AN INVESTIGATION INTO THE MEASUREMENT OF WORKPLACE INJURY SEVERITY

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Abstract

Currently, the New Zealand Injury Information Manager, Statistics New Zealand, is scoping possible injury severity thresholds for workplace injury reporting purposes. Severity levels define which injuries to include within different reporting scenarios. This paper investigates methods of measuring workplace injury severity in Australia, the United Kingdom, Canada, the United States, and the widely-accepted quantitative approaches to injury severity levels, the 'Abbreviated Injury Scale' (AIS) and the 'International Classification of Disease-Based Severity Score' (ICISS), and discusses their application to Statistics New Zealand's workplace injury reporting.

Introduction

Quantifying the severity of an injury is a contentious issue. Is a broken arm less severe than a broken leg? What about a closed fracture compared to an open fracture? Should paper cuts be included in statistical reports along with shallow cuts, lacerations, and open wounds that result in death? Currently, the New Zealand Injury Information Manager, Statistics New Zealand is reviewing its work-related injury reporting process and is investigating standard definitions of severity for reporting purposes.

Work-related injuries are a huge problem within New Zealand and internationally. They have ongoing costs and consequences which adversely affect businesses. Figures indicate that in 2005 86 people died as a result of work-related injuries. A total of 132 work-related injury claims were made per 1,000 full time workers; each of these claims costing an average of NZD $805. The total cost for all work-related injuries was just under $200 million for the year (Statistics New Zealand).

This report firstly explores quantitative approaches to measuring injury severity. These are internationally accepted injury severity scoring systems. It then investigates case studies in Canada, the United Kingdom, the United States and Australia. The application of this research to the New Zealand context is then discussed.

Injury Severity Scoring Models

The Abbreviated Injury Scale (AIS) and the International Classification of Disease-based Injury Severity Score (ICISS) are two of the main quantitative approaches that attempt to assign injury severity scores to injuries.
Abbreviated Injury Scale

The Abbreviated Injury Scale (AIS) is a measure of injury severity. It was first developed in 1971 for the 'Association for the Advancement of Automotive Medicine.' It is now used widely as an injury severity scoring system. Each injury that occurs in each specific body region is given an injury descriptor and a severity score. This process is carried out by trained specialists. The severity scores range from one to six; one is minor, two to four are levels of increasing severity, five is severe, and six is currently untreatable. These scores are based on threat to life, permanent impairment, treatment period, and energy dissipation levels. A system called ICDMAP has been developed to code injuries within 'The International Statistical Classification of Diseases and Related Health Problems, Ninth Revision (ICD-9)'to AIS scores. ICD-9 was previously the most widely used health classification system; however it has been succeeded by the 10th addition ICD10.

AIS has been further developed to take into account multiple trauma cases in a system called the Injury Severity Score (ISS) or the New Injury Severity Score (NISS). ISS takes into account the three most severe aspects of an injury from different body regions.[1,2] The New Injury Severity Score (NISS) has been suggested as an alternative to ISS (Osler, Baker and Long 1997); the three most severe injuries used in the calculation are from any part of the body, irrespective of region.

Several studies compare ISS and NISS. Sutherland et al indicates that NISS is significantly better than ISS at predicting the threat to life of these injuries. It allows the severity score of multiple traumas to a body region to be compared to a single trauma from that same region (Sutherland, Johnston and Hutchinson 2006). Husum et al shows that NISS was a better predictor than ISS for limbs, however, there were no significant differences overall (Husum and Strada 2002).

ICD-Based Injury Severity Score

A more recently developed method of injury severity scoring is known as the ICD-Based Injury Severity Score (ICISS), which is made up of 'probability of survival scores'. Each injury within ICD-10 is assigned a score that quantifies an individual's probability of survival.

The 'probability of survival' scores are known as Survival Risk Ratios (SRR). These are calculated by determining the ratio of the number individuals with a certain injury admitted to hospitals who survive, against the total with that injury admitted. Individuals who are not admitted to hospital, such as those dying before they are admitted, are excluded from the ratio. ICISS scores have limited accuracy for rare injury diagnoses due to the small sample sizes involved in these calculations (Cryer 2006). ICISS scores are calculated using local hospital data; results across countries are therefore not necessarily comparable. New Zealand SRR scores are based on records from the National Minimum Data Set (NMDS). The NMDS includes a record of approximately all private and public hospital stays across the country. The NMDS is collated and managed by New Zealand Health Information Service (NZHIS). Australian Scores are calculated from the National Hospital Morbidity Database (NHMD), again including approximately all records of hospital stays from private and public hospitals across the country. Results show New Zealand and Australian scores to be statistically comparable (Stephenson, Henley, Harrison and Langley 2004).

For multiple trauma cases the three SRRs with the lowest probability of survival are multiplied together to give an ICISS score. Research has been conducted to see if the multiplicative ICISS score or the single SRR score (the worst aspect of the injury) is a better predictor of survival in a multiple trauma case. It has been suggested that the lowest SRR is a more accurate indicator of survival than an ICISS score and explains more variance in this situation (Kilgo, Osler and Meredith 2003).

International Models

The national statistical agencies of Canada, the United States, Australia, and the United Kingdom produce numerous workplace injury reports. Injuries reported on often reflect the type of data available, and not necessarily a pre-determined severity level. It appears likely that injuries included in these reports are assumed to be of adequate severity to be of interest.

In Canada work-related injury statistics are collected by the Association of Workers' Compensation Boards of Canada (AWCBC).[3] Severity levels for inclusion of non-fatal injuries in the report are based on time-loss. Injuries must have received sufficient time-loss compensation from the appropriate jurisdiction's workers' compensation board or commission. Also included are permanent disabilities receiving compensation as a result of occupational overuse. The Canadian Institute for Health Information (CIHI) produces a biennial report on 'Major Injury in Canada'. The severity level set are those

that have an ISS greater than 12, and have been admitted to a participating hospital, or treated/died in the emergency department[4]. Statistics Canada runs the Canadian Community Health Survey (CCHS)[5]. The severity levels needed for inclusion in this report are those that limit activities. Limitation of activities is based on individual perception.

The Health and Safety Executive (HSE) collects United Kingdom work-related injury data. HSE categorises workplace injuries into three severity levels; fatal, major, and those resulting in more that three days leave from the workplace (weekends and holidays are included as a part of this time). The criteria for major injuries are specified in 'A guide to the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations, 1995.' That is, major injuries are those that fit within a pre-defined list of injuries[6].

The United States Bureau of Labour Statistics reports workplace injuries[7] if they are recordable cases[8]. Recordable cases are broken into three categories: injuries that involve days away from work with/without restriction of activity or job transfer, those only involving restriction in activities/job transfer, and 'Other Recordable Cases'. 'Other' includes remaining recordable cases. This is similar to the UK where injuries are reported on if they fit within a pre-defined list. A non-fatal injury included in the US Web-Based Injury Statistics Query and Reporting System (WISQARS)[9] is based on admittance to emergency departments for treatment. This is a bench mark severity level; the assumption is that these injuries are serious enough to be of interest. Fatal data for all injuries comes from information collected from the United States Bureau for the Census.

Inclusion of workplace injuries in Australia's triennial National Health Survey (NHS)[10] and ABS Work-Related Injury Survey[11] are based on individual perception and recall. Individuals in the survey are asked about all workplace injuries that have occurred to them during the previous four weeks. Further to this, the Australian Institute of Health and Welfare (AIHW) uses Australia's National Hospital Morbidity Database[12] (NHMD) to produce workplace injury statistics. The data set includes all injuries requiring admittance into any private or public hospital.

Discussion

Researching international severity systems for workplace injury reporting purposes shows that severity levels used by national statistical agencies tend to be defined by time loss, injuries requiring admittance to hospital, reporting on standard 'severe' injuries or basing inclusion in reports on perception of severity.

The measure of severity that an agency or a researcher uses depends on the data available to them. A statistical agency conducting a survey can not use a severity scoring system such as AIS or ICISS. To use AIS or ICISS injury

data has to be coded to an injury classification system by qualified coders; this is not possible in a survey situation where individuals are asked to tell about previous injuries that they have experienced. It is also hard to gauge time loss or any basic classification of injury from individual recall. Therefore in survey situations looking at how an individual views his or her injury is often the best measure of severity.

National statistical agencies frequently use self-defined classification systems to select injuries for inclusion in workplace reports. This is a way around the use of qualified coders to classify injury cases to the ICD classification system. Injuries in the list are considered to be of a certain severity to be of interest.

If injury data is taken from an administrative data source, gauging severity is limited by the nature of the data itself. For example, Workers Compensation Boards tend to have good measures of time loss, therefore basing severity on time loss is a logical solution. If a data is taken from a source that records injuries admitted to hospitals or emergency departments, then the severity measure used for inclusion into reports is often admittance into hospital/ emergency departments.

AIS and ICISS severity systems quantify severity. Statistical agencies can use this method of reporting if their data is classified to the ICD-9 or the ICD-10 classification system. Canada's CIHI reports on injuries admitted to hospitals that have an ISS of 12 or higher.

Conclusion

Researching workplace injury severity shows that defining injury severity is a complicated issue. Methods of defining injury severity levels have been evaluated. There are several quantitative severity scoring systems that can be used. Time-loss from work, admittance to hospital are also used as a severity focus, amongst others.

Statistics New Zealand, as New Zealand's Injury Information Manager needs to determine the best way for it to define injury. Statistics New Zealand currently receives administrative data from the Accident Compensation Corporation (ACC) and hospital information from the National Minimum Data Set (NMDS). The NMDS is collated and managed by New Zealand Health Information Service (NZHIS). The main focus of ACC data is compensation of injuries, and the main focus of the NMDS is a record of hospitalisation of injuries. The mechanism already used is to look at workplace injuries resulting in compensation from ACC and those resulting in hospitalisation for NZHIS data.

Another potential severity dimension for ACC data is to use time-loss in conjunction with cost. NZHIS data could be further broken down into number days spent in hospital, with the assumption that injuries with a longer stay are more severe.

Another option is to use a pre-defined list of 'severe' injuries. A potential problem is that pre-defined set of injuries would discount the fact that each injury classified has a range of severity levels. For example, different lacerations have different depths. This list would also be subject to change and hence would not necessarily be comparable across years.

It is also possible to use the ACC and NZHIS data to focus on quantitative method such as ICISS or AIS. Severity scoring methods have the advantage of focussing on the most up to date research. Statistics New Zealand would always like to focus on the most up-to-date approach to severity scoring, however this means ongoing changes to academic methods would reduce comparability across years.

There is the option of Statistics New Zealand investigating the feasibility of conducting a workplace injury survey that has an inbuilt severity measure. This would involve considerable financial cost, time and resource.

The above options of measuring workplace injury severity levels are to be presented to Statistics New Zealand for evaluation and further discussion.

Notes

1   Head and neck, face, chest, abdomen, extremities, and external.

2   The three AIS scores are squared and added together. Scores range from 0 to 75. If an injury has AIS score of 6 (currently untreatable) this is immediately assigned as ISS score of 75.

3   This is through the National Work Injury Statistics Programme (NWISP). NWISP produces two types of statistics for the annual publication 'National Work Injury and Disease Statistics'. These are the number of non-fatal work related injuries and the number of workplace fatalities for all Canadian jurisdictions.

4   The data is obtained from the National Trauma Registry Comprehensive Data Set (NTR CDS).

5   The survey sampling frame is all households within Canada. This excludes Indian reserves, some remote areas, and Canadian Force Bases. Repetitive strain injuries are not reported as injuries.

As quoted from the HSE website www.hse.gov.uk/pubns/hsis1.pdf

'Schedule 1 Regulation 2(1) Major Injuries:

i) Any fracture, other than to the fingers, thumbs or toes.

ii) Any amputation.

iii) Dislocation of the shoulder, hip, knee or spine.

iv) Loss of sight (whether temporary or permanent).

v) A chemical or hot metal burn to the eye or any penetrating injury to the eye.

vi) Any injury resulting from an electric shock or electrical burn (including any electrical burn caused by arcing or arcing products) leading to unconsciousness or requiring resuscitation or admittance to hospital for more than 24 hours.

vii) Any other injury -
(a) Leading to hypothermia, heat-induced illness or to unconsciousness,
(b) Requiring resuscitation, or
(c) Requiring admittance to hospital for more than 24 hours.

viii) Loss of consciousness caused by asphyxia or by exposure to a harmful substance or biological agent.

ix) Either of the following conditions which result from the absorption of any substance by inhalation, ingestion or through the skin -
(a) Acute illness requiring medical treatment; or
(b) Loss of consciousness.

x) Acute illness which requires medical treatment where there is reason to believe that this resulted from exposure to a biological agent or its toxins or infected material.'

7   The BLS is affiliated with the United States Department of Labour. Their Survey of Occupational Injuries and Illness (SOII) collect information on non-fatal injuries. This is done via a random selection of private work organisations, across 44 states and territories. Data is individually processed by BLS affiliated state agencies. The BLS's Census of Fatal Occupational Injuries (CFOI) reports on fatal injury cases.

As quoted from the BLS website www.bls.gov/iif/oshdef.htm

'Recordable cases include work-related injuries that result in death, loss of consciousness, days away from work, restricted work activity or job transfer, medical treatment (beyond first aid), significant work related injuries or illnesses that are diagnosed by a physician or other licensed health care professional. These include any work related case involving cancer, chronic irreversible disease, a fractured or cracked bone, or a punctured eardrum.
Injuries are regarded as a recordable case if they fit within the following criteria.

-Any needlestick injury or cut from a sharp object that is contaminated with another person's blood or other potentially infectious material.

-Any case requiring an employee to be medically removed under the requirements of an OSHA health standard.

-Tuberculosis infection as evidenced by a positive skin test or diagnosis by a physician or other licensed health care professional after exposure to a known case of active tuberculosis.

An employee's hearing test (audiogram) reveals 1) that the employee has experienced a Standard Threshold Shift (STS) in hearing in one or both ears (averaged at 2000, 3000, and 4000 Hz) and 2) the employee's total hearing level is 25 decibels (dB) or more above the audiometric zero (also averaged at 2000, 3000, and 4000 Hz) in the same ear(s) as the STS'

9   This is a programme initiated by the Centers for Disease Control and Prevention (CDC) through the National Electronic Injury Surveillance System-All Injury Programme (NEISS-AIP). All injuries reported to the 100 emergency departments in the sampling frame, excluding injuries where the principal diagnosis is unknown, or the injuries was for adverse effects of therapeutic drugs or of surgical and medical care are included.

10   This survey is undertaken by the Australian Bureau of Statistics (ABS) and was last completed 2004 to 2005. The sample frame is all Australians in private dwellings, excluding diplomatic personal, overseas visitors, overseas service personal in Australia, and all dependents. Residents of hospitals, hospices, and other residential institutions are also excluded. The NHS asks questions on work-related injuries of individuals 15 years and above.

11   Runs yearly in conjunction with the Labour Force survey. Individuals need to be over 14, and to have experienced a work-related injury during the previous 12 months.

12   Injuries are classified in terms of 'hospital separations' which is a full stay at hospital, from admission to discharge. Death statistics are included in the database. Excluded are self-harm injuries and those related to adverse affects of medical related procedures.

References

Australian Bureau of Statistics (2006). National Health Survey: Summary of Results. *National Health Survey 2004-05: Users' Guide,* 4364.0, 69-74.

Breslin, F., Smith, P., Koehoorn, M. and Lee, H. (2006). Is the Workplace Becoming Safer? *Perspectives: Statistics Canada,* 75-001-XIE, 18-23.

Cryer, C. (2006). Severity of injury measures and descriptive epidemiology, *BMJ Journals*, **12**(2), 67-68.

Cryer, C., Davie, G. and Langley, J. (2006). Appendix B: Definitions used for the production of the charts In *A Chartbook of the New Zealand Injury Prevention Strategy serious injury outcome indicators 1994-2004*, 47-62.

Expert Group on Injury Severity Measurement. (2004). Discussion document on injury severity measurement in administrative datasets.

Flaherty, D. (2005). National Trauma Registry: Comprehensive Data Set (NTR CDS): Privacy Impact Assessment, 1-10.

Husum, H. and Strada, G. (2002). Injury severity score versus new injury severity score for penetrating injuries. *Prehospital and Disaster Medicine*, **17**(1), 27-32.

Kilgo, P., Osler, T. and Meredith, W. (2003). The worst injury predicts mortality outcome the best: Rethinking the role of multiple injuries in trauma outcome scoring, *Journal of Trauma – Injury Infection and Critical Care*, **55**(4), 599-607.

National Occupational Health and Safety Commission. (2004). *Hospitalisations due to Work-related injury in Australia (2000-2001)*, 12-14.

Osler, T., Baker, S. and Long, W. (1997). A modification of the injury severity score that both improves accuracy and simplifies scoring, *Journal of Trauma – Injury Infection and Critical Care*, **43**(6), 922-926.

Stephenson, S., Henley, G., Harrison, J. and Langley, J. (2004). Diagnosis based injury severity scaling: investigation of a method using Australian and New Zealand hospitalisations, *BMJ Journals*, **10**, 379-383.

Sutherland, A., Johnston, A. and Hutchison, J. (2006). The new injury severity score: Better prediction of functional recovery after musculoskeletal injury, *Value in Health*, **9**(1), 24-27.

http://www.statcan.ca/english/freepub/82-221-XIE/2006001/defin1.htm, 4/08/2006.

http://www.statcan.ca/english/freepub/82-221-XIE/2006001/tables/1hlthsta/cond5.htm, 4/08/2006.

http://www.statcan.ca/english/concepts/health/cchsinfo.htm, 4/08/2006.

http://www.hse.gov.uk/statistics/sources.htm, 7/08/2006.

http://www.bls.gov/iif/oshwc/osh/os/osnr0023.txt, 7/08/2006.

http://www.bls.gov/iif/oshdef.htm, 7/08/2006.

http://www.bls.gov/iif/oshfat1.htm, 7/08/2006.

http://www.bls.gov/iif/oshstate.htm, 7/08/2006.

http://www.cdc.gov/ncipc/wisqars/nonfatal/definitions.htm#nonfatalnjury, 7/08/2006.

http://abs.gov.au/Ausstats/abs@.nsf/0e5fa1cc95cd093c4a2568110007852b/7b18467197c69e7bca256f5400710940!OpenDocument, 9/08/2006.

http://www.abs.gov.au/AUSSTATS/abs@.nsf/DOSSbyTopic/AA53D48F38B5B609CA256BD000286974?OpenDocument, 9/08/2006.

http://www.aihw.gov.au/hospitals/nhm_database.cfm, 12/08/2006.

http://www.trauma.org/scores/iss.html, 18/08/2006.

http://www.trauma.org/scores/ais.html, 18/08/2006.

http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=AR26_2001sum_e, 3/08/2006.

http://www.ccohs.ca/oshanswers/information/injury_statistics.html, 4/08/2006.

http://www.hse.gov.uk/pubns/hsis1.pdf, 18/08/2006.

http://www.aast.org/02abstracts/02absOral_049.html, 11/8/2006.

http://www.statcan.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3226&lang=en&db=IMDB&dbg=f&adm=8&dis=2, 2/8/2006

http://www.awcbc.org/english/NWISP_Stats.asp#Accepted_time-loss_injuries, 4/08/2006.

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