining Injury Events from Discharges
Critical for estimating the total hospital inpatient care cost of an injury event is developing a method for identifying readmissions associated with the event. Previous IPRU investigations have shown that nearly all readmissions occur within 12 months of injury.

Calculating the Cost of Each Discharge
The process of converting information from a single NMDS discharge into a cost involves three steps, assigning a DRG, assigning a cost weight, and calculating a cost. Though NZHIS completes this process routinely, the resulting costs are historic costs as the DRG version, cost weight schedule, and price have changed over time. In order to produce more consistent costs, each discharge would need to be assigned a DRG coded to the same version so a

consistent cost weight schedule and price could be applied. The most recent cost weight schedule available (WIES8C) can be applied to AR-DRGs version 4.1 or 4.2, which have been included in the NMDS since 1 July 2001. In order to produce a longer time series of current costs either older discharges would have to be coded to AR-DRG 4.1 or 4.2 or an older cost weight schedule would have to be used. Both approaches are possible but would involve mapping of diagnoses between ICD versions. The different ICD and DRG versions used in New Zealand since 1994 are summarised in the report.

The total hospital inpatient care cost of each injury event is sum of the cost of each discharge calculated as described above.

Time, resources required, and cost of implementation
The marginal cost to IPRU of adding the previously described cost information to the data that it holds would be relatively small. IPRU could add cost information to the NIQS web-based query system currently available at http://www.otago.ac.nz/ipru/Statistics/NIQS.html. However, only a limited range of descriptive variables would be available and unit level data would not be available. Individual queries relating to cost could be answered with the cost depending on the extent of the queries.

Pilot Run – Fall Injury Discharges
The pilot run used average DRG costs from the Ministry of Health rather than the cost weight approach outlined above. The total cost of inpatient care for falls was found to have increased from $57.1m (1994) to $70.0m (2000). Examples of the cost of playground falls involving children and hip fractures among older women are given to demonstrate the extent of the data.

Discussion
The two key steps in the proposed method are the identification of injury events from discharges and the calculation of costs from DRGs. There are limitations inherent in both steps.

The definition of an injury event may vary depending on the question of interest. The effect on the WIES methodology of the use of mapped diagnosis and procedure codes is unknown but any problems are likely to be greater the older the data. The method has focussed on generating current costs. In may be of interest for some questions to generate historic costs. These may also be problematic to calculate. Local costs may also be useful to answer some questions but again may be difficult to calculate.

DRGs may also be limited. Where payments to hospitals are based on DRGs the hospitals have an incentive to select codes to maximise payments. Where they are not the hospitals may have little incentive to accurately record information about a patient.

The method also does not include any costs from private hospitals.

Longer term, linkage with other databases would allow other aspects of the cost of an injury event to be incorporated. IPRU has previously linked ACC and NMDS data sets. Cost elements added by ACC data are some primary care and indirect costs of lost wages. ACC data also has added variables, e.g. work relatedness. Limitations of ACC data are that ACC costs often do not reflect the total resource costs and that the ACC entitlements database is biased towards earners.

Recommendations

1. **The method described in this report be implemented.**

2. **Further investigations into the limitations of adding ACC costs information be conducted.**

Background

The Labour Market Policy Group of the Department of Labour commissioned this report. Our remit was to provide, 'A report describing in detail a method to apply hospital inpatient costs to the population of injuries resulting in inpatient treatment, as outlined in [our earlier] proposal.' We were requested to include the following information in the report:

- A clear outline of what cost information is being addressed and what information gap is being addressed
- How the cost information generated [will] address the criteria in the draft costs of injury strategy
- An outline of the source data and any known or potential access and privacy issues with utilising that data on an ongoing basis
- Format/specifications and quality issues with the data
- Details of proposed method, including
    - Expected output (what information would be generated and what it would tell us?)
    - Quality issues
    - Base data required
    - Outline of how base data will be converted into the information proposed
- Details of the time, resources required, and cost of implementing the proposed method
- Results of pilot runs using NZHIS data source
- Discussion of any insights gained from developing and testing the method, including
    - further questions
    - hidden costs or costs that are difficult to quantify or break down by injury data categories outlined in section 3.1 of [our earlier] proposal
    - limitations with what the method is able to tell us, including limitations of focussing on public hospital inpatients
    - implications of using the results
- Recommendations for future work, including
    - steps to achieve the medium term and long term aims outlined in [our earlier] proposal
    - potential to link with ACC data
    - how this will fit with the criteria in the draft costs of injury strategy

The structure and headings in the remainder of this report follow this specification.

1 Outline of costs information and information gap being addressed

In order to set priorities for injury prevention, both overall and for specific groups, it is important to be able to determine the number, severity, and cost of different types of injury. Cost information is also critical for economic evaluations of the effect of interventions. The only national all cause injury databases that are free from major biases are those maintained by the New Zealand Health Information Service (NZHIS). These are the morbidity (inpatient hospital discharges) and mortality (fatalities) databases[1]. The morbidity database, which is known as the National Minimum Data Set (NMDS)[1], has been used extensively for providing non biased estimates of the incidence and trends in different types of injury. A notable example is the analysis undertaken by IPRU that underpins the New Zealand Injury Prevention Strategy[2].

The total cost of injury includes direct costs, (e.g. money paid out by ACC, VoteHealth and the public), indirect costs, (e.g. the value of lost production), and intangible costs, (e.g. the value of lost quality of life due to injury). Calculating the value of all of the components of direct, indirect, and intangible costs presents numerous challenges. Perhaps the simplest costs to estimate are the direct costs.

The direct medical cost of an injury can be divided into a number of categories:

1. Primary care
2. Emergency services (including A&E)
3. Hospital inpatient care
4. Outpatient services
5. Other

Costs estimates of (3) will represent a significant proportion of the total cost. Though ACC contributes to all of these categories, much of this is through bulk funding of public health care. These bulk funded costs cannot be disaggregated to estimate the cost per injury event of hospital inpatient care. The NMDS represents an alternative source for this information.

The aims of this report are to:

1. Describe in detail a method to apply hospital inpatient costs to the population of injury events resulting in inpatient treatment;

2. Discuss methods to apply ACC costs to the population of injury events resulting in inpatient treatment.

The method is illustrated using injury episodes resulting from falls.

[1] While ACC data are national they suffer from a number of biases, e.g. toward earners.

2 How the cost information addresses the criteria in the costs of injury strategy

2.1 Relevance

Persons who are admitted to hospital for the treatment of injury include the vast majority of the population of injury victims with an injury representing a significant threat to life. In addition substantial numbers of those admitted would have some significant subsequent disability. Consequently a reduction in injuries requiring hospital inpatient treatment is a priority for injury prevention. However, within this group, threat to life and threat of disability, and hence cost, may vary considerably. Cost information will thus provide an extremely important complementary dimension to incidence data for the purposes of determining prevention priorities. Hospital cost information will also allow those involved in the delivery of injury prevention services to determine the benefit/cost ratios for specific interventions. For example, ACC presently has no method of determining how its bulk payment to public hospitals is distributed by, e.g. mechanism or type of injury.

2.2 Be flexible dynamic

The proposed work will allow the subsequent updating of cost information on an ongoing basis since the injury and cost information is routinely collected for other administrative reasons and this is unlikely to be discontinued.

2.3 Be efficient and affordable

This project involves no primary data gathering and as such is very efficient. It is likely to be as affordable as one could get for the expected outputs.

2.4 Be accessible

All the data is accessible. IPRU has developed protocols with data providers that have ensured access is relatively trouble free and timely.

2.5 Transparent

The costs are very easy to understand, as are the categories they can be disaggregated by (e.g. motor vehicle crash, fracture neck of the femur).

2.6 Cater for a wide range of stakeholders

IPRU has a contract with the MoH which provides for IPRU to make information available to the public on injuries requiring inpatient treatment. This has resulted in IPRU establishing an injury data query website (http://www.otago.ac.nz/ipru/Statistics/NIQS.html) and personalised query system. IPRU has received a wide variety of queries from a diverse range of individuals and agencies. Being able to add cost information would greatly enhance this service (e.g. how many dog bites were there in 2000 and what were the hospital costs associated with them?).

2.7 Supplement rather than duplicate databases being developed by information manager

We are unaware of any intention by the Information Manager to create an enhanced hospital inpatient database of injury victims such as is proposed here. Moreover the Injury Information Manager faces many injury data needs and challenges and it is extremely unlikely that all these will be addressed in the short to medium term. The IPRU has briefed the Injury Information Manager late in 2002 on IPRU's programme of research on injury surveillance. It is IPRU's intention to repeat such briefings on a needs basis.

2.8 Not impose unnecessary compliance costs

There are no compliance costs for the data providers.

2.9 Meet the requirements of the Privacy and Human Rights Act

These are addressed by the requirement for all IPRU's research projects to meet health research ethical guidelines.

3 Outline of source data. Access or privacy issues with utilising the data on an ongoing basis

3.1 Hospital Data

The NMDS includes information about all day patients and inpatients discharged from public hospitals throughout New Zealand. IPRU obtains data on injury discharges from the NMDS yearly with provisional data obtained approximately 6 months and 'final' data approximately 18 months after the end of each calendar year. The data set includes a range of variables useful in describing an injury event. These variables are described in detail below (see section 4). The data obtained is modified and enhanced by IPRU to identify a consistent set of injury events over time. This process is described in detail in sections 5.1 and 5.2.

3.2 Diagnostic Related Groups (DRGs)

3.2.1 What are DRGs and How Are They Determined?

DRGs are intended to classify hospital discharges into groups that receive similar treatment and hence incur similar cost. For the last decade New Zealand has used an adapted version of an Australian DRG system. The Australian DRGs were derived in a two-stage process. Firstly, retrospective surveys of cost information from public and private acute hospitals throughout Australia were conducted starting in 1991 [3, 4]. Secondly, characteristics of discharges that had the greatest influence on cost were identified from the survey data. DRGs were then constructed using the identified characteristics.

3.2.2 How We Can Use DRGs to Estimate the Cost of Each Discharge

The cost of each discharge is estimated in three stages. The process is outlined in Figure 3-1. The stages are:

1. Assign a DRG to each discharge using so-called 'Grouper' software.
   E.g. A given diagnosis of 'head injury' may be grouped into DRG x – Moderate Head Injury.

2. Determine a cost weight for each discharge using the Weighted Inlier Equivalent Separations (WIES) methodology. This is an Australian system, which has subsequently been amended to reflect New Zealand health care practice. In 2001/2 the version in use was WIES8A.[5] E.g. The cost weight of a DRG x – Moderate Head Injury may be 0.9361.

3. Multiply the cost weight derived in stage 2 by the price of a cost weight with the value of 1.0 to produce a dollar estimate of the cost of the discharge.
   E.g. If the price of a cost weight of 1.0 were $2,500 then Moderate Head Injury with cost weight of 0.9361 would have an estimated cost of $2,500 x 0.9361 = $2,340.

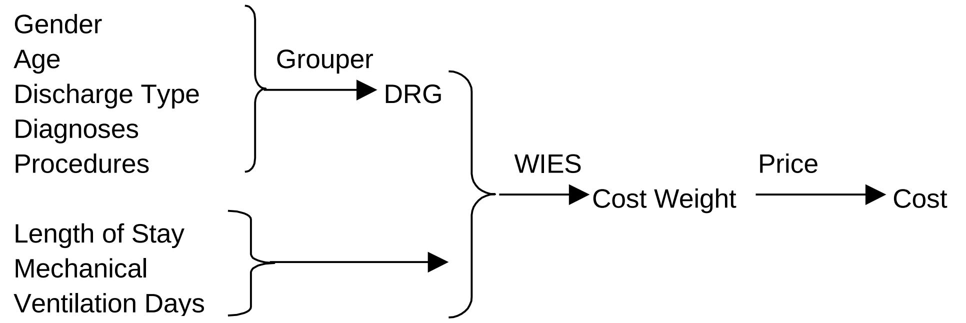

Figure 3-1 NZHIS Derivation of costs of discharges using DRGs and cost weights

The NMDS data held by IPRU includes DRGs coded using the Australian National DRGs (AN-DRGs) version 3.1 from 1994 and the Australian Refined DRGs (AR-DRGs) version 4.1 from 1 July 2001. The grouper software used by NZHIS prior to July 2001 used the first 15 diagnosis and 15 procedure codes from each discharge. The grouper software used since 1 July 2001 uses the first 20 diagnosis and 20 procedure codes. NZHIS currently assigns cost weights to inpatient and day patient discharges recorded in the NMDS.[1] Such cost weights have been included in the NMDS since July 1999.

3.3 Access or Privacy Issues

As part of IPRU's agreement with NZHIS to hold data IPRU provides a Recipient Undertaking. Among other requirements, IPRU is not allowed to supply unit record level data to others. IPRU has ethical approval to hold data with NHI numbers. This is required for the internal linkage used to identify injury events from discharges (see section 5.2).

4 Format/specifications and quality issues with the data.

The specifications of relevant variables are given below.

4.1 Activity

Description
This broadly identifies what the injured person was doing when injured. It is not coded for cases involving complications of surgical and medical care.

Values
Categories are:
- While engaged in sporting activity
- While engaged in leisure activity
- While working for income
- While engaged in other types of work
- While resting, sleeping, eating or engaging in other vital activities
- While engaged in other specified activities
- During unspecified activity

Years Available
June 1999 – present

Coding Frame
ICD-10-AM Activity Codes[6]

Quality Issues
The IPRU is currently investigating the quality of the activity coding by examining a large sample of NMDS records. Other variables being examined as part of this study are: cause/mechanism, intent, injury type, and setting.

A separate analysis of activity coding, undertaken by IPRU, showed that almost half of injury cases that could have been coded as having occurred during a specified activity were coded as having occurred 'During Unspecified Activity'.

4.2 Cause/Mechanism and Intent

Description
The NMDS includes a 4 digit external cause of injury code (E-Code) which is recorded for all hospitalisations with a diagnosis of injury. The E-code identifies both the cause/mechanism of injury as well as the intent. The causes/mechanisms can be categorised into broad groups (e.g. motor vehicle crashes, falls, and fires). They also include much greater detail (e.g. for motor vehicle crashes whether the crash occurred on a public road, whether only one or multiple vehicles were involved, and whether the person injured was a driver, passenger, cyclist or pedestrian can be identified). The intents specify whether the injury was unintentional, as a result of an assault/homicide, self-inflicted, or of undetermined intent.

Values
There are over 1000 possible 4 digit E-codes in each of the coding frames listed below. During the period from 1994 to 1998, for example, 983 different E-codes were used. There are numerous broad groups that have been identified in the E-codes. The International Collaborative Effort (ICE) on Injury Statistics have published matrices for each of the coding frames below that provide one set of mutually exclusive causes/mechanisms and intents.[7, 8] The ICE matrices are attached as Appendix 1.

Years Available
1994 – present

Coding Frame

ICD-9-CM-A[9]	1994 – June 1999
ICD-10-AM[6]	July 1999 – present

Quality Issues
IPRU is currently investigating the quality of this information (see section 4.1).

During the period from 1994 to 1998, for example, only 0.19% of injury cases did not have an e-code. A further 0.3% of injury cases had an e-code that did not specify the intent.

4.3 Injury Type (Diagnosis)

Description
The NMDS provides for up to 99 (25 until June 1998[10]) 5 digit diagnosis codes for each hospital admission describing in detail the nature and, where applicable, location of the injuries sustained. These can be categorised into broad groups by nature of injury (e.g. fractures, open wounds, burns) and body region injured (e.g. head, lower limb). However, they include much greater detail (e.g. for skull fractures, what bone was fractured, whether there was an associated open wound and whether there was any associated loss of consciousness).

Values
There are over 2000 possible 5 digit diagnosis codes in each of the coding frames below. During the period from 1994 to 1998, for example, 2203 different diagnosis codes were used. There are numerous broad groups that have been identified in the diagnosis codes. One approach to grouping the diagnosis and nature of injury codes is by using the Barell matrix.[11] This only applies to the first coding frame listed below. The Barell matrix is attached as Appendix 2.

Years Available
1994 – present

Coding Frame

ICD-9-CM-A[9]	1994 – June 1999
ICD-10-AM[6]	July 1999 - present

Quality Issues
IPRU is currently investigating the quality of this information (see section 4.1).

4.4 Severity

Description

Severity is not directly coded on the NMDS however a method for estimating the threat to life of a person's injuries using the types of injuries suffered (the ICISS method[12]) is being examined by the authors and shows considerable promise.[13]

Values

ICISS gives an estimate of the probability of death between 0 and 1.

Years Available

1994 – present

Coding Frame

Not applicable.

Quality Issues

The results of early investigations [13] are that ICISS is a good predictor of probability of death when applied to ICD-9-CM-A [9] data. Further research by the authors examining the applicability of ICISS to ICD-10-AM [6] is in progress.

4.5 Setting (Place of occurrence)

Description

This identifies the type of location where the injury occurred. It is not coded for transport related injuries for the period July 1999 – June 2001.

Values

Categories are:

ICD-9-CM-A	ICD-10-AM
Home	Home
Farm	Residential institution
Mine or quarry	School, other institution and public administrative area [a]
Industrial place and premises	Sports and athletics area
Place for recreation and sport	Street and highway
Street or highway	Trade and service area
Public building	Industrial and construction area
Residential Institution	Farm
Other specified	Other specified places
Unspecified	Unspecified place

[a] Note: From July 2001 this category was separated into School, Health service area and Other.

Years Available

1994 – present

Coding Frame

ICD-9-CM-A Place of Occurrence Codes [9]	1994 – June 1999
ICD-10-AM Place of Occurrence Codes [6]	July 1999 - present

Quality Issues
The IPRU is currently investigating the quality of this information (see section 4.1).

Independently, previous IPRU analysis has shown that during the period from 1994 to 1998, for example, only 0.2% of injury cases did not have a location code, however, over 40% of cases were coded as having occurred in an 'Unspecified' setting.

4.6 Age

Description
Age of the patient at date of discharge (in years). As the underlying data is the date of birth more precise ages can be derived.

Values
0 -

Years Available
1994 – present

Coding Frame
Not applicable

Quality Issues
The quality of this data is unknown. The data is present for all cases.

4.7 Gender

Description
Gender of the patient.

Values
Male, Female.

Years Available
1994 – present

Coding Frame
Not applicable.

Quality Issues
The quality of this data is unknown. IPRU has ascertained during the period from 1994 to 1998, for example, only 0.002% of injury cases did not have a specific gender code.

4.8 Prioritised Ethnicity

Description
Prioritised self identified ethnicity of the patient. Up to three ethnicities can be reported. Where multiple ethnicities are reported, a single ethnicity is assigned based on the priorities outlined in the coding frame below.

Values
There are 32 ethnicities at the most detailed level of the coding frame below. These can be grouped with the highest level contained five categories. These are:
- Maori
- Pacific Islander
- Asian
- Other
- New Zealand European

Years Available
1996 – present

Coding Frame
New Zealand Standard Classification of Ethnicity 1996 [14]

Quality Issues
There has been research into the quality of ethnicity numerators in New Zealand health data but most of this has focused on mortality data. There have been some investigations related to hospitalisation data.[15] These indicate Maori may be underreported in the National Health Index, which is the basis of these data.

4.9 Geographic Region

Description
The place of residence of people injured is recorded in the NMDS in the form of the area unit in which they live. An area unit is a geographic region defined by Statistics NZ generally with a population of 3000-4000 people. Urban area units are about the size of a suburb. Area units can be aggregated to describe people injured by region, local authority or DHB.

Values
There are approximately 1800 – 1900 area units in New Zealand.

Years Available
1994 – present

Coding Frame
IPRU has coding frames to aggregate area units into local authorities, regions, or DHBs. Other aggregations are possible.

Quality Issues
The quality of this information is not known.

4.10 Socio-Economic Status

Description
The socio-economic status of people injured is not recorded on the NMDS but the NZ Index of Deprivation (NZDep) can be added. NZDep indicates the level of deprivation of the area unit in which injured people live (see section 4.9 above for a description of area units) based on data from the census.

Values
NZDep provides an ordinal score of 1 to 10 or a indexed score with a mean of 1000, standard deviation of 100 for each are unit.[16]

Years Available
Three versions of NZDep have been published coinciding with the censuses of 1991, 1996, and 2001.[17]

Coding Frame
Not applicable.

Quality Issues
NZDep has been validated to the degree that it has been shown to have similar relationships with health outcomes to those that other SES measures have.[18]

5 Method

5.1 Details of Source Data

Data will be selected from the NMDS. Criteria for selection of cases from the NMDS will need to be determined. The authors have previously published research discussing NMDS injury case selection issues.[19]

Paramount to the study of any disease or phenomenon is the clear definition of the variables of interest. The definition of injury has been fraught with challenges and complexities. Importantly, injuries unlike diseases must be defined simultaneously by the causative event and by the resulting pathology. For example, bruising can occur in the absence of an injury event (e.g. in the case of sepsis or a bleeding disorder) and thus, taken alone, cannot be considered an injury. Similarly there are many events, such as car crashes, that result in no pathology, even if 'victims' are bought to an emergency department for observation. Thus, the theoretical definition of injury must incorporate both cause and outcome. Equally challenging is the operational definition of injury, for example, which diagnoses, codes or combination of codes from the International Classification of Diseases.

Using the New Zealand experience, we have demonstrated that estimates of the incidence of injury can vary substantially depending on one's operational definition of injury.[19] This has important implications for determining costs. (See appendix 3 for detailed discussion of the issues). There is at this stage no international consensus on this matter. Irrespective, what is defined as injury depends to a large extent on the end users needs (e.g. injury epidemiologists may not consider "medical injury" to be within the sphere of injury epidemiology. ACC, on the other hand, may consider it to be of considerable interest.

There have principally been two coding frames used to code many of the relevant variables in the NMDS (see section 4). These are the Australian version of the clinical modification of the 9th edition of the International Classification of Diseases (ICD-9-CM-A)[9] and the Australian clinical modification of the 10th edition of the International Classification of Diseases (ICD-10-AM)[6]. Data from 1 July 1999 onwards was coded using ICD-10-AM.

5.2 Determining Injury Events From Discharges

The IPRU has done considerable work to enhance this database for use in injury epidemiology including developing a method for identifying readmissions associated with a single injury event. This is critical for determining the total cost of inpatient care for an injury event. Discharges are identified as readmissions if they satisfy either of the two criteria:

1. Where multiple discharges have the same date of injury and NHI number all but the one with the oldest admission date is coded as a readmission; or

2. Where multiple discharges have the same NHI numbers any case with an admission date within one day of another case's discharge date is coded as a readmission.[19]

Previous IPRU investigations have shown that for the vast majority of injury events resulting in hospitalisation all occasions of inpatient care occur within 12 months of the injury. Hence, cost estimates will be able to be produced for the second to most recent year of data available without significant underestimation of costs due to censored data.

5.3 Calculating the Cost of Each Discharge

As described above, the process of converting information from a single NMDS discharge into a cost involves three steps, assigning a DRG, assigning a cost weight, and calculating a cost (see section 3.2.2). Though NZHIS completes this process routinely, the resulting costs are historic costs as the DRG version, cost weight schedule, and price have changed over time. In order to produce more consistent costs, each discharge would need to be assigned a DRG coded to the same version so a consistent cost weight schedule and price could be applied. The most recent cost weight schedule available (WIES8) can be applied to AR-DRGs version 4.1 or 4.2, which have been included in the NMDS since 1 July 2001. In order to produce a longer time series of current costs either older discharges would have to be coded to AR-DRG 4.1 or 4.2 or an older cost weight schedule would have to be used. The different ICD and DRG versions used in New Zealand since 1994 are summarised in Figure 5-1.

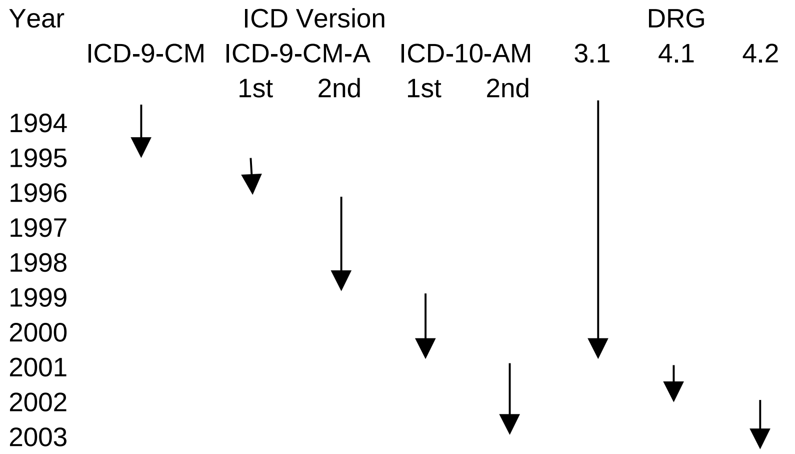

Figure 5-1 Changes in DRG and ICD Principal Coding Frames Used in New Zealand

Older discharges could be coded to AR-DRG 4.1 by first forward mapping the codes from ICD-9-CM-A to ICD-10-AM then applying the newer grouper software. Forward and back maps are available from the Australian National Centre for Classification in Health. NZHIS could apply the new grouper software for an appropriate fee.

Using an older cost weight schedule is the easier option as the NMDS has included AN-DRG version 3.1 codes since 1994. A cost weight schedule (WIES5) is available so costs could be calculated, however, the cost weights are dated so may not reflect current practice. The price of a cost weight of 1 would also need to be updated to produce current $ costs. The AN-DRGs version 3.1 are based on ICD-9-CM-A diagnosis and procedure codes. These are generated by NZHIS by back mapping for cases since 1 July 1999, which are coded to the ICD-10-AM coding frame. Though this will generally be sufficient for answering most questions, the mapping inevitably leads to less specific coding in some categories. There is also potential for the AN-DRG version 3.1 codes to not be entirely compatible over time as the grouper software used to generate these codes has changed.

The method we have proposed will produce costs that depend upon the patient's length of stay in hospital. If changing treatment patterns through time have reduced lengths of stay, costs will have been falling. If, for the purpose examining a particular question, it is necessary to adjust for this change in length of stay over time, the analyst would need to determine the mean cost per DRG for the most recent year. These mean costs could then be applied to all discharges taking place in all the years of interest.

5.4 Calculating the Cost of Each Injury Event

The total hospital cost for an injury event is the sum of the costs for all associated discharges. The set of discharges associated with each event would be developed as described in section 5.2 and the cost of each discharge would be calculated as described in section 5.3.

5.5 Time, resources required, and cost of implementing the proposed method

IPRU currently holds data for 1994-2001 and has enhanced it as specified in the preceding sections. The costs of developing and maintaining this database have been substantial. The marginal cost of adding the previously described cost information to these data would be relatively small to IRPU. The cost to any other group of purchasing, cleaning and enhancing the data could be considerable. We have not produced an estimate of costs since, at this stage, the nature and frequency of outputs has yet to be specified.

IPRU could add cost information to the NIQS web-based query system currently available at http://www.otago.ac.nz/ipru/Statistics/NIQS.html, however this does not include the full range of descriptive variables discussed in section 4. At present the system allows a user to select the years, mechanism/cause, manner/intent, age group, gender, and district health board of interest and generates incidence and incidence rates by year. Adding cost information would allow the same range of inputs and would add two extra outputs, the total and the mean cost of inpatient care. The cost of this development would be relatively small.

In order to make use of the full range of descriptive variables IPRU would have to make provision for answering specific queries based on the data set. It would not be possible under such an arrangement for IPRU to provide access to unit level data, as this would breach our recipient undertaking with NZHIS. The cost of answering queries based on this data would depend on the nature and extent of the queries.

An alternative would be for another group to undertake the task of purchasing, cleaning and enhancing the data and attaching the costs as described in this report. The ethical issues surrounding release of unit level data would still be present.

6 Pilot Run – Fall Injury Discharges

6.1 Method

Injury events were defined as those where the first discharge had a principal diagnosis of injury (800-999, see section 4.3).[19] Falls were defined as injury events where the first discharge had an e-code of 880-886, 888, 957, 968.1 or 987 [7] (see section 4.2). ICD-9-CM-A diagnosis and e-codes from 1 July 1999 onwards were obtained by backmapping the ICD-10-AM codes.

Data available did not include cost weights so costs were estimated using average DRG costs obtained from the Ministry of Health[20]. These costs may not match those that would be produced by using cost weights, as the distribution of lengths of stay of injury discharges may not be typical within a DRG.

6.2 Results

6.2.1 Cost per injury event

There were 131,676 fall events identified for 1994 to 2000 that resulted in inpatient hospitalisation. The estimated total cost of inpatient care for these events was $438m giving a mean cost of $3329 per event. The mean cost per event rose from $3122 in 1994 to $3395 in 2000 (see Table 6.1). The cost per year of inpatient care for fall events rose from $57.8 million to $70.0 million.

Table 6.1 Cost of falls per injury event by year of first discharge

Year of Discharge	Injury Events	Mean Cost per Event ($)	Total Cost ($ millions)
1994	18526	3,122	57.8
1995	17670	3,176	56.1
1996	18003	3,343	60.2
1997	18599	3,371	62.7
1998	18867	3,407	64.3
1999	19384	3,470	67.3
2000	20627	3,395	70.0

6.2.2 Number of discharges per injury event

The overwhelming majority of fall injury events involved a single admission to hospital. However the mean number of discharges per injury event increased over the period (see Table 6.2).

Table 6.2 Mean Discharges per Injury Event 1994-2000

Year	Discharges per Event
1994	1.10
1995	1.12
1996	1.18
1997	1.18
1998	1.19
1999	1.20
2000	1.20

6.2.3 Duration of hospital treatment for injury events

The 18,526 injury events first discharged in 1994 resulted in 1,773 subsequent discharges almost all of which occurred in 1994 or 1995 (see Table 6.3).

Table 6.3 Total Subsequent Discharges by Year Where the First Discharge Year Was 1994

Year	Subsequent Discharges
1994	1657
1995	112
1996	2
1997	1
1998	1
1999	0
2000	0

6.2.4 Specific Examples

In order to demonstrate the detail available from this data two examples are given: Changes in playground falls involving children and hip fractures among older women.

Example 1: Changes in the Cost of Playground Falls Involving Children
The first example examines changes in the cost of playground falls involving children. Children are defined as people aged 0 to 14 years old. Firstly, to put the problem in context, Table 6.4 shows the total cost of inpatient care for child falls by 3 digit e-code. 'E884 - Other falls from one level to another' account for $33.6 million. This is 56% of the costs of child falls.

Table 6.4 Cost of Child Falls by 3 Digit E-Code

E-Code	Description of E-Code	Discharges	Cost ($ 000s)
E880	Fall on or from stairs or steps	1688	2392
E881	Fall on or from ladders or scaffolding	299	484
E882	Fall from or out of building or other structure	2358	3792
E883	Fall into hole or other opening in surface	1452	2133
E884	Other fall from one level to another	23568	33595
E885	Fall on same level from slipping, tripping, or stumbling	4073	5899
E886	Fall on same level from collision, pushing, or shoving, by or with other person	2820	4224
E888	Other and unspecified fall	5103	7059
E957	Suicide and self inflicted injuries by jumping from a high place	0	0
E968	Assault by other and unspecified means	3	2
E987	Falling from high place, undetermined whether accidentally or purposely inflicted	10	18

Looking at E884 in more detail (Table 6.5) shows the most substantial contributor is falls from playground equipment. Trampolines were included in playground equipment for some of the period analysed so have been included in playground equipment for the rest of this analysis.

Table 6.5 Cost of Child Falls From One Level to Another (E884) by 4th Digit of E-Code

4th Digit of E-Code	Description	Cost ($ 000s)	% of Cost
0	Playground Equipment	14833	44%
1	Cliff	226	1%
2	Chair	3046	9%
3	Tree	2319	7%
4	Bed	1579	5%
5	Trampoline	1181	4%
6	Wheelchair	91	0%
7	Commode	8	0%
9	Other	10312	31%

Now, focusing on child falls from playground equipment (and trampolines), Figure 6-1 shows the most expensive age group are those aged 5-9 years old and the costs of this group have increased over the period.

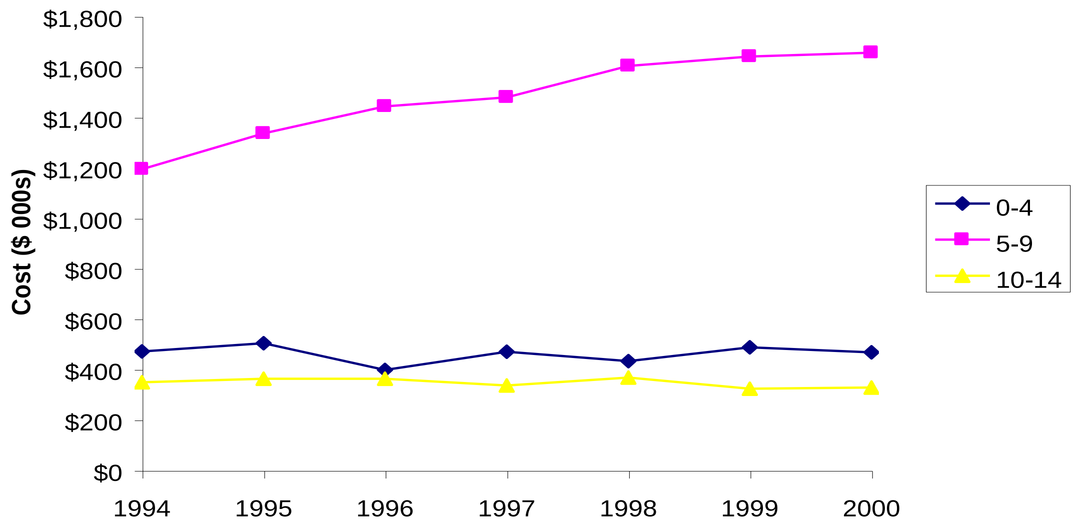

Figure 6-1 Falls From Playground Equipment Among Children By Age Group and Year

Figure 6-2 shows the cost of diagnoses of injuries incurred by 5-9 years olds falling from playground equipment by year. By far the largest component of costs is upper limb fractures. The cost of upper limb fractures has increased substantially over the period.

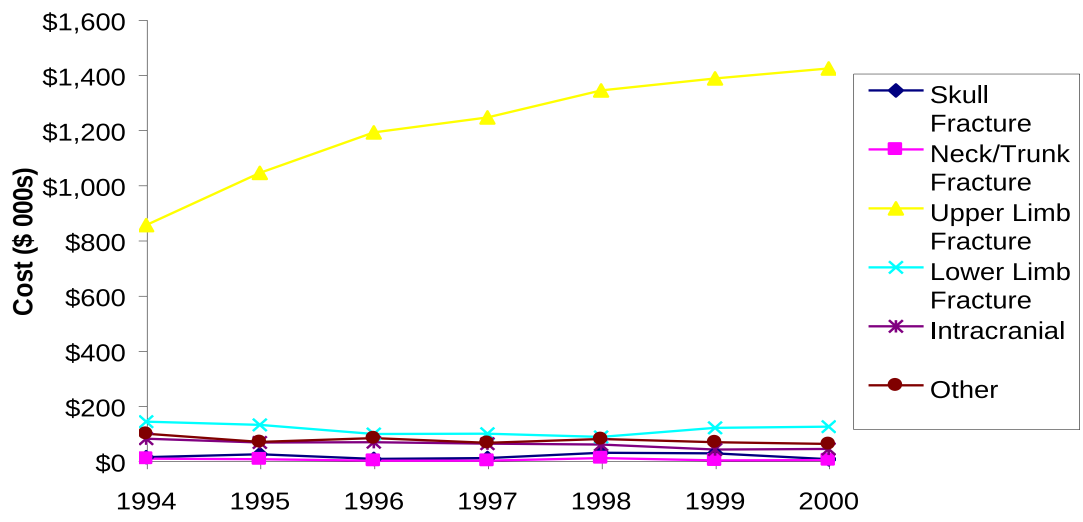

Figure 6-2 Cost of Playground Falls Among 5-9 Year Olds by Diagnosis Group

Figure 6-3 shows the cost of 3 digit diagnoses of upper limb fractures incurred by 5-9 year olds falling from playground equipment by year. Fractures of the radius and ulna were more expensive in total than fractures of the humerus. The cost of both humerus and radius and ulna fractures have increased over the period.

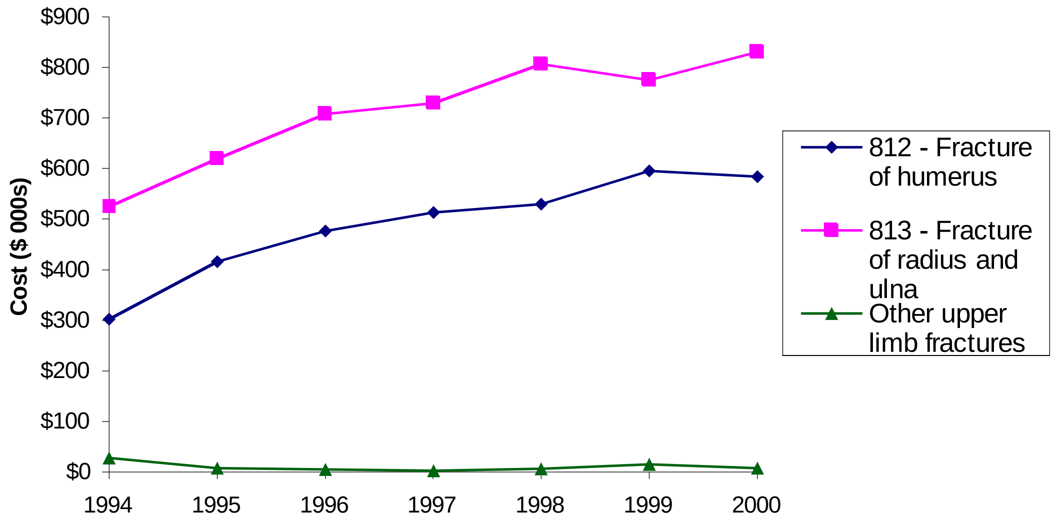

Figure 6-3 Cost of Upper Limb Fractures Resulting From Playground Falls Among 5-9 Year Olds by 3 Digit Diagnosis

Example 2: Cost of Hip Fractures Among Older Women

Hip fractures cost $169.5 million and hence accounted for 39% of the cost of falls from 1994-2000. Females accounted for 76% of this cost ($128.7 million). The number of hip fractures, mean cost and total cost of inpatient care for hip fractures among women is shown in Table 6.6. The mean cost rises with age from about 60 years old. Women over 65 years old account for 93% of the total cost.

Table 6.6 Frequency and Cost of Hip Fractures Among females 1994-2000 by Age

Age	Number of hip fractures	Mean Cost ($)	Total Cost ($ 000s)	% of Total Cost
0-4	25	3448	86	0%
5-9	18	5962	107	0%
10-14	56	6111	342	0%
15-19	6	7529	45	0%
20-24	4	8673	35	0%
25-29	3	5064	15	0%
30-34	5	6784	34	0%
35-39	13	7163	93	0%
40-44	22	7282	160	0%
45-49	31	7833	243	0%
50-54	97	7459	723	1%
55-59	136	7822	1064	1%
60-64	229	8263	1892	1%
65-69	550	8623	4742	4%
70-74	1249	8798	10989	9%
75-79	2278	8890	20252	16%
80-84	3667	8969	32889	26%
85-89	3507	8946	31375	24%
90-94	2012	9070	18248	14%
95+	602	8928	5375	4%

Table 6.7 shows the setting in which the hip fractures occurred among women aged 65 years and older. The analysis is restricted to 1994 to 1998 to avoid the change in coding frame. Most of the cost is associated with fractures that occurred at home or in residential institutions.

Table 6.7 Setting of Hip Fractures among 65+ year old women (1994 – 1998 only)

Location Code	Description	Frequency	Total Cost ($ 000s)
0	Home	4833	42863
1	Farm	10	81
2	Mine or quarry	3	24
3	Industrial place and premises	5	42
4	Place for recreation and sport	55	449
5	Street or highway	229	1968
6	Public building	222	1977
7	Residential Institution	3094	27502
8	Other specified	61	529
9	Unspecified	1030	9074

The distribution of hip fracture costs for women aged 65 and older by DHB is shown in Table 6.8. It is worth noting that the differences in cost between regions may reflect differing levels of medical complications.

Table 6.8 Cost of Hip fractures among 65+ year old women by DHB

DHB	Frequency	Mean Cost ($)	Total Cost ($ 000s)
Northland	398	8834	3516
Waitemata	1333	9177	12233
Auckland	1608	9126	14675
Counties Manukau	863	8804	7598
Waikato	1019	8797	8964
Lakes	295	8563	2526
Bay of Plenty	679	8816	5986
Tairawhiti	147	8566	1259
Hawkes Bay	640	8802	5633
Mid Central	689	8979	6186
Taranaki	458	8427	3860
Whanganui	271	8331	2258
Capital and Coast	820	8661	7102
Hutt	472	8622	4070
Wairarapa	178	9110	1622
Nelson Marlborough	490	8350	4092
Canterbury	1858	9417	17497
West Coast	98	9938	974
South Canterbury	295	9006	2657
Otago	762	8858	6750
Southland	343	9029	3097
Unspecified	149	8836	1317

7 Discussion of insights gained from developing and testing the method

7.1 Strengths and Limitations of the Method

The process to implement the proposed method is relatively simple. The two key steps are the identification of injury events from discharges and the calculation of costs for DRGs. The first of these steps is routinely done by IPRU and the second is done by NZHIS using the WIES methodology and implemented in the NMDS via the cost weight variable. However, there are limitations inherent in both steps.

The use of injury events rather than discharges as a denominator is a strength of the approach outlined in this report. However, it may not be possible to construct a cost database where the unit record is an injury event as the definition of the extent of an injury event will vary depending on the question of interest. For example, is a fall in hospital part of the same event as the burn that resulted in the hospitalisation? If the question is, how much do hospitalised burns cost? The answer is 'yes' since treating the fall is part of the cost that results from the burn. On the other hand, if the question is, how much do injuries incurred while in hospital cost? The answer is 'no' since, if all injuries occurring in hospital are treated as part of the event resulting in hospitalisation, this question could not be answered. Careful consideration must be given to the form of any cost database to allow a variety of injury event definitions to be applied.

The use of the cost weights available in the NMDS is also potentially limited. The WIES methodology used to derive the cost weights is applicable to the second edition of ICD-10-AM, which has been in use in New Zealand since 1 July 2001. The cost weights in the NMDS for the period 1 July 1999 – 30 June 2001 were derived by first forward mapping the diagnosis and procedure codes available from ICD-10-AM first edition to second edition then applying the WIES methodology. The effect of the mapping on resulting cost weights is not known but is likely to be small due to the relatively minor changes in going from the first to the second edition of ICD-10-AM. Applying the WIES methodology to earlier data, which is coded to ICD-9-CM-A, would be more problematic as the changes from ICD-9-CM-A to ICD-10-AM were significant. The extent to which this is a problem depends on what period the cost database is intended to cover.

There are two important considerations in deciding how to estimate costs: choosing between the use of contemporary (i.e. historical) costs or current costs and between the use of local costs or national costs.

When considering the use of contemporary (historical) cost information, the question of changing treatment patterns might create problems, for example, if patients are discharged from hospital sooner than previously, the cost of treating injuries might be lower now than it has been in the past. If the aim is to consider the allocation of resources by type of injury, we would be better to apply current rather than historical costs. Moreover, contemporary costs would need to be adjusted to allow for changes in the value of the currency. This process can be problematic, particularly where health service costs have not changed in line with general price inflation.

Local costs reflect local treatment patterns and local costs of resources, however, inconsistent costing methodologies have been applied. For example the Ministry of Health report 'From Strategy to Reality - The WAVE Project'[21] comments that

> *'No one knows how much is actually being spent as the figures lie buried in different, often conflicting, accounting methods.'*

There are other practical difficulties in the use of local costs. Changes in the geographical structure of health services would make it extremely difficult to assign current local costs to historical recorded patient care. Any slight advantage that might arise through the use of local cost structures would not justify the difficulty and likely expense of overcoming this problem.

DRGs themselves are also limited. Where DRGs form the basis of payment to hospitals, there is an incentive for hospitals to select codes that maximise payments. This has given rise to a phenomenon referred to as 'DRG creep', in which there is a tendency for the average recorded complexity of discharges to increase. This in turn creates pressure on funders to use DRG systems that can be precisely defined and for which costs within DRG classifications are relatively homogeneous. When DRGs do not form the basis of payment to hospitals however, there is potentially little incentive for the hospitals to take the same care in ensuring all the information needed to correctly identify a patient's DRG is provided.

The majority of injury discharges will be assigned to a small number of DRGs. Even given an injury event may have multiple DRGs where it has multiple discharges and the adjustment for length of stay it must be remembered that DRGs are calculated using aggregate costs and therefore only represent averages despite their being available at a unit level.

The coverage of the NMDS is limited to public hospitals. Though private hospitals do not provide care for a substantial number of injury victims in the acute phase, the cost of post acute and elective treatments for injury victims may be considerable. NZHIS does hold some private hospital data but the coverage is fragmented, e.g. NZHIS does not have any complete years of Southern Cross data. In addition, private hospitals have not been required to provide external cause coding for their injury discharges.

7.2 Adding Other Costs

In the longer term the aim of this work would be to extend the database to incorporate other aspects of the cost of an injury event. This would require linkage with other databases containing information from which costs can be estimated. An obvious potential source of data is ACC. IPRU has completed several projects involving linkage of ACC and NZHIS data sets.[22-25] For example, IPRU has linked entitlement claims from the non-earners account[23] and is in the process of linking the earners account to injury hospitalisations. The results of these linkages suggest that while only a small proportion of all ACC entitlement claims may have an associated injury hospitalisation record, a reasonably large proportion of injury hospitalisations may have an associated ACC entitlement claim. The ACC data would also potentially provide other information not always present in the NMDS, for example, a large free text field describing the circumstances of injury and greater specificity for the nature of the sport for sporting injuries (e.g. rugby, soccer).

Incorporating ACC costs would contribute towards estimation of direct, indirect, and intangible costs. The direct costs include payments to GPs, physiotherapists and other primary providers. The indirect costs include compensation for lost wages and payments for retraining. The intangible costs include compensation for mental stress, which may be paid to claimants for sexual abuse or physical injury.[26] However, in all of these cases the costs to

ACC would have to be adjusted to reflect the total cost, for example, primary providers usually require a direct payment from claimants on top of the payment received from ACC.

The second major difficulty with using ACC data is the bias in the extent of the entitlements database. In order for a claim to be included in the entitlements database it must involve compensation paid directly to the claimant. This means, for example, that an injured earner is more likely to be included than a non-earner (e.g. a child). Take the case of a lower leg fracture. If an earner suffers this and as a result misses two weeks of work this will result in an entitlement claim. If the injured person is a child however, the time missed will be from school rather than from work and no entitlement claim will result (excluding other grounds for entitlement). As a result, the entitlement claims database will only include the direct costs associated with the claim from the earner and not those associated with the child. The ACC entitlements database is also likely to be lacking in information relating to self inflicted injuries, which, in theory, rarely receive entitlements from ACC.

As previously mentioned NMDS is restricted to public hospital data and private hospital data held by NZHIS is limited. ACC data may provide a source for much of the cost of care provided in private hospitals. For example, data provided by ACC indicates they funded $238 million of elective surgery from 2001 to 2003 that took place in private hospitals (Not all of which would be associated with injury events involving an acute public hospital admission). All elective surgery claims are treated as entitlements.

7.3 "How the cost information addresses gaps in the costs of injury information framework"

Table 7.1 below shows the coverage of IPRU's short and medium term goals in terms of the costs of injury information framework. The table is limited to injuries resulting in inpatient hospital care. This is a reasonable starting point as unlike the other obvious alternative, ACC entitlements, the resulting data set is reasonably unbiased and includes information on a wide range of key variables, e.g. circumstances and severity of injury. It will be noted that the addition of the ACC data can, independent of the primary and indirect costs add value to the determination of direct costs in the form of more detailed information on the circumstances of injury, work relatedness, and specificity for sporting injuries.

Table 7.1 Costs of Inpatient Hospitalisations Included in the Short and Medium Term Aims

	Direct Costs						Indirect Costs			Intangible Costs
Injury Categories	Primary		A&E	Inpatient	Out Patient	Other	Lost Wages		Other	
	ACC	Other		Cost Weights			ACC	Other		
Cause/Mechanism and Intent	MT			ST			MT			
Injury Type (Diagnosis)	MT			ST			MT			
Severity	MT			ST			MT			
Setting (place of occurrence)	MT			ST			MT			
Age	MT			ST			MT			
Gender	MT			ST			MT			
Prioritised Ethnicity	MT			ST			MT			
Geographic Region	MT			ST			MT			
Socio-Economic Status	MT			ST			MT			
Free Text Description of Injury Circumstances	MT			MT			MT			
Work Relatedness of Injuries	MT			MT			MT			
Specific Sport for Sporting Injuries	MT			MT			MT			

ST = Short Term
MT = Medium Term

8 Recommendations

This project has sought to describe a method to determine the direct costs of public hospital inpatient care for injury events. The results have shown that the method is feasible and will produce useful additional information for setting priorities for injury prevention. **We recommend the method described in this report be implemented.**

Ultimately it would be desirable to determine the direct, indirect, and intangible costs for these inpatient injury events. The next obvious step towards achieving this goal would be to add costs relating to ACC entitlement claims. IPRU has demonstrated that linkage between hospital inpatient and entitlement claims is feasible. **We recommend that further investigations into the limitations of adding ACC costs information be conducted.**

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Appendix 1

ICE ICD-9 Framework of E-Code Groupings for presenting injury mortality and morbidity data

	Manner/intent				
Mechanism/ cause	***Unintentional***	***Suicide***	***Homicide***	***Undetermined***	***Other****
Cut/pierce	E920	E956	E966	E986	E974
Drowning/ submersion	E830, E832, E910	E954	E964	E984	--
Fall	E880-E886, E888	E957	E968.1	E987	--
Fire/burn	E890-E899, E924	E958.1, .2, .7	E961, E968.0, .3	E988.1, .2, .7	--
Fire/flame	*E890-E899*	*E958.1*	*E968.0*	*E988.1*	--
Hot object/ substance	*E924*	*E958.2, .7*	*E961, E968.3*	*E988.2, .7*	--
Firearm	E922	E955.0-.4	E965.0-.4	E985.0-.4	E970
Machinery	E919	--	--	--	--
MV traffic[t]	E810-E819 (.0-.9 [¤])	E958.5	--	E988.5	--
Occupant	*E810-E819 (.0,.1)*	--	--	--	--
Motorcyclist	*E810-E819 (.2,.3)*	--	--	--	--
Pedal cyclist	*E810-E819 (.6)*	--	--	--	--
Pedestrian	*E810-E819 (.7)*	--	--	--	--
Unspecified	*E810-E819 (.9)*	--	--	--	--
Pedal cyclist, other	E800-E807 (.3), E820-E825 (.6), E826.1, .9, E827-E829 (.1)	--	--	--	--
Pedestrian, other	E800-E807 (.2), E820-E825 (.7), E826-E829 (.0)	--	--	--	--
Transport, other	E800-E807 (.0,.1,.8,.9), E820-E825 (.0-.5,.8,.9), E826.2-.8, E827-E829 (.2-.9), E831, E833-E845	E958.6	--	E988.6	--
Natural/ environmental	E900-E909, E928.0-.2	E958.3	--	E988.3	--
Bites and stings	*E905.0-.6,.9; E906.0-.4,.9*	--	--	--	--
Overexertion	E927	--	--	--	--
Poisoning	E850-E869	E950-E952	E962	E980-E982	E972
Struck by, against	E916-E917	--	E960.0, E968.2	--	E973, E975
Suffocation	E911-E913	E953	E963	E983	--
Other specified, classifiable	E846-E848, E914-E915, E918, E921, E923, E925-E926, E929.0-.5	E955.5,.9; E958.0,.4	E960.1, E965.5-.9, E967, E968.4	E985.5; E988.0,.4	E971, E978, E990-E994, E996, E997.0-.2
Other specified, not elsewhere classifiable	E928.8, E929.8	E958.8, E959	E968.8, E969	E988.8, E989	E977, E995, E997.8, E998, E999
Unspecified	E887, E928.9, E929.9	E958.9	E968.9	E988.9	E976, E997.9
All injury	**E800-E869, E880-E929**	**E950-E959**	**E960-E969**	**E980-E989**	**E970-E978, E990-E999**
Adverse effects	--	--	--	--	E870-E879, E930.0-E949.9
*Medical care***	--	--	--	--	E870-E879
Drugs[tt]	--	--	--	--	E930.0-E949.9
All external causes	--	--	--	--	**E800-E999**

NOTE: "--" represents categories in which no E codes are assigned.

*Includes legal intervention (E970-E978) and operations of war (E990-E999).

[t]Three fourth-digit codes (.4--"occupant of streetcar," .5--"rider of animal," and .8--"other specified person") are not separated because of theŽminimal number of deaths in these categories. However, because they are included in the overall "Motor Vehicle Traffic" category, the sum of these categories can be derived by subtraction.

[¤]This parenthetical notation implies that the decimal should be applied to each individual three-digit E code in the grouping.

[¦] Adverse effects have been excluded from the "all injury" category but are included in the "all external causes" category.

**Includes a) adverse effects to patients during surgical and medical care and b) surgical and medical procedures as the cause of abnormal reactions or later complications without mention of negative events at the time of procedure.

[tt]Includes drugs and medicinal and biological substances causing adverse effects when used therapeutically.

ICE ICD-10 External Cause of Injury Mortality Framework

Mechanism	All injury	Unintentional	Intent Suicide	Homicide	Undetermined	Legal intervention/ war
All Injury	V01-Y36, Y85-Y87, Y89, *U01-*U03	V01-X59 , Y85-Y86	X60-X84, Y87.0, *U03	X85-Y09, Y87.1, *U01-*U02	Y10-Y34, Y87.2, Y89.9	Y35-Y36, Y89(.0, .1)
Cut/pierce	W25-W29, W45, X78, X99, Y28, Y35.4	W25-W29, W45	X78	X99	Y28	Y35.4
Drowning	W65-W74, X71, X92, Y21	W65-W74	X71	X92	Y21	
Fall	W00-W19, X80, Y01, Y30	W00-W19	X80	Y01	Y30	
Fire/ hot object or substance	X00-X19, X76-77, X97-X98, Y26-Y27, Y36.3, *U01.3	X00-X19	X76-X77	X97-X98,*U01.3	Y26-Y27	Y36.3
Fire/flame	X00-X09, X76, X97, Y26	X00-X09	X76	X97	Y26	
Hot object/substance	X10-X19, X77, X98, Y27	X10-X19	X77	X98	Y27	
Firearm	W32-W34, X72-X74, X93-X95, Y22-Y24, Y35.0, *U01.4	W32-W34	X72-X74	X93-X95, *U01.4	Y22-Y24	Y35.0
Machinery	W24, W30-W31	W24, W30-W31				
All Transport	V01-V99, X82, Y03, Y32, Y36.1, *U01.1	V01-V99	X82	Y03, *U01.1	Y32	Y36.1
Motor Vehicle Traffic						
Occupant	V30-V79 (.4-.9), V83-V86 (.0-.3)	V30-V79 (.4-.9), V83-V86 (.0-.3)				
Motorcyclist	V20-V28 (.3-.9), V29 (.4-.9)	V20-V28 (.3-.9), V29 (.4-.9)				
Pedal cyclist	V12-V14 (.3-.9) , V19 (.4-.6)	V12-V14 (.3-.9) , V19 (.4-.6)				
Pedestrian	V02-V04 (.1, .9) V09.2	V02-V04 (.1, .9) V09.2				
Other	V80 (.3-.5), V81.1, V82.1	V80 (.3-.5), V81.1, V82.1				
Unspecified	V87(.0-.8), V89.2	V87(.0-.8), V89.2				
Pedal cyclist, other	V10-V11, V12-V14 (.0-.2), V15-V18, V19 (.0-.3, .8, .9)	V10-V11, V12-V14 (.0-.2), V15-V18, V19 (.0-.3, .8, .9)				
Pedestrian, other	V01, V02-V04 (.0), V05, V06, V09 (.0,.1,.3,.9)	V01, V02-V04 (.0), V05, V06, V09 (.0,.1,.3,.9)				
Other land transport	V20-V28 (.0-.2), V29-V79 (.0-.3), V80 (.0-.2, .6-.9), V81-V82 (.0,.2-.9), V83-V86 (.4-.9), V87.9, V88, V89 (.0, .1 .3, .9), X82, Y03, Y32	V20-V28 (.0-.2), V29-V79 (.0-.3), V80 (.0-.2, .6-.9), V81-V82 (.0,.2-.9), V83-V86 (.4-.9), V87.9, V88, V89 (.0, .1 .3, .9)	X82	Y03	Y32	Y36.1
Other Transport	V90-V99, Y36.1,*U01.1	V90-V99		*U01.1		
Natural/ environmental	W42, W43, W53-W64, W92-W99, X20-X39, X51-X57	W42, W43, W53-W64, W92-W99, X20-X39, X51-X57				
Overexertion	X50	X50				
Poisoning	X40-X49, X60-X69, X85-X90, Y10-Y19, Y35.2,*U01(.6-.7)	X40-X49	X60-X69	X85-X90,*U01.6-.7	Y10-Y19	Y35.2
Struck by or against	W20-W22, W50-W52, X79, Y00, Y04, Y29, Y35.3	W20-W22, W50-W52	X79	Y00, Y04	Y29	Y35.3
Suffocation	W75-W84, X70, X91, Y20	W75-W84	X70	X91	Y20	
Other specified, classifiable	W23, W35-W41, W44, W49, W85-W91,Y85, X75, X81, X96, Y02, Y05-Y07, Y25, Y31, Y35(.1,.5), Y36(.0,.2,.4-.8), *U01.0, .2, .5, *U03.0	W23, W35-W41, W44, W49 W85-W91, Y85	X75, X81, *U03.0	X96, Y02, Y05-Y07, *U01.0, .2, .5	Y25, Y31	Y35(.1, .5) Y36(.0, .2,.4-.8)
Other specified, nec	X58, Y86, X83, Y87.0, Y08, Y87.1, Y33, Y87.2, Y35.6, Y89(.0,.1), *U01.8, *U02	X58, Y86	X83, Y87.0	Y08, Y87.1, *U01.8, *U02	Y33, Y87.2	Y35.6, Y89 (.0, .1)
Unspecified	X59, X84, Y09, Y34, Y89.9, Y35.7, Y36.9, *U01.9, *U03.9	X59	X84, *U03.9	Y09, *U01.9	Y34, Y89.9	Y35.7 Y36.9
Adverse effects	Y40-Y59, Y60-Y84, Y88					
Drugs	Y40-Y59, Y88.0					
Medical care	Y60-Y84, Y88(.1-.3)					

Notes: This framework was developed to be consistent with the framework developed based on ICD-9 external cause of injury codes as published in http://www.cdc.gov/mmwr/PDF/rr/rr4614.pdf Drowning is the one external cause that has been redefined in this matrix. Codes for water transportation-related drowning, V90 and V92, are included in the transportation codes rather than with the drowning codes. In the ICD-9 version of the matrix, the comparable codes, E830 and E832, were included with drowning. This change was made to be consistent with other mechanisms involved with water transport-related injuries. In this version, V81.1 and V81.2 were moved from the row for motor vehicle traffic- occupant to the row for motor vehicle traffic- other. This version also contains the new ICD-10 codes for terrorism. The codes are bolded and are preceded with "*'. See http://www.cdc.gov/nchs/about/otheract/icd9/terrorism_code.htm

Mechanism ICD-10 Transportation codes

All Motor Vehicle Accidents combine motor vehicle traffic and non-traffic
Motor Vehicle accident codes are equivalent to codes in the NCHS 113 Cause of death list.

Motor vehicle accidents	
Motor Vehicle Traffic	
Occupant	V30-79 (.4-.9), V83-V86 (.0-.3)
Motorcyclist	V20-V28 (.3-.9), V29 (.4-.9)
Pedal cyclist	V12-V14 (.3-.9), V19 (.4-.6)
Pedestrian	V02-V04 (.1, .9), V09.2
Other	V80 (.3-.5), V81.1, V82.1
Unspecified	V87(.0-.8), V89.2
Motor Vehicle non-Traffic	
Pedestrian	V09.0, V02-V04 (.0)
Pedal cyclist	V12-V14 (.0-.2), V19 (.0-.2)
Other	V20-V28 (.0-.2), V29 (.0-.3) V30-V39 (.0-.3) V40-V49 (.0-.3) V50-V59 (.0-.3) V60-V69 (.0-.3) V70-V79 (.0-.3) V81.0, V82.0 V83-V86 (.4-.9) V88 (.0-.8) V89.0
Other land transport	
Pedestrian	V01, V05, V06, V09 (.1,.3,.9)
Pedal cyclist	V10, V11, V15-V18, V19 (.3,.8,.9)
Animal rider or occupant of animal drawn vehicle	V80(.0-.2, .6-.9)
Occupant of railway train or railway vehicle	V81 (.2-.9)
Occupant of streetcar	V82 (.2-.9)
Other and unspecified	V87-V88 (.9), V89 (.1,.3,.9), X82, Y03, Y32
Other Transport	
Accident to or on watercraft (other than drowning)	V91, V93
Transport-related drowning	V90, V92
Other & unspecified water transport accidents	V94
Air and space transport accidents	V95-V97
Other and unspecified transport accidents	V98-V99, Y36.1, *U01.1

Appendix 2

The Barell Matrix

The Barell Injury Diagnosis Matrix, Classification by Body Region and Nature of the Injury

based on **5** digit icd-9 CM codes

Region	Sub-region	#	Body region	ICD-9-CM codes	FRACTURE 800-829	DISLOCATION 830-839	SPRAINS & STRAINS 840-848	INTERNAL 850-854,860-869 952, 995.55	OPEN WOUND 870-884, 890-894	AMPUTATIONS 885-887, 895-897	BLOOD VESSELS 900-904	CONTUSION / SUPERFICIAL 910-924	CRUSH 925-929	BURNS 940-949	NERVES 950-951 953-957	UNSPECIFIED 959
Head and Neck	Traumatic Brain Injury	1	Type 1 TBI	800,801,803,804(.1-.4,.6-.9), (.03-.05,.53-.55) 850(.2-.4), 851-854, 950(.1-.3), 995.55	800,801,803,804(.1-.4,.6-.9) 800,801,803,804(.03-.05,.53-.55)	/	/	850(.2-.4) 851-854*, 995.55	/	/	/	/	/	/	950.1-.3	/
		2	Type 2 TBI	800,801,803,804(.00,.02,.06,.09) (.50,.52,.56,.59) , 850(.0,.1,.5,.9)	800,801,803,804(.00,.02,.06,.09), 800,801,803,804(.50,.52,.56,.59)			850(.0,.1,.5,.9)								
		3	Type 3 TBI	800,801,803,804(.01,.51)	800,801,803,804(.01,.51)	/	/	/	/	/	/	/	/	/	/	/
	Other head, face and neck	4	Other Head	873(.0-.1,.8-.9), 941.x6, 951, 959.01	/	/	/	/	873.0-.1,.8-.9	/	/	/	/	941.x6	951	959.01*
		5	Face	802, 830, 848.0-.1, 872, 873.2-.7, 941(.x1,.x3-.x5,.x7)	802	830	848.0-.1	/	872, 873.2-.7	/	/	/	/	941.x1,.x3-.x5,.x7	/	/
		6	Eye	870-871, 918, 921, 940, 941.x2, 950(.0,.9)	/	/	/	/	870-871	/	/	918, 921	/	940, 941.x2	950(.0,.9)	/
		7	Neck	807.5-.6, 848.2, 874, 925.2, 941.x8, 953.0, 954.0	807.5-.6	/	848.2	/	874	/	/	/	925.2	941.x8	953.0, 954.0	/
		8	Head, Face and Neck Unspecified	900, 910, 920, 925.1, 941.x0, .x9, 947.0, 957.0, 959.09	/	/	/	/	/	/	900	910, 920	925.1	941.x0,.x9, 947.0	957.0	959.09
Spine and back	Spinal Cord (SCI)	9	Cervical SCI	806(.0-.1), 952.0	806.0-.1	/	/	952.0	/	/	/	/	/	/	/	/
		10	Thoracic/ Dorsal SCI	806(.2-.3), 952.1	806.2-.3	/	/	952.1	/	/	/	/	/	/	/	/
		11	Lumbar SCI	806(.4-.5), 952.2	806.4-.5	/	/	952.2	/	/	/	/	/	/	/	/
		12	Sacrum Coccyx SCI	806(.6-.7), 952(.3-.4)	806.6-.7	/	/	952.3-.4	/	/	/	/	/	/	/	/
		13	Spine+ Back unspecified SCI	806(.8-.9), 952(.8-.9)	806.8-.9	/	/	952.8-.9	/	/	/	/	/	/	/	/
	Vertebral Column (VCI)	14	Cervical VCI	805(.0-.1), 839(.0-.1), 847.0	805.0-.1	839.0-.1	847.0	/	/	/	/	/	/	/	/	/
		15	Thoracic /Dorsal VCI	805(.2-.3), 839(.21,.31), 847.1	805.2-.3	839.21,.31	847.1	/	/	/	/	/	/	/	/	/
		16	Lumbar VCI	805(.4-.5), 839(.20,.30), 847.2	805.4-.5	839.20,.30	847.2	/	/	/	/	/	/	/	/	/
		17	Sacrum Coccyx VCI	805(.6-.7), 839(.41-.42), 839(.51-.52), 847.3-.4	805.6-.7	839(.41-.42,.51-.52)	847.3-.4	/	/	/	/	/	/	/	/	/
		18	Spine+ Back unspecified VCI	805(.8-.9), 839(.40,.49), 839(.50,.59)	805.8-.9	839(.40,.49,.50,.59)	/	/	/	/	/	/	/	/	/	/
Torso	Torso	19	Chest (Thorax)	807(.0-.4), 839(.61,.71), 848(.3-.4), 860-862, 875, 879(.0-.1), 901, 922(.0-.1,.33), 926.19, 942.x1-.x2 953.1	807.0-.4	839.61,.71	848.3-.4	860-862	875, 879.0-.1	/	901	922(.0,.1,.33)	926.19	942.x1-.x2	953.1	/
		20	Abdomen	863-866, 868, 879(.2-.5), 902(.0-.4), 922.2,942.x3, 947.3, 953(.2,.5)	/	/	/	863-866, 868	879.2-.5	/	902.0-.4	922.2	/	942.x3, 947.3	953.2, 953.5	/
		21	Pelvis & Urogenital	808, 839(.69,.79), 846, 848.5, 867,877-878, 902(.5,.81-.82), 922.4, 926(.0,.12), 942.x5,947.4, 953.3	808	839.69,.79	846, 848.5	867	877-878	/	902(.5,.81-.82)	922.4	926(.0,.12)	942.x5, 947.4	953.3	/
		22	Trunk	809, 879(.6-.7), 911, 922(.8-.9), 926(.8-.9), 942(.x0,.x9), 954(.1,.8-.9), 959.1	809	/	/	/	879.6-.7	/	/	911, 922.8-.9	926.8-.9	942.x0, 942.x9	954.1, .8-.9	959.1
		23	Back and Buttock	847.9, 876, 922(.31-.32), 926.11, 942.x4	/	/	847.9	/	876	/	/	922.31-.32	926.11	942.x4	/	/
Extremities	Upper	24	Shoulder & upper arm	810-812, 831, 840, 880, 887(.2-.3), 912,923.0, 927.0, 943(.x3-.x6) ,959.2	810-812	831	840	/	880	887.2-.3	/	912, 923.0	927.0	943.x3-.x6	/	959.2
		25	Forearm & elbow	813, 832, 841, 881(.x0-.x1), 887(.0-.1), 923.1, 927.1, 943(.x1-.x2)	813	832	841	/	881.x0-x1	887.0-.1	/	923.1	927.1	943.x1-.x2	/	/
		26	Wrist, hand & fingers	814-817, 833-834, 842,881.x2, 882, 883, 885-886, 914-915, 923(.2-.3) ,927(.2-.3), 944 ,959(.4-.5)	814-817	833, 834	842 /	/ /	881.x2,882, 883	885-886	/ /	914-915, 923.2-.3	927.2-.3	944 /	/ /	959.4-.5
		27	Other & unspecified	818, 884, 887(.4-.7), 903, 913, 923(.8-.9), 927(.8-.9), 943(.x0,.x9), 953.4, 955, 959.3	818	/	/	/	884	887.4-.7	903	913,923.8,.9	927.8-.9	943.x0..x9	953.4, 955	959.3
	Lower	28	Hip	820, 835, 843, 924.01, 928.01	820	835	843	/	/	/	/	924.01	928.01	/	/	/
		29	Upper leg & thigh	821, 897(.2-.3), 924.00, 928.00, 945.x6	821			/	/	897.2-.3	/	924.00	928.00	945.x6	/	/
		30	Knee	822, 836, 844.0-.3, 924.11, 928.11, 945.x5	822	836	844.0-.3	/	/	/	/	924.11	928.11	945.x5	/	/
		31	Lower leg & ankle	823-824, 837, 845.0, 897(.0-.1), 924(.10,.21), 928(.10,.21), 945(.x3-.x4)	823-824	837	845.0	/		897.0-.1	/	924.10,.21	928.10,.21	945.x3-.x4	/	/
		32	Foot & toes	825-826, 838, 845.1, 892-893, 895-896, 917, 924(.3,.20), 928(.3,.20), 945(.x1-.x2)	825-826	838	845.1	/	892-893	895-896	/	917, 924.3,.20	928.3,.20	945.x1-.x2	/	/
		33	Other & unspecified	827,844(.8-.9), 890-891, 894, 897(.4-.7), 904(.0-.8), 916, 924(.4-.5), 928(.8-.9), 945(.x0,.x9), 959.6-.7	827	/	844.8-.9	/	890-891,894	897.4-.7	904.0-.8	916, 924.4-.5	928.8,.9	945.x0-.x9	/	959.6-.7
Unclassifiable by site	Other & unspecified	34	Other/ multiple	819, 828, 902(.87,.89), 947(.1-.2), 953.8, 956	819, 828	/	/	/	/	/	902.87,.89	/	/	947.1-.2	953.8, 956	/
		35	Unspecified site	829, 839(.8-.9), 848(.8-.9), 869, 879(.8,.9), 902.9, 904.9, 919, 924(.8,.9), 92[illegible] 946, 947(.8,.9), 948, 949, 953.9, 957(.1,.8,.9), 959(.8,.9)	829	839.8-.9	848.8-.9	869	879(.8-.9)	/	902.9, 904.9	919, 924.8,.9	929	946, 947.8,.9 948, 949	953.9, 957.1,.8,.9	959.8,.9
	System wide	36	System-wide & late effects	905-908, 909 (.0,.1,.2,.4,.9), 930-939,958, 960-994, 995.50-.54,.59, 995(.80-.85)	Foreign body (930-939), Early complications of trauma (958), Poisoning (960-979), Toxic Effects (980-989), Other and unspecified effects of external cause (990-994) Child and adult maltreatment (995.50-.54, 59, 995.80-.85) Late effects of injuries, poisonings, toxic effects and other external causes (905-909) excluding 909(.3,..5)											

Special diagnostic codes for trauma: Flail Chest (807.4) Pneumothorax (860)

For purposes of classification, head injuries are labeled as **Type 1 TBI** if there is recorded evidence of an intracranial injury or a moderate or a prolonged loss of consciousness (LOC), Shaken Infant Syndrome (SIS), or injuries to the optic nerve pathways.

Type 2 TBI includes injuries with no recorded evidence of intracranial injury, and LOC of less than one hour, or LOC of unknown duration, or unspecified level of consciousness. **Type 3 TBI** includes patients with no evidence of intracranial injury and no LOC.

* **Note from CDC**: 959.01 (added to ICD-9-CM in 1997) is not intended to be assigned to TBI cases; however, in the USA it has been assigned incorrectly to a substantial proportion of cases previously coded 854.

The Matrix is available on the net at www.cdc.gov/nchs/about/otheract/ice/barellmatrix.htm

The Israeli Center for Trauma and Emergency Medicine Research , Gertner Institute, Sheba Medical Center, Tel Hashomer, Israel 52621. Fax:972-3-5353383 e-mail: limorad@gertner.health.gov.il May 2002

Appendix 3

What is an injury?

John Langley

Director

Injury Prevention Research Unit

Dept of Preventive and Social Medicine

Dunedin School of Medicine

University of Otago

Dunedin

New Zealand

Telephone: 64 3 479 8342

Fax: 64 3 479 8337

Email: john.langley@ipru.otago.ac.nz

Ruth Brenner

Investigator, Epidemiology Branch

Division of Epidemiology, Statistics, and Prevention Research

National Institute of Child Health and Human Development

National Institutes of Health

9.1 Department of Health and Human Services

9.1.1 United States of America

Key words: injury, ICD, medical injury, nosology

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Paramount to the study of any disease or phenomenon is the clear definition of the variables of interest. The definition of injury has been fraught with challenges and complexities. Importantly, injuries unlike diseases must be defined simultaneously by the causative event and by the resulting pathology. For example, bruising can occur in the absence of an injury event (e.g. in the case of sepsis or a bleeding disorder) and thus, taken alone, cannot be considered an injury. Similarly there are many events, such as car crashes, that result in no pathology, even if 'victims' are bought to an emergency department for observation. Thus, the theoretical definition of injury must incorporate both cause and outcome. Equally challenging is the operational definition of injury, for example, which diagnoses, codes or combination of codes from the International Classification of Diseases (ICD) [1] define injury. In this paper we discuss strengths and shortcomings in existing theoretical and operational definitions of injury.

Theoretical Definitions

The theoretical definition of injury is problematic since there is no scientific basis for a distinction between disease and injury [2]. Nevertheless there seems to be consensus in many of the public health orientated injury texts that the "energy definition" best describes the causes and pathologies of interest. That is "injury" refers to damage to the body produced by energy exchanges that have relatively sudden discernible effects [3]. While this seems to be a reasonable starting point, a number of issues remain. These issues are perhaps best explored through specific examples. First, what is meant by "damage to the body". If damage to the body refers to tissue damage, strict adherence to the theoretical definition would lead to the exclusion of many events that are routinely classified as injuries. For example, ingestion of a foreign body, such as a coin, often results in no tissue damage and foreign bodies can be removed from other orifices such as the nose or ear, without damage to the surrounding tissues. Similarly, a sexual assault which results in no tissue damage but from which the victim experiences severe depression, will only be covered by the theoretical definition if the scope of bodily damage is broadened to include psychological damage. There would seem to be a case for such harm to be included in a theoretical definition given that significant numbers of those in injury research and practice consider this a legitimate area of concern for the field. Moreover, in New Zealand (popn 4m) at least, the agency, Accident Compensation Corporation, which has the primary mandate for injury prevention, rehabilitation, and compensation, compensates victims who suffer such harm. In the 2000/2001 financial year 267 people were compensated for psychological injury at a total cost $NZ2,659,000.

Second, consider also the meaning of "energy exchange." Clearly a surgical incision is the result of intentional transfer of mechanical energy and this transfer results in tissue damage, yet, traditionally surgical incisions are not included in counts of intentional injuries. Perhaps, when the benefits of the purposely intended injury are thought to outweigh the costs, the theoretical definition is not applicable. But that approach is inconsistent with our approach for counting injury due to the lawful use of force (e.g. police), where presumably the benefits are also thought to outweigh the costs of using such force. In this case, however, provision is made in ICD to code injuries due to this cause (E970-978: Legal intervention).

Most injury prevention experts expand the theoretical definition of injury to include not only bodily damage caused by transfers of energy but also damage caused by the absence of energy [3]. While this serves us well by bringing injuries due to a number of causes (e.g. drowning, hypothermia, and asphyxia) under the broad umbrella of the theoretical definition, it also obscures the boundaries as it could be argued that the final pathway for death of any etiology is ultimately an absence of energy.

Finally, the notion that an injury must have “sudden discernable effects” leads to the exclusion of tissue damage due to chronic low-energy exposures (e.g. carpal tunnel syndrome) but as Robertson has pointed out some have modified the energy definition to include such cases [3].

The development of the theoretical “energy” definition of injury by Haddon represented a significant advance in our thinking and provided a useful basis on which to consider injury control measures [4]. One of its major strengths is the inclusion of both cause and outcome in the definition. However, as the field of injury prevention has advanced it is clear that there is now a need to refine the concepts outlined in this theoretical definition.

Operational Definitions

Arguably the most common operational definitions of injury, although rarely directly stated as such by most authors, are all those pathologies included in the Injury and Poisoning chapter (XVII) of the ninth revision of the International Classification of Diseases (ICD) or all those events coded to ICD Supplementary External Causes of Injury and Poisoning (commonly referred to as E codes) [1]. The former chapter includes all those pathologies most scientists and members of the public would describe as injury (e.g. fracture, dislocation, open wound). The latter includes all those mechanisms or events which ‘cause’ injury (e.g. motor vehicle traffic crash, fall, sharp objects).

Consider first the Injury and Poisoning chapter. The title of the chapter alone raises interesting issues. Many injury researchers and practitioners would consider poisoning to be one of a range of pathologies which operationally define injury. That being the case why is the chapter named in this manner?

The chapter includes some pathologies that are clearly not injuries. For example: 994 "Effects of other external causes" which includes conditions such as motion sickness, and effects of hunger; 995 “Certain adverse effects not elsewhere classified” which includes conditions such as anaphylactic shock, adverse effect of drugs, and allergic reactions to foods; and 996-999 “Complications of surgical and medical care not elsewhere classified”; The chapter also makes provision for “Effects of foreign bodies entering through orifice” (930-939) yet these classifications do not directly describe pathology and as we have already mentioned many such events do not result in discernable damage to the body (e.g. young child sticks a small toy up his nose). In other words there is no injury. Even allowing for the possibility that injury may have occurred, this range of codes is anomalous as it is inconsistent with our approach to other injuries. For example we do not have a grouping of codes for “effects of motor vehicle crashes”. Rather we require the actual pathology to be coded.

The converse situation also exists within ICD-9, namely that there are conditions which fall outside the 800-999 range but which some would classify as injury. These include musculoskeletal conditions related to the knee and back (717, 718, 724) and certain conditions of the eye (366.2). Some have argued that most of these conditions are chronic and should thus be excluded from an operational definition of injury, presumably on the basis that the theoretical definition of injury should be confined to pathologies that occur suddenly. Assuming one accepts this argument, it raises an interesting question. Are we to assume, for example, that all strains and sprains coded in the range 840-848 have occurred acutely? Given that there are no guidelines in this respect we feel such an assumption would be unwise. In 1999 at the International Collaborative Effort on Injury Statistics meeting in Washington, Pickett sought to identify all injury codes outside chapter XVII [5]. Various recommendations for dealing with these were discussed at the meeting but no consensus was reached.

Some have argued that “Certain adverse effects not elsewhere classified” (995) and “Complications of surgical and medical care, not classified elsewhere” (996-999) are "medical injuries" and should be excluded from the definition of injury. The justification given is that the aetiology is different than other injuries and that these types of injuries require different means of prevention [6]. As has been argued elsewhere [7], neither argument is sufficient ground for exclusion. Rather the decision should be based on whether the injuries meet an accepted theoretical definition of injury. While some would in fact appear not to meet the theoretical “energy” definition, such as 996.0 “Mechanical complication of cardiac device, implant and graft” others almost certainly do, for example 998.2: “Accidental puncture or laceration during a procedure”. Importantly, the inclusion or exclusion of “medical” injuries has dramatic effects on estimates of incidence. For example, in New Zealand in 1998 there were 67,428 public hospital discharges which had injury (800-999) as the primary diagnosis [7], and 17% of these were in the range 995-999.

The ICD injury and poisoning codes do not include psychological injury. Such harm presumably could be covered by the ICD codes for over mental health outcomes (Mental Disorders290-319). In New Zealand cases with psychological injury could potentially be identified by ascertaining injury events using external cause codes and then searching for accompanying codes indicative of a relevant mental disorder. This is possible in New

Zealand because hospital discharges for injury events are routinely assigned external cause of injury codes, even if there is no apparent tissue damage . However, external cause codes are not routinely assigned in many other countries and, even when they are assigned , it is not clear that coders routinely document psychological consequences of injury.

The US Injury Surveillance Workgroup of the State and Territorial Injury Prevention Directors Association (STIPDA) have grappled with the above problems and have recently produced the inclusion/ exclusion criteria for identification of injuries from hospital discharge data [8]. A number of issues are worthy of note. First, no explanation is given for the exclusions/inclusions. For example, late effects of injuries, poisonings, toxic effects and other external causes (905-909) are included. This contrasts with the coding practice in New Zealand where the following explanation is given: “Late effects of injury and poisoning (ICD codes 905-909) are no longer entered as principal diagnosis; preference is given to the residual conditions, with the late effects entered as a secondary “diagnosis” (P8) [9]. The approach adopted in New Zealand would appear consistent with the instructions in ICD-9 (P501) although it must be said that those instructions are difficult to interpret [1]. Second, with the exception child maltreatment syndrome (995.5) , most "medical injuries" have been excluded. Third, the working group acknowledges that there may be codes outside the 800-999 range which qualify as injury but until such stage as a consensus can be reached on these codes, they recommend exclusion of these pathologies from injury counts.

Consider now, the supplementary classification of external causes of injury and poisoning. Reliance on external cause of injury codes to operationally define injuries, has led to other problems. Most importantly, these codes can be used to describe events that result in little or no injury. This occurs most often when a person seeks medical care following an event (e.g.

a car crash or a fall), but when the event resulted in no injury. Recent work in New Zealand has shown that 26% of all persons discharged from a public hospital, and whose record was assigned an E code, did not have a diagnostic code within the Injury and Poisoning range (800-999) [7]. In ICD-10 the external cause chapter is now titled “Injury and poisoning and certain other consequences of external causes” [10]. This is more descriptive of what has always been included in the chapter.

Consider the case of drowning as an example of the definitional confusion which arises from the failure to distinguish the pathology of interest from external causes which may result in that pathology. Typically the term drowning is used to refer to deaths due to asphyxia in liquid. Non-fatal injury outcomes arising from similar processes are often referred to as near drownings. The difficulty here is that the concept of near drownings includes everything from losing your footing in the surf and temporarily losing control of the situation with no detectable pathology right through to major neurological damage as a result of asphyxia. In the latter case should we not be coding the actual pathology - the injury to the brain? In the former case why are we counting these cases if there is no damage namely we do not after all code “near lacerations or near burns”.

10 Conclusions

Some have suggested that discussions about what is and what is not an injury is an esoteric exercise of interest only to nosologists and theorists. Using the New Zealand experience, however, this paper has demonstrated that estimates of the incidence of injury can vary substantially depending on one’s operational definition of injury. This has important implications for determining priorities, developing indicators for monitoring trends, and undertaking international comparisons. The International Collaborative effort on Injury

Statistics represents an excellent international forum through which to seek international consensus on both the theoretical and operational definition of injury

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