The International Collaborative Effort on Injury Statistics

Lois A Fingerhut, Chair

The International Collaborative Effort on Injury Statistics (Injury ICE) is an international activity sponsored by the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS); with current financial support from the World Bank. The first meeting was held in May 1994 and held annually since then. The Injury ICE works as a forum for international exchange and collaboration among injury researchers who develop and promote international standards in injury data collection and analysis. The mission is to improve international comparability and quality of injury data for the ultimate aim of providing the data needed to better assess the causes and consequences of injury, differences in injury occurrence over time and place, and the most effective means of prevention and control.

Over the course of the ICE, there have been many organizational collaborations including the US Centers for Diseases Control and Prevention's National Center for Health Statistics, the National Center for Injury Prevention and Control and the National Institute for Occupational Safety and Health, the US National Institute of Child Health and Human Development (a financial sponsor for more than 10 years), WHO's Department of Violence and Injury Prevention and Disability, the GBD Injury Expert Group, Pan American Health Organization, European Union/Commission, WHO Center Heads for Classification, and Washington City Group (UN sponsored activity focusing on disability metrics). In addition, ICE has had participants from more than two dozen countries around the world.

Projects have often revolved around making the best use of available administrative data. Injury ICE participants were key to the development of reporting frameworks for both external causes of injury mortality and morbidity as well as injury morbidity and mortality diagnoses. ICE participants are currently working on the development of indicators of both fatal and nonfatal injury that can be used in international comparisons and in tracking trends, on the measurement of injury severity, on disability metrics, and on the quality of external cause of injury coding.

In addition, many Injury ICE participants are actively engaged in two related projects—the Global Burden of Disease methodologies for estimating the number of global injuries (see www.globalburdenofinjuries.org) and the development of ICD-11's two injury chapters.

More information about the Injury ICE can be found at www.cdc.gov/nchs/advice.htm.

Launch of the Global Injury Mortality Database

Kavi Bhalla, James Harrison, Lois Fingerhut, Saeid Shahraz, Jerry Abraham, Pon-Hsiu Yeh, on behalf of the GBD Injury Expert Group.

Summary: The Global Injury Mortality Database (GIMD) contains death tabulations disaggregated by country, year, age, sex, and external cause categories. The database contains external causes categorized to the GBD Injury definitions and the ICE Injury Matrix definitions. The database is publicly available at www.globalburdenofinjuries.org

What is the source of this data?

These data are tabulations of deaths recorded by national civil registration systems. This mortality dataset represents the bulk of the mortality data collected by the GBD Injury expert group. Much the starting data was obtained from the WHO Mortality Database, publicly available from the WHO website. In addition, the call for data put out by the expert group has resulted in various researchers and agencies providing us access to data for the GBD-2005 project. We have processed these data sets and have made them available here. We will periodically update this database with new data sets as they are received by us. Population estimates are derived from the United Nations World Population Prospects - 2006 publicly available from the UN Population Division website.

What variables does the Global Injury Mortality Database contain?

The database contains the following variables: year, country, age (grouped in 5 year intervals), sex, ICD code list (the type of ICD coding in the underlying data), external cause,

How was the mortality data processed prior to inclusion in this database?

DATABASE PROCESSED TO GBD-INJURY DEFINITIONS: We took the following steps to process this data to GBD-Injury definitions. First, we reclassified the data to the GBD-2005 age, sex, and external cause categories. Note that the ICD coded causes of death were coded to 69 specified and partially-specified external cause categories. Results from this first step are provided as the "raw" version of the database. It should be noted that the quality of the data varies substantially but all data has been included here regardless of quality. Finally, redistributed deaths coded to partially specified causes over the 48 fully-specified GBD-Injury external cause categories. All redistributions were done pro-rata within age-sex groups (unless specified differently below).

DATABASE PROCESSED TO ICE DEFINITIONS: We reclassified the death registration data to the external cause categories described in the ICE external cause matrix. Note that the ICE definitions are for 4-digit ICD10 coded data. Hence for countries that had causes coded using 3-digit ICD-10 or ICD-9 are not available in the ICE version of the dataset. These are included in the GBD version of the dataset.

You can contribute to this public resource by providing data to the project. Please contact kavi_bhalla@harvard.edu for more information.

What do we know about "undetermined intent of injury?"

Lois A Fingerhut,
Chair ICE on Injury Statistics
LA Fingerhut Consulting

In the lexicon of the International Classification of Diseases, external causes of injury are classified into several categories of intentionality- unintentional (or accidental), self-inflicted or suicide, assault or homicide, undetermined, operations of war and legal intervention. Of these, undetermined intent is problematic because its definition is not intuitively clear and its implementation is not at all routine.

The ICD states "This section {undetermined intent} covers events where available information is insufficient to enable a medical or legal authority to make a distinction between accident, self-harm and assault. It includes self-inflicted injuries, but not poisoning, when not specified whether accidental or with intent to harm (X40-X49). Follow legal rulings when available." *Poisoning defaults to the category 'unintentional' unless certifier indicates undetermined.*

The Global Burden of Disease project is planning to assign injury deaths of undetermined intent across other categories of injury by an as yet not specified methodology. The work reported here was undertaken to investigate cross-country differences in the use of undetermined intent and to see if there is an obvious method to distribute them.

In a recent review of injury mortality data from the WHO mortality database, injury deaths from about 60 countries were classified into the external cause of injury mortality framework. Deaths were first categorized solely by intent, then by intent and age, and finally by intent and mechanism of injury. This analysis looks at the first two. In all over 850 thousand injury deaths were considered in countries in the WHO database that coded to the 4^{th} digit of ICD-10. For all countries combined, an average of 7% of injury deaths, regardless of age group, were coded to undetermined intent with the highest proportions in Dominican Republic (2004) 46%, Suriname (2000) 37%, Thailand (2002) 24%, Venezuela (2005) 24%, Haiti (2003) 22%, and Serbia & Montenegro (2002), 20%. In 25 of the countries, the percentage was 3% or lower.

When age is added to the picture, several additional countries are added to those with relatively high proportions of undetermined intent. For children under 15 years, 19% of injury deaths in the UK were coded as undetermined (7% for all countries). For young persons 15-24 years, Venezuela and Peru also had relatively high percentages (29% and 19% respectively); at 25-44, French Guiana had 17% coded as undetermined.

It is noteworthy that of all the countries with the highest proportions of injury deaths coded as undetermined Haiti, Dominican Republic and Venezuela also had among the lowest proportions of injury deaths coded as suicides.

Before a final determination is made regarding how to distribute deaths of undetermined intent, country practices must be taken into account.

Strengthening mechanisms of collaboration with WHO and other "Key players"

Kidist K Bartolomeos

This is a brief introduction to the management of the WHO's Department of injuries and violence prevention data-related activities at head quarters (HQ), regional and country offices and the potential areas for collaboration.

Most of the injury data related activities at the global level are coordinated under topic areas "unintentional injuries" and "violence prevention" and "disability". Given limited funding specifically for cross cutting injury data work, more and more, data related activities in the department are being integrated into priority topics such as road traffic, violence (e.g. child maltreatment) and child injuries. At the regional and country level, the type of activities and the level of involvement by the regional or country office depend on the type of request and availability of expertise to respond to requests. When requests are received from regional offices and depending on the request, technical assistance is provided, facilitated or coordinated from HQ. More and more, other UN agencies such as UNDP and UNICEF are supporting, in selected countries, data- related activities (such as research and population based surveys) linked to their area of work. WHO is working closely with these agencies to promote a more coherent response to injuries and violence.

Examples of possible areas of collaboration between partners:.

- **Technical support to countries:** Globally, injury and violence prevention is getting increased visibility and awareness and as such there is increased need in many low-income and middle-income countries for technical support to countries to put in place appropriate data collection system and evaluate existing ones.
- **Capacity development:** Increasing national country capacity for data collection, analysis and dissemination on injuries, violence and disability is also another priority for the WHO global injury and violence prevention program.
- **Improving methods and estimates:** There is the need to assess and address data gaps with existing country, regional and global data.

However the nature of the collaboration and what kind of role ICE and the GBD Injury Expert group play in global injury and violence activities and what the mechanism for that collaboration should be will depend on each partner's need, availability of resources (funding), interest from individual experts on specific topics etc.

Injury Mortality Indicators

Colin Cryer, Injury Prevention Research Unit, University of Otago, New Zealand.
Lois Fingerhut, Chair, International Collaborative Effort on Injury Statistics, Washington DC

Background

Comparing injury rates from different countries can suggest priorities for research and intervention. Alongside the 9th World Conference on Injury Prevention and Safety Promotion held in Merida, Mexico in March 2008, the ICE on Injury Statistics held a meeting whose stated goal was: "To reach consensus on what are the 10 most important indicators of injury incidence that offer the potential for international comparisons as well as for regional or global monitoring"

Aims

To describe the process of developing the ICE indicators, presents the specifications of selected injury mortality indicators, along with comparisons between selected countries for those specified indicators.

Method

Prior to the Merida meeting, participants had been asked to send what they considered the most important five indicators of injury incidence. The responses were discussed at that meeting of participants from 19 countries and representatives from both WHO and PAHO. Following the meeting, Fingerhut and Cryer produced documentation to support the chosen indicators. A subsequent ICE on Injury Statistics meeting was held in October 2008 in Washington DC, at which the indicator specifications were developed further for : "all injury", motor vehicle traffic crashes, self-harm and assault mortality indicators. We produced charts of the agreed indicators using the WHO mortality database for 7 geographically representative countries with complete death registration (United States, Argentina, Venezuela, Spain, United Kingdom, Japan, and New Zealand).

Results

Comparisons across the seven countries, of the recent 5-year trends in these fatal injury indicators, were presented - along with percent deviation from initial rate, to highlight relative changes over time. There were large differences in the age-standardised rates across countries. Typically, there were also contrasting trends between countries.

Discussion

The purpose of this paper was to identify those indicators of injury incidence that should be in the armoury of any country, and to produce specifications for those indicators that can be applied by any country that has access to reasonable quality data, either at a national level, or at a sub-national level but which can be used to represent the national picture. This we achieved for selected injury mortality indicators.

Morbidity Indicators—How do we move forward?

Lois A Fingerhut, Chair ICE on Injury Statistics

The process for advancing the morbidity indicator project began with recognizing the two morbidity indicators that were agreed to at the March 2008 Injury ICE meeting—an overall indicator of hospitalized injury and one that focused on hospitalization of traumatic brain injury. It was recognized that the first would have to be limited to severe injuries only but the method for doing that (for example, ICISS-based or AIS based was left open). The TBI indicator was considered more problematic for some participants for several reasons, one being that not all hospitalization data are ICD coded and hence there would be operational definition issues to be resolved. Secondly, the question was raised about the ability to design an intervention using a nature of injury indicator, rather than an external cause indicator.

The agenda for 2009 moving forward includes discussions of different methods for defining a case for the specification of valid morbidity indicators.

Injury incidence over time based on hospital admissions – filtering by thresholds, risk categories or indicator diagnoses

Rolf Gedeborg, Dept of surgical sciences & Uppsala clinical research center, Uppsala University, Sweden. *rolf.gedeborg@surgsci.uu.se*

Incidence estimates based on admission to hospital are potentially biased because of regional and temporal variations in admission criteria and service utilization patterns. There are several potential methods to address this, (a) Selection of severe injuries using the threshold ICD-based injury severity score (ICISS) value, (b) Selection of indicator diagnoses considered to have a high probability of admission, and (c) Stratifying according to risk categories based on ICISS.

The study population consisted of 731,828 incident injury admissions during 1998-2004. Difference in incidence (95% CI) between 2004 and 1998 was calculated. Out-of-hospital mortality appeared to increase (4.1; 95% CI 2.3 to 6.0) while hospital mortality remained stable (0.9; 95% CI -0.3 to 2.2). Total injury-related hospital admission rate decreased markedly. In contrast, severe injuries (ICISS $\leq$ 0.941) increased over time but with low precision in the estimate (3.0; 95% CI -2.7 to 8.7). When stratified, the rates for minor and moderate injuries decreased, the rate for serious injuries increased while rates for severe and critical injuries remained stable. The trends of indicator diagnoses were quite varying: Hip fracture and femoral shaft fracture rates decreased, subdural hematomas and pneumo/hemothorax rates increased, while spinal cord injury rates remained stable.

With a notable decrease in the total incidence of hospital admissions for injuries, the threshold method indicates an increase in severe injuries, stratification clarifies that this increase is limited to one intermediate severity strata while the two low severity strata decrease and the two most severe remained stable. Individual indicator diagnoses of severe injury may showed quite different trends.

Injury Morbidity Indicators – How should incident cases of injury be defined

Colin Cryer, Injury Prevention Research Unit, University of Otago, New Zealand.

Background

One of the major challenges confronting developers of valid injury morbidity indicators is to identify a robust case definition of injury incidence.

Aims

To present the case definition used for the New Zealand Injury Prevention Strategy (NZIPS) injury outcome indicators as a potential basis for use in the specifications of the ICE injury morbidity indicators.

Method

The presentation was based on two main sources:

1. Cryer C, Langley J. Developing valid indicators of injury incidence for “all injury”. *Injury Prevention* 2006; **12:** 202-206.
2. Langley J, Stephenson S, Cryer C, Borman B. Traps for the unwary in estimating person based injury incidence using hospital discharge data. *Injury Prevention* 2002; **8**: 332-337.

Some potential improvements to the NZIPS serious injury outcome indicators case definition were also explored.

Results

The case definition used for the NZIPS serious non-fatal injury indicators has the following elements:

- Based on publicly funded admissions to hospital;
- Uses incident cases through the exclusion of readmissions to hospital;
- Identifies cases of injury primarily through the principal diagnosis of injury;
- Focuses on serious injury identified as ICISS$\leq$0.941.

The paper discussed advantages and disadvantages of relaxing the third of these to identify injury where any diagnosis on the hospital record is an injury diagnosis, even if the primary diagnosis is non-injury (eg. mental health condition). Additionally, it discussed alternative ways of identifying serious injury, namely using worst injury diagnosis-specific survival probabilities (DSPs), or alternatively through the use of diagnoses with a high probability of admission.

Discussion

The NZIPS indicators case definition was presented with a view to elements being adopted as part of the case definition for the ICE injury morbidity indicators, for use in international comparisons. Such a case definition is still to be discussed and agreed.

Apollo project definitions in “Case Definitions, Injury Morbidity Indicators” session. International Collaborative Effort on Injury Statistics and Global Burden of Disease Injury Expert Group joint meeting. Boston, USA October 8-10, 2010

Maria Segui-Gomez.

We conducted an in-depth interview of researchers in 23 European countries to assess the availability and content of medical, police and other population-based datasets to monitor incidence and types of injuries in their countries. Hospital discharge records were available in all these countries, albeit with different degrees of accessibility to researchers. Whether the records collected information on the admission being a readmission or an urgent admission and whether injuries and mechanisms were coded (jointly or separately), in which code version and for how many specific injuries varied between countries. Thus, we set for an operational definition calling of any one record containing at least one injury (nature) codes: ICD9CM 800-999 or 380.12, 363.31, 370.24, 371.82 or 388; or ICD10 S00-T98 or F10-F19. For each such record, researchers were to compile up to 3 diagnoses per discharge, the mechanism of injury (if available) whether in ICD9CM, ICD10, ICECI or other variations, gender and age of subject, date of admission and discharge, type of admission (urgent, programmed), whether this was a readmission, and discharge disposition.

Researchers from eighteen of these countries were able to produce these data for the year 2004 and to augment it and analyze it using a common protocol that fed a web-query data systems publicly available at www.unav.es/preventiva/apollo/asistente/

We are using the same operational definitions and analytical procedures to compile additional years of data for Spain (currently, we have 2000-2007) and have secured 2005 data from 5 more countries. We are working in other countries so that we can provide estimates that are of use for the Global Burden of Disease project.

Probability of Admission – Project update

Colin Cryer, Injury Prevention Research Unit, University of Otago, New Zealand.

Background

In the report in which we describe the development of the New Zealand Injury Prevention Strategy (NZIPS) serious injury indicators[1], we list the injuries that are captured by case definition of "serious" used for the indicators. This case definition is based on the ICD-10 ICISS severity threshold (ICISS≤0.941), and the threshold was set with the aim of capturing injury diagnoses that have a high probability of admission – in order to remove the effects of any extraneous influences (eg. changes in health service provision) on the indicator trends. The question is: do they capture injury diagnoses with a high probability of admission?

The Probability of Admission project was coordinated by a group of New Zealand Researchers (Colin Cryer, Pauline Gulliver, Brandon de Graaf, John Langley and Gabrielle Davie) and is funded by the Accident Compensation Corporation of New Zealand. A very big "thank you" goes to our international collaborators, who agreed the specification for data provision, and provided the aggregate data on which this work depends.

Aims

To identify ICD diagnoses associated with a high probability of admission.

Method

We identified collaborators who had access to ED data whose diagnoses are coded to ICD, or maps to ICD diagnosis codes. These are: Australia (Victoria) – Soufiane Boufous (ICD-10); Canada (Ontario) – Alison Macpherson (ICD-10); Denmark (Odense) – Jens Lauritsen (ICD-10); Greece (Athens) – Eleni Petridou / Nick Dessypris/Vicki Kalampoki (ICD-10); Spain (Barcelona) – Catherine Perez (ICD-9 CM); USA (national) - Lois Fingerhut / Margaret Warner/Li Hui Chen (ICD-9 CM) & Ted Miller/Bruce Lawrence (ICD-9CM). The New Zealand research team with the collaborators agreed a protocol for data provision. The submitted data was checked in New Zealand and then via liaison with the collaborators. Preliminary results were presented as 3 digit / character breakdowns, then 4 digit character / digit breakdowns of the diagnosis codes.

Results

Very preliminary results were presented from this project. Diagnoses that were identified with high probabilities of admission included: skull fracture with cerebral laceration, fractured vertebrae with spinal cord involvement, fractured neck and shaft of femur, open long bone fractures, traumatic haemo-/pneumo-thorax, selected internal organ injury.

Discussion

Further exploratory analysis is planned to reconcile variations between countries, to better understand differences in terms of the sources of data used, and to explore breakdowns by gender, age group, intent and cause categories.

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[1] Cryer C, Langley J, Stephenson S. Developing valid injury outcome indicators. A report to the New Zealand Injury Prevention Strategy. Injury Prevention Research Unit Occasional Report OR 049. Dunedin: IPRU, University of Otago, September 2004.

External causes of injury—what is the quality of the data?

Lois Fingerhut, Chair ICE on Injury Statistics

A new project for ICE participants was introduced at the 2009 meeting—an assessment of the quality of external cause of injury mortality and morbidity data. The need for such a project arose because of the need to rely on ICD-coded external cause of injury data and the acknowledgment that the data may not always be reliable. One question that was raised is how we evaluate the quality of injury mortality data—do we look, for example, at the percent of injury deaths with codes that are not specific or are of undetermined intent?

Patterns of use of non-specific codes for motor vehicle traffic deaths are illustrative. ICD-10 V89.2 is a code for unspecified motor vehicle traffic accident; in other words, it is not stated how the accident happened nor what kind of vehicle nor who was the person killed (driver, passenger, bicyclist, etc). Percentages ranged from lows of less than 2% in several European countries to more than 80% in others. ICD-10 X59 is the code for unintentional injury unspecified; with countries' use of the code varying widely from more than 20% of all injury deaths to less than 1%.

Presentations at this meeting focused on the quality of external cause data for injury morbidity in Australia, the Caribbean, and in the United States.

Recommended Actions to Improve External-Cause-of-Injury Coding in State Morbidity Data Systems in the United States

J. Lee Annest, Ph.D.
Director, Office of Statistics and Programming (OSP)
National Center for Injury Prevention and Control (NCIPC)
Centers for Disease Control and Prevention (CDC)

Efforts are underway in the United States to develop and implement recommended strategies and action plans to improve ICD-9-CM external-cause-of-injury coding (E-coding) in state-based hospital discharge and emergency department data systems. In February 2009, CDC conducted a partners meeting (including federal, state, and non-government trauma care, injury prevention, and data experts) to discuss E-coding issues and make recommendations for improvements. A summary of these recommendations will be published by CDC in late Fall 2009. Recommended actions aim to improve communication and collaboration among stakeholders, demonstrate a business case for high-quality E-coding, improve the collection of high-quality E-coded data, and improve and market the usefulness of E-coded data for state injury prevention efforts. More specifically, some of the major recommended actions include (1) establishing a central repository for sharing E-coding information; e.g., status reports, research findings, guidelines, and standards, (2) demonstrating how E-coded data are useful for assessing injury-related measures of health care quality, (3) integrating E-coding into data standards for electronic health record systems, (4) developing and implementing guidelines for E-coding data quality, including documentation of injury circumstances in the medical record by health care providers and E-coding practices, and (5) developing a tool kit on how to use E-codes in priority setting for injury prevention and trauma care programs and for evaluating their effectiveness at the state and community levels. When implemented, products from many of these actions could provide a useful international resource for information pertinent to improving external-cause-of-injury coding in morbidity data systems in other countries.

External causes of morbidity-A summary of the coding quality literature

Kirsten McKenzie
Deputy Director & Senior Research Fellow
National Centre for Health Information Research & Training
Queensland University of Technology

Hospital separations data are routinely used to monitor and assess injury causation and incidence, to inform injury research, policy and practice, yet there has been very limited research conducted examining the accuracy of external cause of injury coding in morbidity data. A systematic review of the literature was conducted to appraise the available evidence on the accuracy of external cause coding in hospital records identified 8 papers, with 5 conducted using ICD-9-CM (3 from USA, 1 from NZ and 1 from Australia), 2 conducted using ICD-10-AM (1 from Australia and 1 from NZ), and 1 conducted using ICD-10 (from Brazil). All except one of the studies selected cases based on a principal diagnosis of an injury, whilst the remaining study selected cases based on the presence of an external cause code. Accuracy of coding was largely operationalised as the concordance/agreement between the original codes and the recoded data. This review showed that the accuracy of external cause coding using ICD-9-CM ranges from around 64% when examining exact code agreement, to around 85% when examining agreement to the three digit level for ICD-9-CM coded data, and 68% agreement at complete 5 character code level to around 74% code agreement at 3 character code level for ICD-10-AM. Differences in coding accuracy were evident when examining different external cause axes and code blocks. Researchers need to be aware of the reliability of the coded data when seeking to use it for injury surveillance and trend analysis. These coding discrepancies and the impact of these on population health data can be minimised by: improving the quality of documentation in medical records and death certificate to provide clearer information for the coding process, improving the training of coders pertaining to the assignment of external cause coding, and instigating routine quality assurance and feedback mechanisms for external cause coding, developing clearer data definitions, standards, and codes and using evidence-based approaches to informing classification developments and improvements, and Increasing the extent to which end-users are aware of the strengths and limitations of these data to ensure valid interpretations are drawn.

Accuracy of injury coding under ICD-10-AM for New Zealand public hospital discharges

J Langley

ABSTRACT

Objective: To determine the accuracy in coding for principal injury diagnosis (PDx), external cause, place of occurrence and activity codes under the Australian Modification of the International Classification of Disease, 10th Revision (ICD-10-AM) for public hospital discharges in New Zealand.

Method: A simple random sample of 1800 injury discharges was selected from the National Minimum Dataset (NMDS) of hospital discharges from July 2001 to June 2004. Records were obtained and coded by the Senior Advisor in Clinical Coding (SACC) independently of the codes already recorded in the NMDS.

Results: Of injury discharges selected from the NMDS, 2% were not coded with a PDx of injury by the SACC. Fourteen percent of the PDxs and 26% of the external cause codes (E-codes V01–Y89) had inaccuracies in the first, second, or third characters. Variation in the accuracy of the PDxs and E-codes was obvious by diagnostic and E- code groupings; 22% of the place of occurrence codes (Y92) and 29% of the activity codes (Y93) were incorrect. Accuracy of the PDxs and E-codes was related to the clarity of the documentation in the medical records.

Conclusions: For countries that are considering implementing ICD-10 or one of its variants, these findings provide insight into possible limitations of the classification and offer guidance on where the focus of training should be placed. For countries that have historical data coded according to ICD-10-AM, these results suggest that some specific estimates of injury and external-cause incidence may need to be treated with caution.

QUALITY OF EXTERNAL CAUSE DATA IN THE CARIBBEAN

Authors: ***Yvette Holder, Affette McCaw-Binns***

Aim: To more specifically assign external cause of death for deaths that were undetermined or poorly defined

Methodology: Data on all injury deaths were captured from multiple sources – police station diaries, autopsy reports, coroners' inquests, hospital records in addition to death certificates from the Registrar's Office in Jamaica. Records were sorted and merged on close matches of name, date of birth, sex and address. For each fatality, data were updated into one complete record and re-coded.

Results:

- 38% of all injury deaths were not registered
- 13% of the remainder were misclassified as SSIs
- Capture rate of homicides increased from 42% to 85%
- Homicides had been mis-classified as "Accidents caused by firearms" and "Legal interventions"
- Homicide rose in rank from 7th leading cause of death to 5th
- Proportional injury mortality due to homicides increased from 18.3% to 31.5%
- Capture rate of fatal road traffic injuries (RTIs) increased from 28% to 83%
- RTIs rose in rank from 21st leading cause of death to 19th
- Proportional injury mortality rates for RTIs increased from 7.1% to 11.5%
- Capture rate of fatal self-inflicted injuries increased from 19% to 97%.
- Self-inflicted deaths were usually misclassified as "Accidental threats to breathing" and "Accidental poisoning"

Conclusion:

That estimates based on published injury mortality rates would be grossly underestimated, but every effort should be taken to ensure the completeness of data, especially the training of certifying physicians in the correct medical certification of cause of death.

Adverse Effects of Treatment and Complications: Review of the WHO injury mortality database

Jennifer A. Taylor, PhD, MPH - Department of Environmental & Occupational Health, Drexel University School of Public Health - Philadelphia, PA USA 215.762.2590 Jat65@drexel.edu

What are these events?

- "Misadventures to patient during surgical and medical care" (ICD: E870-E876),
- "Surgical and medical procedures as the cause of abnormal reaction of patients or later complication, without mention of misadventure at the time of procedure" (ICD: E878-E879),
- "Drugs, medicinal and biological substances causing adverse effects in therapeutic use" (ICD: E930-E949).

What do we know?

Most of the mortality estimates we have emanate from morbidity studies which include in-hospital deaths.

- Harvard Medical Practice Study (chart review) = adverse events are 3.7% of all hospitalizations. Of 3.7%, Drug Complications = 19% (Brennan, T. A. et al., 1991; Leape, L. L. et al., 1991).
- Quality in Australian Health Care Study QAHCS (chart review) = adverse events are 16.6% of all hospitalizations.
- Reporting of Hospital Adverse Events in Australian Hospitals, Victoria (admin. data) = 5% of discharges had an adverse event E-code in 1994-1995; ADEs = 19% (O'Hara, D. A. & Carson, N. J., 1997).
- Wisconsin (E-&N-codes) = 133/1,000 d/c (13%) 2005 hospital discharge data:
    - E and N-codes demonstrated 59.9% sensitivity and 97.4% specificity compared to medical records review.
    - E-codes have been found more useful for detecting certain types of medical injuries (due to drugs or radiation), while N-codes were found more useful for others (due to medical or surgical procedures). (Layde, P.M., et. al (2005). Advances in Patient Safety: Vol. 2, 119-132.)

WHO Mortality Data

- Analysis of 2004 data - Top 30 countries: based on any death with Code 22 - Adverse effects of medical treatment (aka E870-79, E930-49 and Y40-Y84, Y88)
- US 9,333 deaths (3.1/100,000 pop.)
- France 5,957 deaths (9.7/100,000 pop.)
- Australia 1,248 etc… [Analysis available on request]

Are these numbers accurate?

- IOM: 44,000-98,000 deaths per year in US *vs. 9,333 from WHO Mortality database*
- National Health and Hospitals Reform Commission report: 4,500 deaths per year in Australia *vs. 1,248 from WHO Mortality database*

Conclusion

The data available from the WHO Mortality data base appear to be underestimates of the mortality burden from adverse effects of medical care and drugs – IF *the number of deaths from the two cited studies (above) are accurate*. It is difficult to assess this underestimation because gold standard (chart review) studies are not available in most countries. One of the challenges is the *methods* of these estimates. For example the 44,000-98,000 deaths estimated in the United States are from 4 state chart review studies, while the mortality statistics come from national death records. The methodology for the 4,500 deaths cited in the Australian National Health and Hospitals Reform Commission report were not readily available. What are the main differences in the methodologies from which these estimates emanate? Is it definitional? Is it coding? Further research into the methods used for the higher estimates is warranted. Given the trends in the number of adverse effects by age, I would say that the data in several countries are behaving the same way I have observed in the US (i.e., there is a small spike during 1-5 years of age, a dip that slightly increase over the lifespan, and an huge increase after age 65 and older). I would view this as a vote of confidence in the data.

Update on the Abbreviated Injury Severity (AIS) applied to administrative data. International Collaborative Effort on Injury Statistics and Global Burden of Disease Injury Expert Group joint meeting. Boston, USA October 8-10, 2010

Maria Segui-Gomez

The Abbreviated Injury Scale was last updated in 2008 (AIS2005 update 2008). The AIS2005 and its 2008 update contain more injury codes than its predecessor, the AIS1990 update 1998 version. This is mostly due to the insertion of orthopaedic injury codes, many derived in conjunction with the Orthopaedics Trauma Association. In addition, codes related to blast injury and hypothermia have been introduced. The new scale allows for complimentary coding of issues related to the aspect, the mechanism of injury or even the restraint use (if in motor vehicles) using an array of optional "post dot" codes. In regards to the severity assessment, the revised version still uses a panel approach to consensus derived anatomical severity score that is an ordinal scale ranging from 0 to 6, although several injuries have been "downgraded" to lower severity scores than in the 1990 update 1998 version. This is primarily so for injuries in the head and thorax body regions. In addition to the severity score, the new version includes, for the first time the predicted Functional Capacity Index per each listed injury (so called pFCI-AIS), which has been simplified for this purpose from the 0-100 scale in the original FCI development to a 5 point ordinal scale ranging from 1 (worst expected impact) to 5 (no impact at all).

The Association for the Advancement of Automotive Medicine, the developer of the scale, has recently reorganized its AIS committee, creating subcommittees in charge of further scale developments, training and certification processes, and business.

Consequences of misclassified ICD-10 injury diagnoses in a national hospital discharge registry

While classification of injuries and estimates of injury severity based on ICD-10 injury coding are powerful epidemiological assets, little is known of the extent and characteristics of primary coding errors and their consequences of such applications.

Material and methods

From the national hospital discharge register we identified 15,899 incident injury cases in one region during the years 2000-2004. A random sample of 967 patient records was reviewed. Errors in ICD-10 codes were corrected and the consequences for classification of injuries and external causes, as well as injury severity estimates were analyzed.

Results

In 21.4% (95% CI: 18.9 to 24.1%) of 967 hospital admissions, at least one ICD-10 code for injury was changed or added. Out of 1,370 injury codes 10.1% were corrected. The majority of errors were in the forth position of the code; 94.8% of the injury codes were correct to the third position. In 10.8% of the hospital admissions at least one new ICD-10 injury code was added. In the injury matrix classification, 4.6% (95% CI: 3.4 to 6.2%) of the cases had some category removed and 12.2% (95% CI: 10.2 to 14.5%) had at least one injury category added. For cases with coding errors, the mean ICD-based injury severity score changed slightly (difference 0.021, 95% CI 0.007 to 0.032). The area under the receiver operating characteristic curve was 0.892 for predicting hospital mortality and remained unchanged after corrections of codes (95% CI for difference: -0.022 to 0.013).

Conclusion

Errors in ICD-10 coded injuries in hospital discharge data are common but most of them are not severe. The consequences for categorization are moderate and the consequences for injury severity estimates are probably minor.

A comparison of methods for measurement of injury severity
James E. Harrison and Geoffrey Henley

Background: The ICD-based Injury Severity Score (ICISS) provides a criterion for selecting severe injuries, useful when reporting trends in injury incidence because less affected by extraneous factors than total hospitalised cases. We assessed the relative performance of some variants of ICISS.

Method: Records from the Australian National Hospital Morbidity Database were included if Principal Diagnosis was S00-T89 (ICD-10-AM), the episode ended in the two years to 30 June 2007 and the mode of separation was not transfer to another acute-care hospital or statistical discharge.

The ICISS variants studied were: multiplicative; worst injury; treating co-morbidity as a covariate (instead of and as well as age); hybrid (pre-coordinating multiple injury codes within each body region); and omitting same-day cases.

Survival proportions specific to each injury diagnosis code (Osler's 'SRR') were used to calculate ICISS, the method differing between variants. Performance of each variant in predicting survival was assessed by logistic regression modelling.

Findings: Multiplicative and worst injury approaches had similar discrimination and calibration (H-L statistic). Replacing age with co-morbidity improved discrimination in multiplicative and worst injury models but calibration deteriorated. Including both co-morbidity and age improved discrimination (multiplicative and worst injury); calibration did not change in the former, and deteriorated slightly in the latter. The hybrid approaches did not improve the models. Excluding same-day cases had little effect.

Conclusion: In this setting (all hospitalised injuries; ICD-10-AM coding) the best overall performance was for the multiplicative approach with both age and co-morbidity as covariates.

Reference

Henley G & Harrison JE 2009. Injury severity scaling: a comparison of methods for measurement of injury severity. Injury technical paper series no. 10. Cat. no. INJCAT 126.Canberra: AIHW.

Ordered risk categories for the ICD-based injury severity score (ICISS)

Transforming a continuous variable into categories is generally not a good idea but may be helpful for descriptive purposes and may also be a better alternative to a single threshold value. There is no generally accepted method to define such categories, especially for highly skewed populations. The aim was therefore to suggest an empirical method for this purpose that also makes sense clinically.

50,000 hospitalized injuries and pre-hospital injury deaths in Sweden during 1998-2004 were randomly selected. A general additive model (GAM) of mortality with a smoothed function of the ICD-10 based injury severity score (ICISS) as a single predictor was fitted. Based on the plot of ICISS against the predicted mortality, five categories were suggested so that there was as little change as possible in the mortality risk within each category, and as much change as possible in the mortality risk between categories. Overlaying a density plot of ICISS made it possible to also avoid placing category limits on peaks in the distribution. The actual mortality within the five categories *Minor* (ICISS 0.941 – 1.0), *Moderate* (ICISS 0.665 – 0.940), *Serious* (ICISS 0.355 – 0.664), *Severe* (ICISS 0.220 – 0. 354), and *Critical* (ICISS 0 – 0.219) for the entire national dataset was compared to the predicted mortality.

It was possible to define injury severity categories based on an empirical graphical method that provides meaningful risk categories for the highly skewed distribution of injury severity.

Future ICE work on injury severity measurement: A discussion

Margaret Warner

By the close of the Joint ICE-GBD meeting, participants agreed that that the ICE diagnosis-specific survival probabilities (ICE-DSPs) would be a valuable resource for injury research. DSPs are the proportion of patients with a specific injury ICD code who survived in a reference population; ICE-DSP would be DSPs calculated using data from a variety of countries. The group agreed that the ICE-DSPs would be useful for calculating ICISS scores in settings / populations where national DSPs are not available; ICE-DSPs could be used to generate severity estimates that are comparable internationally; and the ICD-DSPs would help individual countries if there are sparse data within a particular ICD code.

There was agreement that the ICE-DSPs should be generated using ICD-10 coded hospital discharge data from as many countries as possible. ICE participants from Sweden, Australia, and New Zealand are able to provide the data. ICE participants from Norway had previously agreed. Other countries also suggested it was possible to provide data but there were limitations with other data that would need to be worked out (e.g. US only ICD-9 CM, APOLLO project for European data are in summary form). Participants from South Africa suggested they may also have data. SAS coding could be provided for participating countries. It was agreed that a project plan should be developed that includes decisions on whether to include all countries or only those with pre-hospital deaths, whether to stratify the data on age (i.e. ICD-DSPs for children), and the time periods to include.

A second area of future work considered important was developing methodology to determine risk categories based on ICISS. This work would follow from the *Defining categories of injury severity based on ICISS* presented by Rolf Gedeborg during the injury severity session. It was agreed that verifying the methodology and performance in multiple settings would help to create a broader acceptance in the injury research community. A research plan will be developed.

THE INJURY LOAD FRAMEWORK - CONCEPTUALISING THE FULL RANGE OF DEFICITS AND ADVERSE OUTCOMES FOLLOWING INJURY AND VIOLENCE

Ronan A Lyons[1], Caroline F Finch[2], Rod McClure[3], Ed van Beeck[4], Steven Macey[1]

1. *School of Medicine, Swansea University, Wales*
2. *School of Human Movement and Sport Sciences, University of Ballarat, Australia*
3. *Accident Research Centre, Monash University, Australia*
4. *Erasmus University Medical Center, Rotterdam, Netherlands*

The Injury List Of All Deficits (LOAD) Framework is an attempt to develop a comprehensive categorisation of the negative consequences of injury and violence. It incorporates concepts such as psychological trauma in those not physically injured, overuse and chronic injuries, as well as the direct and indirect consequences of acute traumatic injuries and the consequences of maltreatment. A scientific paper has just been accepted by the International Journal of Injury Control and Safety Promotion, based on the presentation at this meeting.

The Injury LOAD Framework was developed through expert consensus discussions held at a variety of meetings over a number of years, including:

- *1st International Seminars on Injury Research Methods* - Vienna (2004)
- *2nd International Seminar on Injury Research Methods* - Cape Town (2006)
- *6th Measuring the Burden of Injuries Conference* - Durban (2006)
- *8th Australian Injury Prevention Network Conference* - Sydney (2006)
- *9th International Conference on Injury Prevention and Control* - Merida (2008).

The paper has been helped considerably during its development by comments from Stephen Luchter, who organised the MBIC conferences until his retirement after the 2006 conference, and by comments from members from Global Burden of Disease (GBD) Injury Expert Group and other GBD clusters.

The Injury LOAD Framework was developed through debate and discussion. These led to the identification of three domains, twenty sub-domains and consideration of short-term, long-term and inter-generational timeframes for the deficits. For each sub-domain supporting scientific literature was obtained; the paper includes some 111 references.

In the 'Individual' domain there are 12 sub-domains covering: immediate, delayed and fetal deaths; pain and discomfort; short term activity restriction; long term physical disability; psychological disability; transmission of concomitant diseases; development of secondary conditions; behavioural change and subsequent health loss; fear of repeated injury; tangible costs born by the individual; intangible costs; and diminished quality of life. The 'Family and Close Friends' domain includes three additional sub-domains reflecting how the consequences of injuries to loved ones affects observers, carers, and dependants. The 'Societal' domain contains five sub-domains: societal fear of injuries and violence; psychological consequences among observers; copy cat events; and the direct medical costs and indirect costs largely born by society. The paper also describes how many of these domains are inter-related and the many feed back loops which operate between domains and sub-domains.

The Injury LOAD Framework identifies substantial overlap/inter-relationships between negative consequences of injury and those usually attributed exclusively to other ICD10 chapters, especially those covering mental health, musculoskeletal disorders, and cardiovascular diseases. It follows logically that quantification of the global burden of disease cannot be created from summing input from assumed non-overlapping groups based on ICD10 chapters; any attempt to do this will inevitably under enumerate the contribution of injuries and violence to the overall burden.

The Injury LOAD Framework could be used for a variety of purposes, including: putting existing burden of injury (BOI) studies into context; helping to plan future BOI studies; identifying research needs for measurement; and stimulating research using record linkage to address such needs.

Following publication, we hope that the Framework can be further improved following reflection and comments from a much wider audience.

Abstract Juanita Haagsma

ICE – GBD injury expert group meeting

Boston, October 2009

Comparison of empirical and panel estimates on population burden of injury – the INTEGRIS study

INTEGRIS WP5 'Injury disability indicators' focused on the disability component (years lived with disability; YLD), which is calculated by multiplying the number of injury cases by the disability weight and average duration of the health outcome. Regarding key aspects of this calculation several options are possible. One of these key aspects concerns linking the injury diagnosis to disability information. Disability information consists of 1) the proportion of injury cases with lifelong consequences, and 2) the disability weight of temporary and lifelong consequences. Disability weights may be adopted from existing panel-derived sets, such as the set of disability weights derived for the Global Burden of Disease study or the set of Dutch injury disability weights. Alternatively, disability weights derived from patient-reported health states using multi-attribute utility instruments (MAUI) such as the EQ-5D may be applied. Each of these approaches has its advantages and disadvantages. WP5 recommends using the patient-derived disability weights, since these disability weights are based on EQ-5D data of a large number of injury patients, capturing the heterogeneity of consequences per injury group. However, patient-derived disability weights meet constraints in measuring health states with complex patterns over time, such as temporary health states. Hence, for certain health states the patient-derived disability weights were appended with panel-derived disability weights that were specifically designed to alleviate the time constraints for temporary health states. The WP5 recommended disability weights by injury diagnoses can be linked to hospital data systems on hospitalized and non-hospitalized injury patients to calculate population burden of injury.

Contact details:
Juanita Haagsma
j.haagsma@erasmusmc.nl
Department of Public Health
Erasmus Medical Center
P.O. Box 2040
3000 CA Rotterdam
Phone: +10 70 38460
Fax: +10 70 44724

DEVELOPMENT OF DISABILITY METRICS USING EMPIRICAL DATA: DATA HUNTING

Belinda Gabbe[1,2], Cameron Willis[1], Shanthi Ameratunga[3], James Harrison[4], Ronan Lyons[5]

[1]*School of Public Health and Preventive Medicine, Monash University, Australia*
[2] *National Trauma Research Institute, The Alfred Hospital, Australia*
[3] *School of Population Health, University of Auckland, New Zealand*
[4] *Research Centre for Injury Studies, Flinders University, Australia*
[5] *School of Medicine, Swansea University, Wales*

The Global Burden of Disease (GBD) project uses panel studies to allocate disability weights for disease groups and injury. The panels usually involve people without experience with the condition, raising the question of whether the disability weights generated through lay panels are representative of the disability experienced by injury survivors. Validation of the disability weights generated by the GBD project requires comparison with disability weights developed from empirical studies of injury outcomes.

A number of population and large scale studies of injury outcomes have been conducted or are currently in progress. A dedicated data hunt is proposed to identify studies with the capacity to generate disability weights. The aims of the project will be to:

i. Identify key empirical data studies from around the world which cover a wide variety of severities and treatment settings
ii. Explore novel injury grouping strategies that reflect the influence of injury patterns on patient disability
iii. Establish the relationship between different disability metrics (e.g. SF-6D and EQ-5D)
iv. Identify key diagnoses, diagnosis or injury groups associated with high indices of disability
v. Validate the GBD disability weights.

The project will be collaborative. A Steering Committee will be established to oversee the work and provide guidance on priorities and reporting. The outcomes of this study will be an improved understanding of the disability experienced by injury survivors around the world, provide evidence for driving change in measuring the burden of injury, and inform the development of global disability indicators.

Systematic Review of SF-12 & EQ-5d Utility Scorings with an Application to Disabled US Veterans

Ted Miller, Pacific Institute for Research & Evaluation, Calverton MD, USA

The outcomes of thousands of injury incidents have been tracked using with short forms of the RAND health status instrument (SF36, SF12, SF6d) or the EQ5d (formerly the EuroQol). We searched the literature to identify preference-based utility scorings of the SF36 and SF12 health status measures. Because a method has been published to estimate EQ5d responses from the SF12 (Gray et al. 2006), we also searched for EQ5d scorings. We identified 29 SF12 scorings from 18 studies and 27 EQ5d scorings (including 4 scorings identified after our analyses were completed). We applied quality criteria, notably choosing a best scoring when multiple scorings were derived from a single data set and screening out two scorings that were based on less than 25 cases. We applied 15 direct SF12 scorings and 25 EQ5d scorings to SF12 data from more than 20,000 U.S. military veterans with service-connected disabilities and separately to more than 10,000 veterans without disabilities. We also formed pooled scorings that collapsed scores for each respondent using the number of cases in each scoring data set as weights. We then compared the score distributions between scorings.

The distributions from the pooled SF12 and pooled EQ5d scorings were virtually identical except for the scores assigned to the worst health states. The floor was 0.20 for the SF12 scorings and -0.07 for the EQ5d scorings. EQ5d scorings derived from visual analog scales (VAS) had a floor of 0.07 compared to -0.29 for ones derived from the time-tradeoff (TTO) method. The 25th percentile scores from the SF12 and EQ5d VAS scorings of 0.43 and 0.45 also exceeded the TTO level of 0.33. Sengupta et al.'s (2004) SF12 scoring based on the Health Utility Index almost perfectly reproduced the entire pooled score distribution. Lawrence et al.'s (2004) scoring also performed very well but it uses proprietary Systemetrics scores by domain in an intermediate step. SF6d scoring derived from the SF12 performed poorly; its floor was 0.345 and the score for the worst health status on all questions was 0.39. Much has been written about the Shaw et al. (2005) scoring of the EQ5d for the US, suggesting it shows scorings must be country-specific. In reality, that scoring used a different scoring equation structure than any of the other 26 scorings. Its values differ as much from the 5 other US scorings as it does from the scorings for other countries. Version 1 of the norm-based SF12 scoring performed similarly to the utility scorings, but Version 2 yielded higher utility scores.

Relative to healthy veterans of comparable age and gender, veterans with service-connected disabilities averaged 20% lower utility. We did not differentiate the mean differences for disabilities resulting from injury versus illness.

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ICE Disability Indicators – Is it possible to identify diagnoses with high probabilities of disability?

Colin Cryer, Injury Prevention Research Unit, University of Otago, New Zealand.

Background

The WHO International Classification of Functioning and Disability (ICF) considers disability along 3 dimensions: bodily structure and function (impairment), activity limitations, and participation restriction. In New Zealand, we investigated whether data collected on compensation for impairment (national ACC lump sum payment data - LSP) could be used to develop serious (threat of) impairment injury outcome indicators. This involved linkage of the ACC LSP to the hospital discharge data. This in turn permitted investigation of diagnosis-specific impairment, presented here.

Aims

To investigate diagnosis-specific linkage rates and impairment statistics in order to address the question: Is it possible to identify diagnoses with high probabilities of disability?

Method

Sources of data: The ACC Lump Sum Payment scheme and the New Zealand National Minimum Data Set (NMDS) of discharges from hospital.
The LSP data is based on an assessment of whole person impairment. The assessment takes place once the outcome of the injury is stable, usually takes place 2 or more years after the injury, and is based on the American Medical Association Guides to Evaluation of Permanent Impairment, 4th Edition. Probabilistic linkage was used to link the LSP data to the NMDS, using AUTOMATCH, based on the matching variables: first to third given name and surname (allowing for spelling discrepancies); day, month, year of birth, National Health Index number; ACC claim form number; day, month and year of injury. Linkage rates and impairment levels were described.

Results

The most prevalent linked cases were head injury, traumatic amputations, fractured femur, and ocular laceration with rupture. The linkage rate was less than 55% in all instances. The percent whole person impairment varied substantially for each of these diagnoses.

Discussion

The results suggest that many eligible cases are not receiving LSP. Within ICD diagnosis, there is heterogeneity of degree of impairment. It is unlikely that one can extrapolate from the linked to all cases. It does not appear possible to use these data to identify diagnoses with high probabilities of disability. Future work, once funded, will focus on the working population, and will use duration of time off work as a measure of participation restriction (disability). Use of similar data linkage methods is likely to result in measures of diagnosis-specific disability.

Acknowledgement

My colleagues: Pauline Gulliver, Daniel Russell, John Langley, Gabrielle Davie. The funder of our impairment indicators development work: the Accident Compensation Corporation of New Zealand (ACC).

Summary of discussions from the session on disability indicators
Ronan Lyons

This session consisted of an introduction to the work of the Disability Metrics Group by the facilitator, Ronan Lyons, followed by five presentations on group research activities. A discussion took place involving the wider GBD-IEG/ICE group on the implications of the findings from individual papers and overall on future research directions of the group.

Ronan Lyons presented first on the development of the Injury List of All Deficits (LOAD) Framework. The Injury LOAD Framework represents an attempt to develop a comprehensive categorisation of the negative consequences of injury and violence. A paper on Injury LOAD will shortly be published in the International Journal of Injury Control and Safety Promotion.

Juanita Haagsma presented on the work of one aspect of the INTEGRIS Study, a European Commission funded project designed to integrate injury statistics across Europe. Within the INTEGRIS project one work package involves the creation of injury disability indicators for the 39 injury groupings used in previous EUROCOST projects.

Belinda Gabbe presented on the development of disability metrics for more refined injury groups. Existing metrics are based on very broad groupings which are very heterogeneous and there is a need to develop metrics for a greater number of more homogenous groups, using empirical data..

Ted Miller presented on a systematic review of SF-12 & EQ-5D utility scorings with an application to disabled US Veterans, identifying 56 different SF12 or EQ5D scoring algorithms. The linked analysis of data, demonstrated a 20% average lower utility score in the disabled group. There was considerable discussion about the merits, and technicalities, of developing comparable utility measures from different instruments.

Colin Cryer r is attempting to identify specific diagnoses amongst hospital admissions that have high probabilities of disability and thus could form the basis for ICE disability indicators. This work involves analysis of linked insurance claims from the no fault ACC system in New Zealand with hospital separation data. Analysis to date suggests that this is still very challenging.

The group also discussed the importance of developing and continuing contacts with the Washington Group on Disability Statistics.
Following detailed discussion amongst the group and the wider Global Burden of Diseases-Injury Expert Group and ICE the following decisions were made:

1. The group will carry out research to operationalise components of the Injury LOAD Framework, particularly those relating to factors other than mortality/disability in injured individuals. Developments in record linkage and increasing data availability in different parts of the world will facilitate such research.
2. The group will continue research to identify specific diagnoses or groups of diagnoses with high probabilities of disability.
3. The group will work on creating new disability metrics for more homogenous injury groupings using individual level data derived from meta-analyses of existing empirical studies.
4. The group will carry out research into the relationship between different utility metrics (e.g. SF-6D and EQ-5D), and different scoring algorithms of such instruments, with the intention of combining data from studies using different instruments.
5. The group will carry out research to compare the impact of choosing different approaches (MAUI versus panel derived) or different disability weightings and durations on disability metrics for specific injury groupings and the population burden of injuries.
6. The group will combine these approaches to refine and improve measurement of the Global Burden of Injuries, our ultimate aim.
7. The group will submit abstracts to the Safety2010 world conference which will be held in London in September 2010.
8. The group will also meet in Swansea, Wales immediately prior to the Safety2010 to report back on developments since the Boston meeting.