Experiences Using New Zealand's Hospital Based Surveillance System for Injury Prevention Research

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Abstract

The focus of this paper is the Injury Prevention Research Unit's (IPRU's) experience in analysing New Zealand's national public hospital injury data set. The existence of the national inpatient data management system has enabled the IPRU to develop an injury morbidity data set for period 1979-1992. The IPRU thus, has data on over three quarters of a million injury events that were serious enough to warrant admission to a hospital. This data set has been used extensively by the IPRU to address a wide range of injury issues.

Apart from the demographic variables those variables that have proved most useful in our work have been: length of stay, readmission indicator, a personal identifier code number named the National Master Patient Index Number (NMPI), WHO International Classification of Disease coding for: diagnoses and external cause of injury (E-code), and written descriptions of external cause of injuries and location of injury event. Practical examples of IPRU's use of each of these variables are given. These examples demonstrate how invaluable New Zealand's inpatient injury data set is for: documenting resource utilisation, accurately determining the incidence of events, undertaking analytical epidemiological studies, and addressing shortcomings in E-codes.

A key aspect of the system is the narrative information. Evidence is produced that demonstrates the electronic recording of narratives of the circumstances of injury is an invaluable tool for conducting epidemiological research which has direct implications for injury prevention policy and practice. Given the numerous objections that are raised about E-coding, injury prevention personnel would be well served to encourage health authorities to electronically record narratives as a first step towards uniform coding.

The Importance of Morbidity Data

Traditionally, injury mortality has been used in determining priorities for prevention. While deaths are clearly a significant outcome of injury it is important to realize that non fatal injuries place a substantial burden on a community. For example, in New Zealand for each injury death there are approximately 32 admissions to a public hospital for the treatment of injury (Langley and McLoughlin 1989). Of greater significance is the fact that the distribution of injury events can vary markedly depending on the outcome of interest. The leading cause of injury death in New Zealand is motor vehicle traffic crashes (MVTC) (37 percent), followed by suicide (21 percent), whereas the leading injury event resulting in an admission to hospital is a fall (25 percent), followed by a MVTCs (19 percent), with self inflicted injury playing a minor role (Langley and McLoughlin 1989). Such variations have been shown to exist in other countries (Baranick et.al. 1983) and clearly need to be considered in determining priorities for prevention.

New Zealand National Hospital Based Data System

There is only one national hospital based 'injury surveillance' system in New Zealand. It is part of the national hospital morbidity data collection system that is managed by the New Zealand Health Information Service of the Ministry of Health. The hospital data base records detail, at discharge, on all persons who have been inpatients or daypatients in public general hospitals, maternity hospitals and registered private hospitals. Data on patient separations from psychiatric hospitals is recorded in a separate Mental Health data set.

For public hospital discharges the data system records information on a range of demographic, injury, and circumstances of injury data elements (see below). A substantially reduced range of data elements is recorded for private hospitals. Significant among those absent from those records are the ICD External causes of Injury and

Poisoning coding, otherwise known as E-codes (WHO 1978). The latter omission, in particular, has precluded the inclusion of private hospital data in studies undertaken by the Injury Prevention Research Unit (IPRU). This exclusion, however, is of little significance from a primary prevention perspective, however, when it is considered that most acute injury, is treated in public hospitals in New Zealand. This is demonstrated by the statistics for 1992 which show there were 59,918 injury inpatients, and 9,951 injury day patients discharged from public hospitals in New Zealand. The comparable figures for private hospitals were: 1,717 and 676. Reference to the injury diagnosis codes for the latter show that treatment is primarily for non acute injury (e.g., late effects of injury) (New Zealand Health Information Service 1993).

In addition to the national hospital injury data set there are a large number of local emergency department based surveillance systems. These, however, vary widely in their coverage, comprehensiveness and methods of recording (Irving 1994) and at present, are of limited use from an injury prevention perspective. The focus of this paper is thus on the IPRU's experience in analysing the national public hospital injury data set (hereafter referred to as the data set).

Summary of Public Hospital Data Elements

The following data are currently collected from public hospitals:

- gender
- age
- marital status
- date of birth
- **length of stay**
- referral source
- discharge date
- source of admission (routine, or from another hospital)
- admission date
- ethnicity
- type of admission (e.g., acute, arranged)
- **readmission indicator**
- type of discharge
- hospital of treatment
- hospital transferred from
- domicile
- **National Master Patient Index Number (NMPI)**
- hospital department treating patient
- event type
- **WHO International Classification of Disease coding for:**
    - **diagnoses**
    - **external cause of injury (E-code)**
    - operation
- **written descriptions of**
    - diagnoses
    - **external cause of injuries**
    - **location of injury event**
    - operations performed

The maintenance of this patient management system has enabled the IPRU to develop an injury morbidity data set for period 1979-1992. IPRU has thus, data on over three quarters of a million injury events that were serious enough to warrant admission to a hospital. This data set has been used extensively by the IPRU to address a wide range of injury issues. Aside from the demographic variables those variables that have proved most useful in our work are printed in bold type above. Applications of these are discussed below.

Length of Stay

In determining priorities for prevention one important consideration is the personal and societal costs of specific categories of injury. Although a class of events may not have a high incidence relative to others, the costs associated with it may be disproportionate to its incidence. Unfortunately, at present we have no simple way of determining all the personal and societal costs for specific classes of injury. One key element in any determination of the cost of injury would be health service utilisation costs. Length of stay in hospital in the acute phase of injury provides a crude indicator of these costs. In 1992 persons whose primary diagnosis was a fractured neck of femur represented 6.3 percent of all discharges from public hospital but 24 percent of the total injury bed day utilisation (NZHIS 1993).

Readmission Indicator

Most IPRU studies have sought to estimate the incidence of specific events. Given that persons are admitted to hospital for the treatement of their injury in the acute and rehabilitative phases it is important to be able to differientate the two. Failure to do so could produce a substantial error in instances where an individual has a series of readmissions for the ongoing rehabilitation of an injury (e.g., skin grafting following thermal injury). In the past reference has been made to the readmission indicator for this purpose. In the 1992 hospital data set there were 69,996 separations which had an E-code assigned to them, 20 percent of these related to readmissions. There has, however been increasing awareness that this field was not well reported and in some of the more recent IPRU studies (e.g., Collins et al 1993) reference has been made to a variety of other variables (e.g., date of injury) to determine incidence. The readmission indicator is no longer a mandatory field.

National Master Patient Index Number (NMPI)

It is important to note that the data system relates to episodes of care, not individuals. From 1988 onwards, all individuals admitted to hospital were assigned a unique identifier which was to be used for all their future contacts with the public hospital system. That identifier has enabled the IPRU to initiate analytical epidemiological studies. One such study, presently in progress, seeks to test the hypothesis that prior injury, especially that due to assault, is a risk factor for subsequent assault. Given that we have national data on admissions, we have been able to use a cohort study design using the total population of New Zealand to test this hypothesis. Very briefly, the method used was as follows. The "exposed" group consisted of all those who had been admitted to a hospital for the treatment of injury in a reference year. Using their NMPI the relevant files were searched to determine if they had been admitted for assault within a twelve month period from the date of their reference discharge date and a serious injury rate for the exposed group is calculated. Since the total population of persons who were admitted to hospital for assault for any specified period is known one is able by deduction to estimate the assault rate for the non-exposed group, that is, those who had not been hospitalised for the treatment of injury in the reference year.

Diagnosis Coding

All injuries are coded according to the ICD injury and poisoning codes, (WHO 1978). These enable us to more accurately identify cases of interest in a number of different respects.

It is not widely appreciated that E-coding is applied to morbidity other than injury and poisoning. The ICD-9 states "Certain other causes which may be stated to be due to external causes are classified in Chapters I to XVI of ICD and for these, the 'E'-code classification should be used as an additional code for multiple condition analysis only." In 1992, there were 69,996 persons who had an E-code assigned to their discharge summary. Of these, 10 percent had a non injury code as their primary diagnosis. Typical of such cases would be a person who suffered epilepsy followed by an immersion incident. In this case the submersion would be assigned an injury code of 994.1 as a secondary diagnosis. Another example would be at patient who suffered injury while being treated in hospital for another non-injury condition.

There are a number of injury events for which it is difficult, if not impossible, to accurately determine incidence by reference to specific E-codes. Submersion incidents provide a good example. The submersion codes in ICD are: E830 "Accident to watercraft causing drowning", E832 "Other accidental submersion or drowning in water transport", E910 "Accidental drowning and submersion", E954 "Suicide and self inflicted injury by submersion [drowning]", E964 "Assault by submersion [drowning]", and E984 "Submersion [drowning], undetermined whether accidentally or purposely inflicted." Reference to these codes alone will result in an underestimate of the incidence of drowning. For example, all submersion incidents which result from motor vehicle traffic crashes (e.g., driver losing control, car running off road and into lake) are coded within the motor vehicle traffic crash grouping (E810-E819). The use of the diagnostic code for submersion provides a solution to this. The code is 994.1 "Drowning and non fatal submersion." A search of the public hospital database for the period 1988-92 inclusive revealed that there were 567 discharges which had this diagnosis. There were nine cases which were the result of motor vehicle traffic crashes (E810-E819).

Similarly, reference to diagnostic codes also allows one to identify coding errors. For example, in the submersion investigation referred to immediately above, we also identified 22 cases which had the code E883 "Fall into holes or other opening in surface" assigned to them. The ICD specifically excludes submersion incidents from this code. It appears that coders in New Zealand have not adhered to ICD guidelines in this regard.

External Cause of Injury (E-code) and Written Descriptions of External Cause of Injuries

One key aspect of any injury surveillance system is information on the circumstances of the injury event. There have repeated calls, particularly in the USA, for uniform E-coding; that is, coding according to the External Causes of Injury and Poisoning Codes of the International Classification of Diseases (WHO) (Runyan et.al. 1992, Graciter 1987). Overseas observers will no doubt be envious of the fact that New Zealand has a national inpatient injury data system which is E-coded.

Runyan et.al. (1992) asserted that "Without E-code information, it is almost impossible to define directions for prevention or to evaluate adequately the success of prevention interventions." While IPRU supports the principle of uniform E-coding it should be noted that E-codes have several shortcomings from a prevention perspective (Langley 1982, Baker 1982). Moreover, it has been IPRU's experience that E-coding is not critical to prevention efforts and much can be achieved by the use of electronic recording of narratives of the circumstances of injury. This point deserves emphasising since it may well be easier in some countries or cities to initially encourage hospitals to electronically record the circumstances of injury in the form of a free text narrative, rather than argue for E-coding. The ideal, of course, is to have both and that is the situation in New Zealand.

Despite limitations associated with free text, this can be a very useful supplement to E-codes. The principal benefits are that: it can provide estimates of the incidents of events which do not have specific E-codes, enable misclassification errors to be detected, and provide more accurate estimates of the incidence of specific events within E-code categories. Below are examples of each of these points taken from the IPRU's experience.

Determining the Incidence of Events Which Do Not Have Specific E-codes

The E-codes attempt to summarize what is frequently a complex injury event by means of a single code. Given the variety of circumstances leading to injury, even within a relatively confined category, this is bound to be less than satisfactory for those concerned with injury prevention, since they often cannot obtain the degree of specificity which would allow prevention action to be initiated or evaluated. Once solution to this limitation is to conduct special surveys, but this can be expensive, time consuming, and in many instances where one is concerned with historical trends, of limited value. Free text descriptions can often address this shortcoming. A good example of this is the McLoughlin et.al. (1986) evaluation of New Zealand's Safety of Children's Night Clothes Act 1977 and the follow up study by Laing et.al. (1991). Critical to those evaluations was a determination of whether the clothing ignition burns recorded involved nightwear and, if so, the type of nightwear (pyjamas vs night dresses). The ICD E-codes do not provide for such a degree of specificity to be achieved. It was, thus, only by reference to narratives that the authors were able to determine the impact of the legislation.

Another good example was the study by Buckley et.al. (1993) which sought to determine the incidence of falls from horses. These events are coded under E828 "Accident involving animal being ridden." There is no fourth digit sub classification. Thus, in the absence of free text descriptions, it would not have been possible to identify the type of the animal being ridden or, indeed, whether the incident involved a fall.

Improving Estimates

Even where E-codes allow a high level of specificity, it is possible that case under-ascertainment can still occur due to shortcomings in the E-codes. Two examples illustrate the point.

"Unspecified Motorcyclists"

Begg et.al. (1994), in a recent study of motorcycle crashes, identified eighteen fatalities and 133 hospitalisations by examining the free text narratives for crashes where the road user was coded as "unspecified." Although provision is made in the E-codes for coding of drivers or pillion passengers of motorcycles, no such specific provision is made for those situations in which the victim is simply described as a "motorcyclist." These cases and analogous ones (e.g., "occupant of a car") are all coded as unspecified road users. Investigators in other countries who rely solely on ICD codings to identify cases will tend to underestimate the incidence of events involving specific classes of road user. Based on her findings Begg et.al. (1994) concluded that the underestimate is not likely to be substantial for mortality but could be significant for morbidity.

"Hidden" Firework Injuries

The ICD manual instructs that injuries due to fireworks should be coded under E923 "Accident caused by explosive material." A fourth digit makes specific provision for the coding of these events (E923.0 "Fireworks"). A recent investigation by the IPRU identified 170 fireworks events over an eleven year period by examining free text descriptions associated with E923. All the words and phrases which were associated with these events (e.g., firecrackers, fireworks, sky rockets), including those which were misspelt, were used to search the entire hospital injury morbidity files for any further cases. In total, an additional 36 cases were found. Sixteen injury events were classified as E917 striking against or struck by objects or persons; and 14 cases were attributed to fire and flames (E890-E899 "Accidents caused by fire and flames").

Written Descriptions of the Location of Injury Event

The ICD makes provision for the coding of ten categories of place of occurrence. This is a very limited classification and hinders prevention initiatives (Langley and Chalmers 1989). The ICD codes do not, for example, permit the identification of injury events which occur at school. These are typically coded as a public place. To complicate the issue further, injuries which occur in school 'playgrounds' are coded under places of recreation and sport. In New Zealand, specific provision is made to record a 12-character description of the place of occurrence. This facility has been used by Langley et.al. 1990 to produce an estimate of the incidence of school injuries. Fanslow et.al. (1991) also used this to produce an estimate of the incidence of assault events in hotels, taverns, and other licensed premises.

Conclusion

As the foregoing demonstrates New Zealand has a hospital data system which is invaluable for injury prevention research in terms of describing the incidence of specific events, undertaking analytical studies, and evaluating interventions. A key aspect of the system is the free text narratives. Evidence has been produced here to demonstrate that the electronic recording of narratives of the circumstances of injury is an invaluable tool for prevention. This point is critical since most emergency departments currently maintain hard copy of such information. The increasing role of computers in hospital administration provides the opportunity to electronically record this information. Given the numerous objections which will be raised about E coding (e.g., staff training, costs: Rivara et.al. 1990), injury prevention would be well served by the encouragement of health authorities to electronically record narratives as a first step towards uniform coding. This allows for the future possibility of subsequent coding although it is appreciated that the information currently recorded may be insufficient to E-code. This problem needs to be addressed by educating medical personnel. The accurate assessment of the mechanism of injury is as important on the medical record as are vital signs (Rivara et.al. 1990).

It has been the IPRU's experience that it would be valuable to have free text data fields tagged for specific items (e.g., occupation, location, event). Clearly, there is considerable scope beyond that which is recorded in New Zealand (e.g., activity, products). As has been shown here, the ideal would be to have both uniform coding and free text data.

References

1. Begg DJ, Langley JD, Reeder AI. Motorcycle crashes in New Zealand resulting in death and hospitalisation I: Introduction, methods, and overview. Accid. Anal. & Prev. 26: 2:157-164. 1994.

2. Buckley SM, Chalmers DJ, Langley JD. Injuries due to falls from horses. Australian Journal of Public Health. 17: 3:269-271. 1993.

3. Buckley SM, Langley JD, Chalmers DJ. Falls from moving motor vehicles in New Zealand. Accid. Anal. & Prev. 25: 6:773-776. 1993.

4. Chalmers DJ. (1991) Falls from playground equipment: An overview. A background paper prepared for the Child Accident Prevention Foundation's National Childhood Injury Prevention Forum, Wellington. Injury Prevention Research Unit, Dunedin.

5. Chalmers DJ, and Langley JD. Epidemiology of playground equipment injuries resulting in hospitalisation. J. Paediatr. Child Health. 26: 6:329-334. 1990.

6. Collins BA, Langley JD, Marshall SW. Injuries to pedal cyclists resulting in death and hospitalisation. NZ Med J. 106:514-517. 1993.

7. Dixon GS, Danesh JN, Caradoc-Davies TH. Epidemiology of spinal cord injury in New Zealand. Neuroepidemiology. 12:88-95. 1993.

8. Fanslow JL, Chalmers DJ, Langley JD. Injury from assault: A public health problem. Prepared for the Alcoholic Liquor Advisory Council. IPRU, Dunedin. 1991.

9. Hume PA, Marshall SW. Sports injuries in New Zealand: Exploratory Analyses. NZ J Sports Medicine (in press).

10. Johnston SE, Langley JD, Chalmers DJ. Serious unintentional injuries associated with architectural glass. NZ Med J. 103:117-9. 1990.

11. Koorey AJ, Marshall SW, Treasure ET, Langley JD. Incidence of facial fractures resulting in hospitalisation in New Zealand from 1979 to 1988. Int. J. Oral Maxillofac. Surg. 21:77-79. 1992.

12. Kotch JB, Chalmers DJ, Langley JD. Child day care and home injuries involving playground equipment. J. Paediatri. Child Health. Vol 29:222-227. 1993.

13. Laing RM and Bryant V. Prevention of burn injuries to children involving nightwear. NZ Med J. 104:363-5. 1991.

14. Langley JD. Description and classifications of childhood burns. Burns. 10:231-235. 1984.

15. Langley JD. Frequency of injury events in New Zealand compared with the distribution of E-codes. Methods of Information in Medicine. 26:89-92. 1987.

16. Langley JD. The incidence of dog bites in New Zealand. NZ Med J. 105:33-35. 1992.

17. Langley JD. The International Classification of Diseases Codes for Describing Injuries and Circumstances Surrounding Injuries: A critical comment and suggestions for improvement. Accid. Anal. & Prev. 14:195-197. 1982.

18. Langley JD, Begg DJ, Reeder AI. Motorcycle crashes in New Zealand resulting in death and hospitalisation II: Traffic crashes. Accid. Anal. & Prev. 26: 2:165-171. 1994.

19. Langley JD and Chalmers DJ. Place of occurrence of injury events in New Zealand compared with the available ICD codes. Methods of Information in Medicine. 28:109-113. 1989.

20. Langley JD, Chalmers DJ, Collins B. Unintentional injuries to students at school. J. Paediatr. Child Health. 26:323-328. 1990.

21. Langley JD and Johnston SE. Purposely self-inflicted injuries resulting in death and hospitalisation in New Zealand. Community Health Studies. 1990; 15:190-199. 1990.

22. Langley JD and McLoughlin E. Injury mortality and morbidity in New Zealand. Accid. Anal. & Prev. 21:243-254. 1989.

23. Langley JD, Marshall S. The severity of road traffic crashes resulting in hospitalisation in New Zealand. Accid. Anal. & Prev. (in press).

24. Langley JD, Phillips D, Marshall S. Inpatient costs of injury due to motor vehicle traffic crashes in New Zealand. Accid. Anal. & Prev. Vol 25:5:585-592. 1993.

25. McLoughlin E, Langley JD, Laing RM. Prevention of children's burns: Legislation and fabric flammability. NZ Med J. 99:804-807. 1986.

26. Marshall S, Kawachi I, Cryer C, Wright D, Slappendel C, Laird I. The epidemiology of forestry work-related injuries in New Zealand 1975-1988 fatalities and hospitalisations. NZ Med J (in press).

27. Norton R, Langley JD. Firearm deaths in New Zealand, 1978-1987. NZ Med J. 106:463-5. 1993.

28. Phillips DE, Langley JD, Marshall SW. Injury - The medical and related costs in New Zealand 1990. NZ Med J. 106:215-8. 1993.

29. Waller AE, Marshall SW. Childhood thermal injuries in New Zealand resulting in death and hospitalisation. Burns. 19: 5:371-376. 1993.

30. Baker SP. Injury Classification and the International Classification of Diseases Codes. Accid. Anal. & Prev. 14:199-201. 1982.

31. Baranick JI, Chatterjee BF, Greene YC, Michenzi EM and Fife D. North Eastern Trauma Study: I. Magnitude of the Problem. Am J Public Health. 73:746-751. 1983.

32. Graitcer PL. The development of state and local injury surveillance systems. Journal of Safety Research. 18:191-198. 1987.

33. Irving LM, Norton RN, Langley JD. Injury surveillance in public hospital emergency departments. NZ Med J (in press).

34. Langley JD. The International Classification of Diseases Codes for Describing Injuries and Circumstances Surrounding Injuries: A critical comment and suggestions for improvement. Accid. Anal. & Prev. 14:195-197. 1982.

35. New Zealand Health Information Service. Hospital and Selected Morbidity Data 1992 . Ministry of Health. Wellington, 1993.

36. Rivara FP, Morgan P, Bergman AB, Maier RV. Cost estimates for statewide reporting of injuries by E-coding hospital discharge abstract data base systems. Public Health Reports. 105:635-637. 1990.

37. Runyan CW, Bowling JM, Bangdiwala SI. Emergency department record keeping and the potential for injury surveillance. The Journal of Trauma. 32:187-189. 1992.

38. World Health Organisation, International Classification of Diseases, Geneva WHO, 1978.

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