Keynote: Priorities for Injury Surveillance

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There has been a significant increase in injury surveillance activities worldwide as many countries are recognising the importance of injury, relative to disease, as a cause of mortality and morbidity. Given that resources are limited it is important we use them to ensure the maximum return for injury control. This paper identifies priorities for the future development of injury surveillance namely:

- Maintain the focus on important injury
- Promote consensus on minimum data sets for specific injury events
- Improve, develop, and apply classification systems/databases
- Get the most out of what we have got
- Improve the comprehensiveness and quality of international comparisons

It should be noted that the discussion presented here is from a western developed country perspective. It is acknowledged that many developing countries have more fundamental priorities.

1. Maintain the focus on important injury

The priorities for injury prevention resources should based on a consideration of deaths, and non fatal injury which is important in terms of threat to life, results in serious disablement, or is costly. These outcomes should, by definition, be the focus of our injury surveillance effort. Regrettably, that often appears not to be the case.

It is not uncommon to read or hear phrases to the effect that the injuries being described are "just the tip of the iceberg". This analogy relates to the fact that approximately 15% of an iceberg is visible at sea level. Applied to the New Zealand situation, for every death, there are 30 injuries requiring hospital inpatient treatment and for every inpatient injury there are 30 requiring outpatient treatment only, (1:30:900) and many more requiring general practitioner treatment.

The analogy with the iceberg is flawed. Whereas the ice we can at sea level is the same as that below sea level that is not the case for the injuries. Injuries resulting in death are clearly more serious than non-fatal injury requiring hospital inpatient treatment.

Another shortcoming with the analogy is that all cause injury ratios can mistakenly be applied to specific injury events and as a consequence result in significant over- or under-estimates. Take for example, submersion incidents. In 1996 in New Zealand there were 101 drowning deaths (defined as those events with one of the following E codes: 830,832,910,954,984. Applying the all cause ratio would result in an estimate of 3030 submersion incidents requiring inpatient treatment. The actual number was 134, 4% of that estimated by the application of the all cause ratio.

Table 1 shows the actual ratios for self-harm, falls, and striking against incidents and for New Zealand. It demonstrates quite clearly that injury icebergs do not comply with the characteristics of natural icebergs.

Table 1: Death to Injury Inpatient ratios - New Zealand: 1995

All injury	1:41
Self harm	1:5
Falls	1:76
Striking against	1:492

A further problem with the iceberg analogy is that often there is an implication that apart from the outcome (e.g., death, serious injury) these events are the same. But are they? Are the circumstances, risk factors and their relative contribution the same? Clearly they are not in many instances. For example, Table 2 shows that distribution of mechanism of self inflicted harm varies markedly depending on the outcome under consideration.

Table 2: Distribution of mechanism of self harm by outcome - New Zealand: 1995

	Deaths	**Serious injury**
Poisonings	35%	89%
Hangings	41%	2%
Submersion	4%	0%
Firearms	12%	1%
Sharp objects	2%	5%
Jump	3%	1%
Other	4%	2%

It has been this iceberg model which has indirectly lead to the development of injury surveillance systems based on emergency department visits. Many of these events are not priorities for injury prevention, and thus injury surveillance, since they are not important in terms of threat to life, disablement, or cost.[1,2] Those that are, are typically admitted (3). Given that many countries do not have national inpatient injury data systems their development should be a priority.

In addition, emergency department visits for minor injury are strongly influenced by social, health service supply, and access factors.[4,5,6,7]

More importantly, there are more pressing needs for injury surveillance. Most countries require better information on deaths, and injury requiring in-patient treatment. For example, in New Zealand and Australia, and no doubt many other countries, there is no simple way of determining from existing databases whether an injury is work related or not.[8,9]

Similarly, while Coroner's files maintain detailed information on the circumstances of death, they are not accessible electronically, and they vary in their quality.[10,11] The establishment of systems for determining the work-relatedness of deaths, and electronic uniform Coronial databases[12,13] are just two examples which deserve far more attention than the promotion of accident and emergency surveillance systems. Other equally important priorities for serious injury, as defined here, are outlined below.

2. Promote consensus on minimum data sets for specific injury events

In New Zealand, all reported fatal, and non-fatal, motor vehicle traffic crashes are investigated by the police and the detail recorded in a standard form which is then entered into the Land Transport Safety Authority (LTSA) database. The database has approximately 50 variables covering driver, vehicle, road, and environmental factors. Similar systems exist in other countries. The resources directed at this no doubt relate directly to the size of the problem. In 1996 suicides (32%) surpassed motor vehicle traffic crashes (30%) as the leading cause of injury death in New Zealand. Suicides are also investigated by the police in New Zealand, but in marked contrast to road deaths there is no specialized reporting form or supporting data base. This is much the same situation for all other injury deaths, even in areas where we have policy and legislation to support a specific problem. A good example of this is domestic pool drownings. New Zealand has pool fencing legislation. Despite this, the recording of circumstances of pool drowning deaths is such that one could not determine for the majority of cases whether, for example, the pool was fenced and whether it complied with the safety specifications required by law.

As an injury prevention research community we urgently need to develop recommended minimum data sets for specific injury events (e.g., falls, assault, drownings), mechanisms (e.g., firearms), activities (e.g., work, sport), and generic risk factors (e.g., alcohol). The recent efforts in relation to firearms[14] and partner assault serve as useful models.[15] Such initiatives are of political and public health importance, at least in the New Zealand context. For example, New Zealand recently introduced legislation which opened up its work-related injury compensation to competition. One requirement of the new legislation is that all insurance companies will need to provide data on the circumstances of injury to a central agency. It is intended that this data be used to monitor the impact of the changes to the scheme and to facilitate injury prevention.

The legislation was passed by parliament in December 1998 and come into effect on 1 July 1999. Government officials have been working studiously to arrive at a minimum data set for each injury case that all insurance providers will be required to provide to the central agency. This task has been seriously hampered by the absence of international or national consensus documents on what should be collected on occupational injury for the purposes of facilitating injury prevention. On a positive note it would appear that what is being proposed is more comprehensive than has been produced before. The proposal is, and will continue to be, under threat for cost reasons. Clearly those who support a comprehensive approach will need to demonstrate the utility of each data element. Given New Zealand's purported poor occupational injury performance their efforts would have additional impact if they could argue that the removal of specific data items would in effect mean that New Zealand would have a internationally substandard surveillance system.

3. Improve, develop, and apply classification systems/databases

3.1 Circumstances of injury

Internationally, the Supplementary Classification of External Causes of Injury and Poisoning (E-codes) of the World Health Organization’s (WHO) International Statistical Classification of Diseases, Injuries, and Causes of Death (ICD) is the most widely used coding frame for categorizing the circumstances of injury and poisoning.[16] The government agencies responsible for health statistics in most member countries of WHO are currently using the 9th revision of ICD (commonly referred to as ICD-9) or a variation of it, such as the clinical modification (ICD-9-CM),[17] to summarize their trauma deaths. In a limited number of countries, authorities are also using ICD-9 to code injuries resulting in hospital inpatient treatment. In addition, other agencies and individuals use E-codes to summarize the circumstances of injury for injured persons presenting to other health service providers (e.g., general practitioners and emergency departments).

Despite their widespread use, these E-codes have been criticized as being inadequate for prevention purposes.[18,19,20] In response to this, agencies both in New Zealand, and in other countries have developed their own coding.[21,22,23] In some instances these map to the ICD[23] but in others they do not.[21]

In 1992, WHO released the tenth revision of the ICD (ICD-10)[24] which includes major revisions to the E-codes used to summarize injury and poisoning. Relative to its predecessor, ICD-10 represents a significant improvement in many areas,[25] Unfortunately, it still falls far short of the mark for many injury prevention needs. Firearm injuries serve to illustrate the point. From a public policy perspective it is important to be able to differentiate between handguns, long guns, military style semi-automatic firearms, and air guns/rifles.[26] Although firearm types have been elevated in status from the fourth digit level in ICD-9 to the three character level in ICD-10, there is a substantial loss of information on firearm type for countries that code at the four digit level using ICD-9 (Table 3). Whereas shotguns and military firearms were separate E-codes in ICD-9 they have now been lumped together (W33). Given the growing concern of many countries to control firearm injuries, this loss of specificity is inappropriate.

Table 3: ICD codes for unintentional firearm injury

ICD-9	**ICD-10**
Firearm missile	Handgun discharge
- Handgun	Rifle, shotgun and larger firearm
- Shotgun (auto)	Other and unspecified
- Military firearms	
- Other	
- Unspecified	

Some would argue that the ICD was not designed to meet many of the expectations which have been placed on it. While this may be true, it is also the case that many agencies and individuals seek to have more than the ICD has been able to deliver to date. One need look no further than the development of alternative coding frames in New Zealand, Australia, and Scandinavia. It is undoubtedly the case that this need will persist and grow as injury receives increasing recognition, proportionate to its impact on health status. In the absence of some internationally agreed classifications for meeting these needs there is bound to be an increasing proliferation of coding frames. These are likely to be poorly thought out, incompatible with one another, and unable to be mapped to the ICD.

The task of developing coding frames to meet the needs of injury practitioners has been taken up by the WHO Working Group on Injury Surveillance Methodology Development. That group released its draft proposal at the 4th World Conference on Injury Prevention and Control in Amsterdam.[27]

This provides a solid foundation for moving forward on this issue. To date however, recruitment to trail this has been less than satisfactory

3.2 Severity of injury

I have already argued that the development of injury surveillance systems based on emergency room visits is problematic since attendance is influenced by social and economic factors. Given that these factors will vary over time this seriously compromises the use of these data for measuring trends. As a consequence I have advocated we give priority to developing inpatient injury surveillance systems. Whether one gets admitted to hospital, however, is also influenced by factors other than the severity of one injury, albeit to a lesser extent than attendance as an outpatient to an emergency department. This situation can be addressed by the application of measures of injury severity. The situation is well illustrated in the New Zealand context by reference to trends in head injury.

Figure 1 suggests that New Zealand has been very successful in reducing head injury requiring inpatient treatment. Figure 2 shows the same data disaggregated according to ICD-AIS.[28] The majority of head injuries are AIS-2 and these are declining. This contrasts with the more severe head injuries which are relatively stable over time. The trend for AIS-2 injuries probably reflects two factors. First, the positive effect of interventions such as cycle helmet wearing.[29] Second, evidence suggests that the with the advent of improvements in the diagnosis of head injury through the use of computer tomography people who may have been admitted in the past for observation are now allowed home.[30]

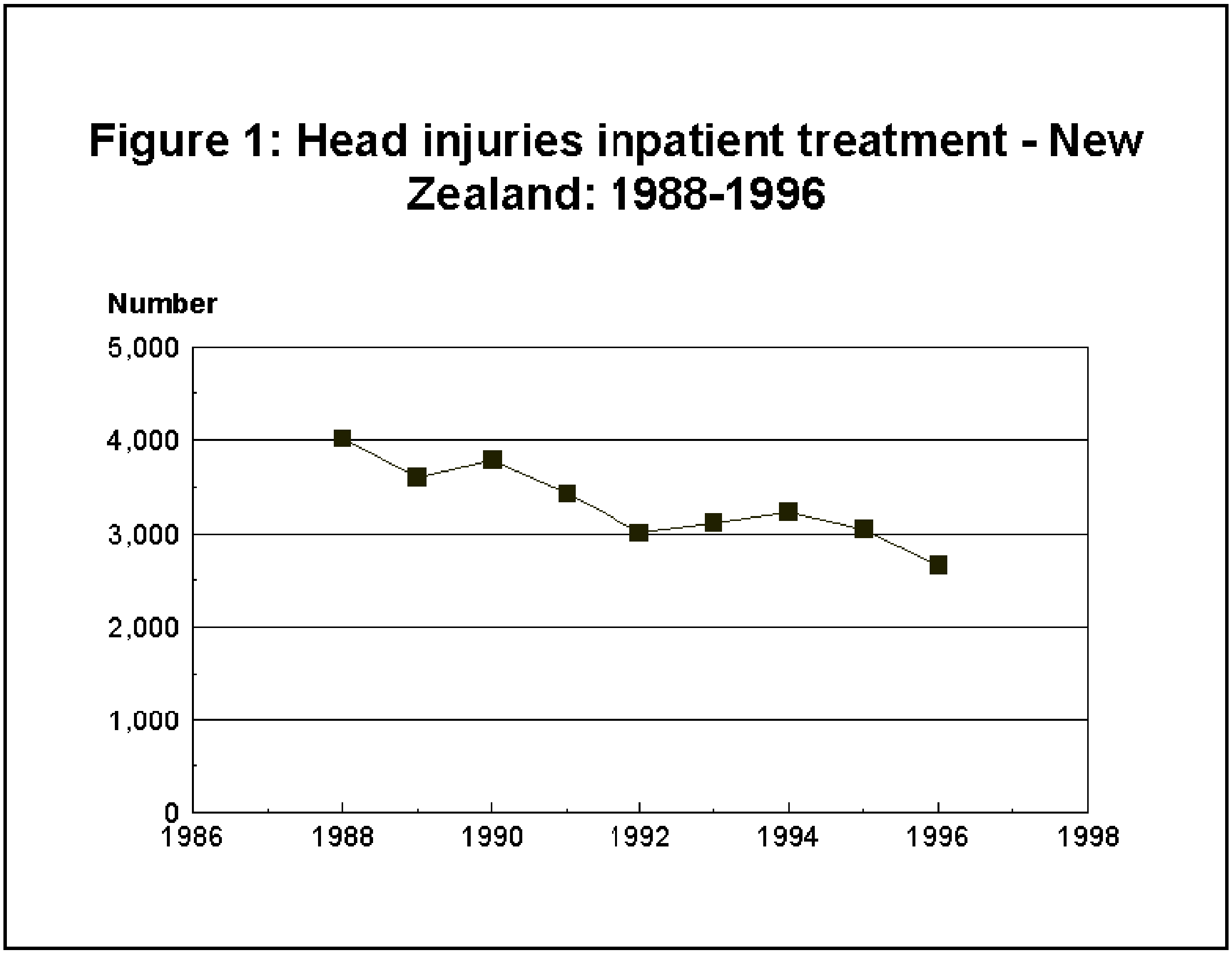
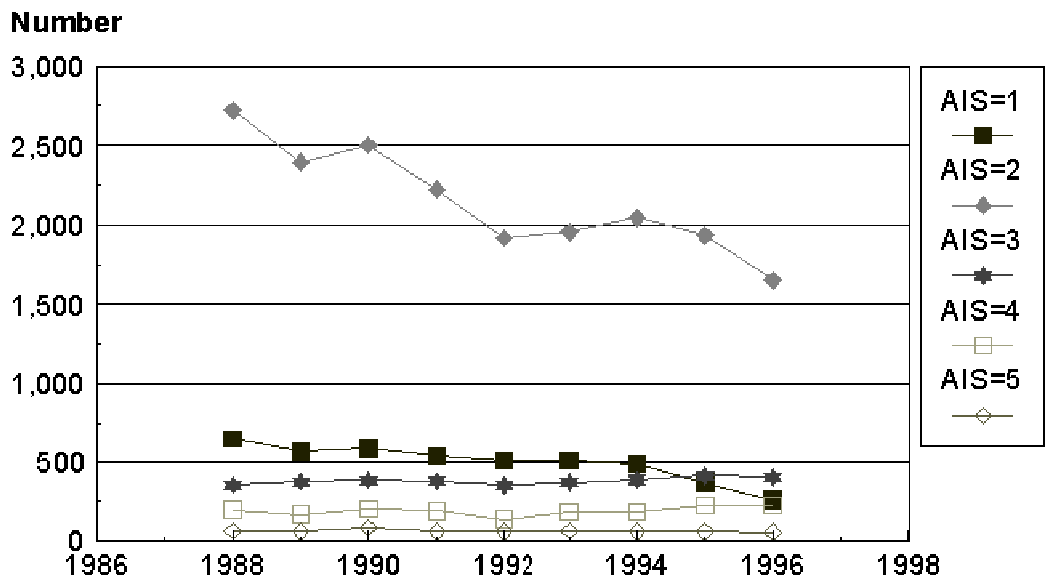


Figure 1: Head injuries inpatient treatment - New Zealand: 1988-1996
Number
5,000
4,000
3,000
2,000
1,000
0
1986
1988
1990
1992
1994
1996
1998

Figure 2: Head injuries inpatient treatment - New Zealand: 1988-1996 by AIS



AIS is the most widely used and accepted anatomical measure of severity. In the example above, AIS scores were derived from a programmed which maps from ICD-9-CM. There are limitations with this indirect method of determining severity (e.g., many ICD codes do not map, it is dependent on the quality of ICD coding). Of perhaps greater concern is that many countries do not use ICD-9-CM . In addition, others are introducing ICD-10, and at present there is no ICD-10 to AIS mapping programmed. One option is to undertake direct coding. Given that it takes 10-20 minutes to assign AIS scores, direct coding for population based surveillance systems based on injury victims who are admitted to hospital is a major financial barrier. More recently there have been efforts to develop systems which are based directly on ICD codes.[31] There have been limited evaluations of this method.

In summary, in considering the implementation of diagnostic coding systems for population injury surveillance a key consideration should be whether severity scores can be derived from these codes.

3.3 Disablement

The absence of data on non-fatal outcomes is a major barrier to prevention and rehabilitation efforts. For example, we need to be able to rapidly determine how many people are: blind, have a major cognitive loss, or are paraplegic as a result of injury. To the best of my knowledge no country records such information on an ongoing basis in a readily retrievable format. Such information is important for determining injury prevention priorities and determining how effective we have been at reducing these outcomes as a result of changes in critical care and rehabilitation services. The absence of readily available data on non-fatal outcomes is very surprising given that many countries have agencies which have a mandate to compensation and rehabilitation of injured victims. Typically such organizations refer to a reduction in injury claims and injury costs. Both of these measures, however, are susceptible to factors other than severity of disablement (e.g., changes in criteria for compensation, time limits on how long a victim may be compensated for). While they may meet many of the organizations performance measurement needs they may have little relationship to the societal (as opposed to an organization's) burden of disablement.

4. Get the most out of what we have got

4.1 Narratives

We will never develop, nor could we implement, coding frames which will meet all our prevention needs. Development is hampered by the diversity in the circumstances of injury and variety of non-mutually exclusive dimensions upon which we consider injury (e.g., work-related injury and crashes). Implementation is hampered by the cost of coding such information.

We need to remind ourselves that many countries do not even have reliable counts of the number of people who have died as a result of injury and many others have yet to implement ICD-9 E-coding for these injury deaths. Counting non-fatal injuries and coding them is a distant dream in countries which represent the a substantial portion of the world population.

Narratives have been shown to be a powerful tool for injury prevention, even for those countries which can afford to code the circumstances of injury.[32,33,34,35]

One thing, that tends to occur naturally is that injury victims, or witnesses, are asked "what happened". Sometimes the responses may be as brief as "I was in a car crash" and other times a more detailed account is provided. In many situations this is recorded in the form of hand written notes. In situations where there are not the resources to 'E-code' such information we should, as a minimum, be promoting the recording of this information electronically. Searching such information for key words is a simple process, at worst it could be done with a word processing package. The capture of such information also provides the opportunity to code it at some future date either manually or by machine reading.[36]

Obviously the quality of such information will be highly variable. While some guidance could be given as to what should be recorded for various classes of event such documentation would probably be a significant barrier to implementation and or compliance would be low. As a minimum however, we should be promoting the recording of a three verb/noun combinations to the questions in Table 4. Such information in conjunction with a diagnosis, which could also be uncoded (e.g., "concussion") is significantly better than recording nothing.

Table 4: Three key questions for the purposes of recording narratives on the circumstances of injury-with an example

Question	**verb**	**noun**
what were your doing	riding (my)	bike
what happened	skidded (on)	gravel
how were you injured	struck (head)	kerb

Finally, the recording of narratives need not be restricted to circumstances of injury. Considerable benefits can arise, for example, from recording occupation.[37]

4.2 Linkage

External linkage (linking two independent agencies files), and internal linkage (linkage of files within a database) present a range of opportunities to us.

External linkage enables us to: a) determine coverage and any bias in coverage of a database, and b) capitalise on the strengths of various databases. An example of each will serve to illustrate the points.

The official New Zealand Police crash database has been shown, by probablistic matching, to under-report by 37%, crashes which result in the victim being admitted to hospital for the treatment of injury.[38] Of greater concern is that reporting rates vary significantly by environmental, demographic, and injury factors. For example, Table 5 shows under-reporting varies significantly by class of road user. Similar results using a similar methodology have been reported elsewhere.[39] One needs to be aware of such biases when allocating resources or determining cost benefit ratios for interventions.

Table 5: Linkage: Bias

Percentage of records linked - occupant type	
	linked
Drivers	70%
Passenger	55%
MC: driver	60%
MC: passenger	54%

In most developed countries there are agencies which have legislative responsibilities for the prevention of specific injury problems. The best examples, are motor vehicle crashes and work-related injuries. Typically these agencies have investigative arms which collect very detailed information on the circumstances of injury. The quality of information they have on the nature and severity of injury is often limited and inaccurate. The reverse tends to be the case with health providers. Neither agency is ever likely to be able, or willing, to collect information at the level of detail the other agency would desire. Linkage provides an extremely useful means of: assessing the coverage of each data base, and enabling more accurate prioritisation, and evaluation.

Internal linkage enables us to: a) distinguish injury events form treatment events, b) the cumulative burden of specific events. An example of each is provided below.

New Zealand's hospital inpatient dataset is a record of discharge events. Thus, following discharge an individual can be readmitted three further times for further treatment. This would be listed as four separate discharges. Given that readmission rates may vary by severity of injury and over time (due to changes in service delivery) it is important to be able to distinguish injury events form discharge events. Figure 3 shows the how significant this difference can be.

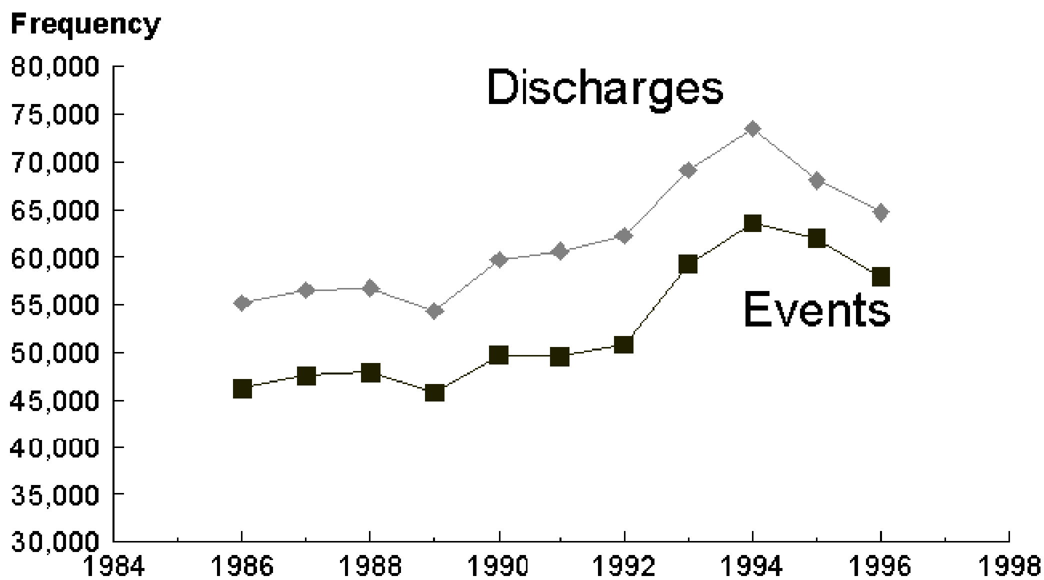


Figure 3: Internal Linkage: Events vs discharges - New Zealand Public Hospitals 1986-96

The reference to "event" in the figure will not be technically correct in some instances. For example, one car crash can result in several people being injured. Further precision could be obtained by linkage with the LTSA database referred to earlier, although due to under-reporting this would not be possible for all cases.

Table 6 shows another benefit of internal linkage, namely, the estimation of the cumulative burden of injury for specific injuries. All too often when assessing the burden of specific injury we focus on the acute phase of inpatient treatment.

Table 6: Internal Linkage: Measurement of burden

% of Cumulative (24 months) days stay in hospital attributable to non-acute phase

Fracture of Lower Limbs	16%
Injury to nerves and spine	26%
Poisoning: by drugs etc.	8%
All injury:	15%

In practice there were more drownings but these are "hidden" within other Ecodes[40].

4.3 Multicause coding

The ICD only allows for the coding of one underlying cause of death. In this context one E-code. Many injury events are multi-factorial and not well described by a single cause. As a consequence some events are under-reported and this may in turn result in missed opportunities for prevention. The situation is well demonstrated by a recent study using New Zealand data which showed that 15% of all drowning incidents were coded as motor vehicle crashes.[40] The use of multi-cause coding would overcome such problems.

5. Improve the comprehensiveness and quality of international comparisons

International comparisons can provide powerful political incentives at a national level where a country performs poorly relative to comparable countries. For example, New Zealand's youth suicide rate is among the worst of several OECD countries. New Zealand's very poor performance coupled with an substantially increasing rates in recent years has resulted in a concerted effort by a number of Ministries to try and reduce this mortality.

There are many traps for the unwary in international comparisons. For example, New Zealand recently opened its compulsory work-related injury insurance scheme to competition. Prior to this there was one single government agency that provided cover. The proponents for change argued that the single insurer system had failed as was evidenced by New Zealand's work-related injury performance relative to other countries.

At present we have no real basis on which to judge New Zealand on one of the key indicators of occupational health and safety performance, our rate of work-related fatal injury relative to other comparable countries. I am unaware of any published peer reviewed scientific paper which demonstrates that New Zealand has one of the worst work-related injury records in the world.

Even if it could be demonstrated that New Zealand's performance is worse than similar developed countries, there are several alternative and more credible explanations for the differences other than differences in work-related insurance arrangements. For example, different rates of work-related death might reflect differences between countries in what constitutes a work-related injury, and/or compliance with reporting.

However, the most significant alternative explanation for different rates of work-related death would probably be differences in the distribution of work-related activity. This is best illustrated by a simple hypothetical example.

Suppose two countries have the following overall work-related fatal injury rates

Country A: 10/100,000 workers
Country B: 20/100,000 workers

It has been demonstrated in several countries that the agricultural industry has very high rates relative to many other industries. Thus if Country B, relative to Country A, had an very high percentage of its workforce involved in agriculture we might expect this difference. In other words comparison of overall rates without reference the differences in hazards can be extremely misleading.

I have already alluded to the importance of ensuring that in comparing countries we need to ensure the definitions for the numerators is the same. The same applies to the denominators. When comparing industry specific rates it is vital to ensure that the industry populations that are being compared are similar. For example, in USA the industry classification of Agriculture, Forestry and Fishing excludes logging, whereas in New Zealand it includes logging. Logging is very high risk thus its inclusion or exclusion has the potential to dramatically affect the industry rate.

In conclusion, I believe insufficient thought has been given to prioritising injury surveillance needs. As a consequence resources are being directed at issues which could be better spent elsewhere. Moreover, we have some pressing surveillance needs in urgent need of attention.

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