

Catalogue no. 11-522-XIE

**Statistics Canada International  
Symposium Series - Proceedings**

**Symposium 2006 :  
Methodological Issues in  
Measuring Population Health**

2006



**Statistics  
Canada**

**Statistique  
Canada**

**Canada**

## Hospital separations: Identification of records for use in tabulating national injury data

Susan G. Mackenzie<sup>1</sup>

### Abstract

Approaches used to select records for tabulation of national injury hospitalization data were identified. Three of the approaches were based on the principal diagnosis in the hospital separation record; the other three required that the record contain a code for an external cause of injury. Differences within these two main groups resulted in identification of six distinct approaches. Each approach was applied to the same set of hospital separation data. The numbers and types of injury records retrieved with the six approaches are compared and implications of the findings for injury surveillance are discussed.

KEY WORDS: Injuries; Hospitalization; Epidemiologic methods; Surveillance

### 1. Background

Study of hospital separations (which include discharges, transfers, and deaths of admitted patients) following treatment for injury is an important component of injury surveillance. Use of different approaches to selecting hospital separation records for tabulation of injuries by the Public Health Agency of Canada (PHAC) and the Canadian Institute for Health Information (CIHI) leads to differences in the total numbers of injury hospitalizations reported by the two agencies. This observation and the lack of a standard approach to selecting records of injury hospital separations for national tabulations led to questions about what differences attributable to variation in selection approach might exist in injury hospitalization reports within Canada and from different countries.

In many countries the International Classification of Disease (ICD) is used to classify reasons for hospitalization. If a person was in hospital for treatment of injury, the record should ideally contain ICD codes for both an injury diagnosis, such as a fractured arm, and an external cause of injury that describes both the intent and mechanism of the injury, such as an unintentional fall from a ladder.

In the Ninth Revision of the ICD (ICD-9) (World Health Organization, 1977) diagnosis codes, even though they do not have an alphabetic prefix, are often referred to as N codes. In the Tenth Revision (ICD-10) (World Health Organization, 2004a), introduced for Canadian hospitalization data between 2001 and 2006, the ICD injury diagnosis codes have S or T prefixes. External cause codes in ICD-9 have an E prefix, and are called E-codes; in ICD-10 their prefixes range from V to Y. To avoid confusion while data classified using both ICD-9 and ICD-10 are in use, it is now common to simply refer to diagnosis codes and external cause codes, terms that apply to both ICD revisions.

The Canadian Hospital Morbidity Database is operated by CIHI as a component of its Trauma Registry. The database contains records of all acute care separations from Canadian hospitals with each record containing up to 16 ICD codes. The primary or principal diagnosis is the diagnosis which describes the most significant condition of the patient which causes the stay in hospital. Whenever this diagnosis is an injury CIHI requires that at least one ICD external cause of injury code also be recorded. Thus, in the study of injuries using hospitalization data, a decision must be made about whether record selection should be based on diagnosis codes, on external cause codes, or on a combination of diagnosis and external cause codes. The present study was undertaken to identify approaches used in

---

<sup>1</sup>Susan G. Mackenzie, Public Health Agency of Canada, Tunney's Pasture AL 1910D, Ottawa, Ontario, Canada, K1A 0K9 (susan\_mackenzie@phac-aspc.gc.ca)

different countries to selecting hospital separation records for national injury tabulations, and to assess the effects of the different selection approaches on the sets of injury hospitalization records retrieved.

## 2. Methods

Members of the International Collaborative Effort on Injury Statistics (Fingerhut, 2004) were sent a short questionnaire about how hospital separation records are selected for preparation of national injury hospitalization tabulations in their countries. The approaches reported were classified according to whether selection was based on injury diagnosis or external cause and also by any exclusions reported.

A complete set of acute care hospital separation records for fiscal year 2000-01 from one Canadian province was obtained from the PHAC holdings of data from CIHI's Hospital Morbidity Database. These records had been classified using ICD-9. A subset of possible injury records was prepared from the complete set retaining all records where either the principal diagnosis code was from the ICD-9 Injury and poisoning chapter or the record included at least one code for external cause of injury. If the record contained more than one external cause the first listed one was used in the study.

Each of the selection approaches identified from the survey responses was applied to the set of possible injury records and the sets of injury records retrieved were compared with respect to: 1) the total numbers of records retrieved, 2) (for the three external cause-based approaches) the numbers and nature of events in which the principal diagnoses were not from the ICD-9 Injury and poisoning chapter, and 3) frequencies of selected external causes of injuries. These external causes and the ICD-9 codes that specify them are shown in table 1.

---

**Table 1** Selected external causes (injury intent and mechanism) and the ICD-9 codes used to specify them\*

---

External Cause	ICD-9 codes
All unintentional injuries	E800-E869, E880-E903, E904 (.1-.9), E905-E929
Falls	E880.0-E888
Motor vehicle traffic crashes	E810.0-E819.9
Other transport events	E820.0-E848
Fire and flames	E890.0-E899
Poisoning	E850.0-E869.9
Natural and environmental causes	E900-E909
Drowning and near drowning	E910.0-E910.9
Suffocation	E911-E913.9
Other foreign bodies	E914-E915
All self-inflicted injuries	E950-E959
All injuries due to assault	E904.0, E960-E969
All injuries of undetermined intent	E980-E989

---

\* Grouping of codes is based on the Centers for Disease Control and Prevention (1997) recommended framework for presenting injury mortality data. Modifications used in the present work affected Falls (E887 was included), and Natural and environmental causes, All unintentional injuries and All injuries due to assault (E904.0 was moved to Injuries due to assault from Unintentional injuries).

### 3. Results

#### 3.1 Survey responses

Fifteen responses provided information from 11 countries and a study of injury hospital separations being done in the European Union. Three responses indicated that national hospital separation data were either not available at all or not classified using the ICD.

Six different approaches to selecting the required injury records were identified: three based on diagnosis codes and three based on external cause codes (table 2). Approaches using combinations of diagnosis and external cause were not reported.

Community injury is a term coined in Australia (Berry, 2006) to describe events where the principal diagnosis is an injury that occurred in a setting such as a car crash, inter-personal violence, sporting or recreational activity, or work. Principal diagnoses from the ICD Injury and poisoning chapter that are complications of surgical and medical care are not included in community injuries. A similar approach is used in the United States of America (Injury Surveillance Workgroup, 2003). Differences between the Australian and US approaches were too small, with the US approach yielding only 0.2% more records, to justify inclusion of both in this work. The Australian approach was used.

In Canada two national organizations retain selected records based on selected external cause codes, but do it differently. PHAC excludes adverse effects and the CIHI Trauma Registry includes only records with external causes that it considers causes of trauma (Canadian Institute for Health Information, 2006).

**Table 2** Six approaches used to select injury records from all hospital separation records, and their use in 11 countries and the European Union study

Selection approach	Definition of approach	Approach used in
<b>Based on diagnosis</b>		
DX-All	All records where the principal diagnosis is from the ICD Injury and Poisonings chapter.	Colombia Denmark El Salvador Jamaica Trinidad and Tobago European Union Study
DX-Comm	Community injury: As for DX-All, excluding records where the principal diagnosis is complication of care, late effect of injury, or adverse effect.	Australia United States of America
DX-Trauma	As for DX-All, excluding records where the developer of the Trauma Registry does not consider the principal diagnosis to be trauma. E.g. poisonings and most drownings. (Aharonson-Daniel, 2006)	Israel
<b>Based on external cause</b>		
EC-All	All records that contain at least one external cause	The Netherlands New Zealand
EC-No AE	As for EC-All, excluding records where the first-listed external cause is an adverse effect of medical care.	Canada (PHAC)
EC-Trauma	As for EC-All, excluding records where the developer of the Trauma Registry does not consider the external cause would result in trauma. E.g. poisonings and most suffocations.	Canada (CIHI)

### 3.2 Identification of possible injury records

The complete set of hospital separation records contained 126,217 records. Of these 14,772 were possible injury records; that is, either the principal diagnosis was in the ICD Injury and Poisonings chapter or the record contained at least one external cause. See table 3.

**Table 3** Distribution of 14,772 possible injury records retrieved from the complete set of hospital separations, by presence of principal injury diagnosis and external cause

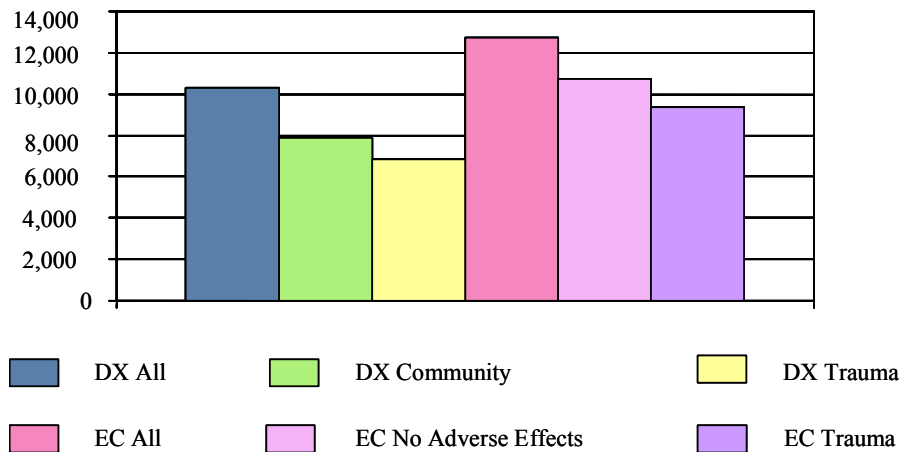
		External cause in record		
		Yes	No	
Principal diagnosis is injury	Yes	8,254 56%	2,019 14%	10,273
	No	4,499 30%	0	4,499
		12,753	2,019	14,772

Fifty-six percent of the possible injury records had both an injury diagnosis and an external cause. Thirty percent had an external cause with a non-injury principal diagnosis. The remaining 14% had an injury diagnosis but no external cause. The principal diagnoses in these last group were complications of care (99.8%) and adverse effects (0.2%).

### 3.3 Selection of injury records

Application of the six selection approaches to the set of possible injuries resulted in retrieval of six sets of injury records. Figure 1 compares the total numbers of records retrieved with the six approaches.

**Figure 1** Total number of injury records retrieved, by selection approach



### 3.4 Records with non-injury diagnoses

When any of the three external cause-based approaches was used to select records a quarter to a third of the records retrieved had a principal diagnosis that was not from the ICD Injury and Poisoning chapter (table 4).

**Table 4** Records retrieved using the External Cause approaches where the principal diagnosis was not from the ICD-9 Injury and Poisonings chapter

	Selection approach		
	EC All	EC No AE	EC Trauma
Total number of records retrieved	12,753	10,749	9,388
Number of records with non-injury principal diagnosis	4,499	2,854	2,242
Percentage of records with non-injury principal diagnosis	35%	27%	24%

Most (85% to 89%) of the non-injury principal diagnoses were classified to the nine ICD-9 chapters listed in table 5. These diagnoses were most often (20% to 34%) V-codes from the ICD-9 supplementary chapter that lists factors influencing health status and contact with health services. The most frequent V-codes were for rehabilitation and convalescence (80 to 84%). The external causes in these records were most often falls and motor vehicle traffic crashes (data not shown).

Diagnoses classified to the mental disorders chapter of ICD-9 accounted for 9% to 16% of the non-injury principal diagnoses. The external cause was a self-inflicted injury for 49% and 56% of these records with the EC All, and EC-No AE approaches, respectively; but only 24% with the EC-Trauma approach, which excludes poisoning. With the EC-All and EC-No AE approaches poisoning accounted for 80% of the self-inflicted injuries (data not shown).

When the principal diagnosis was from one of the other ICD chapters no particular patterns of external causes were seen.

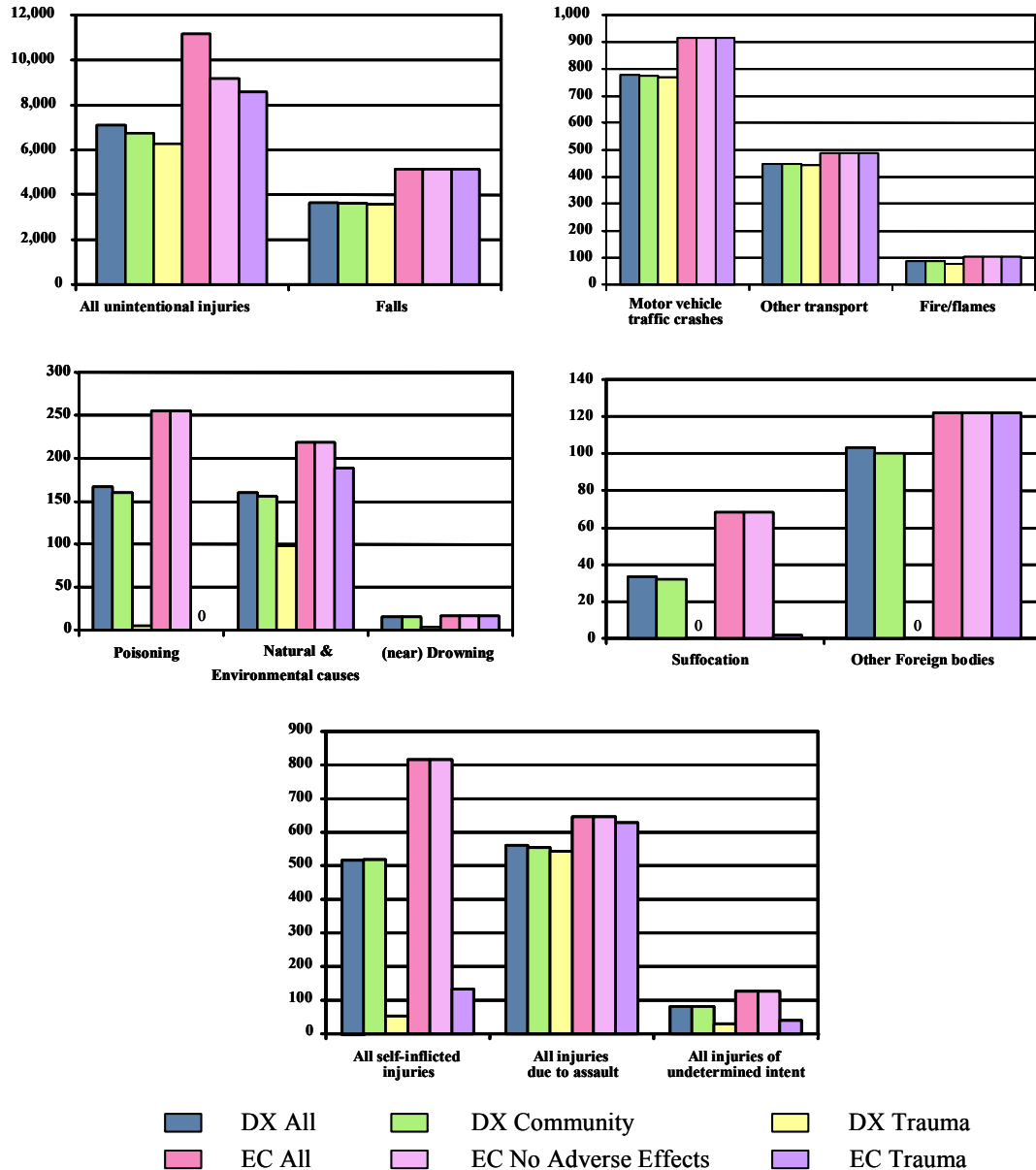
**Table 5** Records with non-injury principal diagnoses, by selection approach and the ICD-9 chapters to which the principal diagnoses were most often classified

		Selection approach		
		EC All	EC No AE	EC Trauma
<b>ICD-9 chapter</b>		N = 4,499	N = 2,854	N = 2,242
Supplement	Factors influencing health status and contact with health services (V-codes)	889	804	770
VII	Diseases of the circulatory system	548	263	237
V	Mental disorders	539	469	210
IX	Diseases of the digestive system	396	126	94
XIII	Diseases of the musculoskeletal system and connective tissue	354	284	203
XVI	Symptoms, signs and ill-defined conditions	337	184	150
II	Neoplasms	264	78	65
VIII	Diseases of the respiratory system	264	158	118
XII	Diseases of the skin and subcutaneous tissue	226	183	147
Percentage of records with non-injury principal diagnoses accounted for by conditions in the above ICD-9 chapters		85%	89%	89%

### 3.5 Frequency of selected external causes of injury

Tabulation of injuries by their external causes is useful because it indicates how injuries occur. The information is valuable in setting priorities for injury prevention and can also indicate where and how resources may usefully be directed. Figure 2 compares the numbers of records retrieved with each of the six selection approaches for selected broad groups of external causes.

**Figure 2** Selected external causes of injury: numbers of records retained, by approach. Note that all events represented in the first four charts are unintentional.



Selection approaches requiring the presence of an external cause of injury generally retrieved more records than those based on injury diagnosis. Within the three diagnosis groups and the three external cause groups there were few, if any, differences in the numbers of records retrieved for external causes such as falls and motor vehicle traffic

crashes that are almost always associated with injuries generally accepted as trauma. The situation was different for external causes associated with diagnoses that are not always considered to be trauma. These include poisoning, choking, late effects of injuries, and adverse effects of care. For such external causes the DX-trauma and EC-trauma approaches retrieved fewer records, sometimes no records at all. Variation in the numbers of records retrieved by selection approach was greatest where there was most diversity of injury type (in the groups of all unintentional injuries, all self-inflicted injuries, and all injuries of undetermined intent).

## **4. Discussion**

The results demonstrate the effects of different approaches to selecting records of hospital separations for injury tabulation. Some of the differences attributable to the selection approach were large, particularly those for the diverse groups of all injuries combined, all unintentional injuries, and all self-inflicted injuries that are often of interest in international comparisons. The main reasons for the differences were: 1) inclusion of records with non-injury principal diagnoses when any of the three external cause approaches was used, 2) exclusion of records with diagnoses not always considered to be trauma or external causes not associated with trauma with either the DX-Trauma or EC-Trauma approach, respectively, and 3) inclusion of records where the external cause was an adverse effect of medical care when the EC-All approach was used.

### **4.1 Records with non-injury principal diagnoses**

Since ICD rules allow for the association of external causes with diagnoses other than acute injuries (World Health Organization 2004b), retrieval of records where the principal diagnosis was not an acute injury had been expected with the external cause approaches. The V-code diagnoses discussed above are an example.

Furthermore, in CIHI records an external cause can be in the record because of an injury that is not the principal diagnosis. This can happen if, for example, a patient hospitalized because of a heart attack falls while in hospital and suffers a minor injury. In this case the principal diagnosis would be the heart attack, the minor injury would be one of the other diagnoses and the fall would be entered as the external cause of injury.

### **4.2 Exclusion of non-trauma records**

Exclusion of records with injury diagnoses not considered trauma and external causes not likely to cause trauma only occurred with the DX-trauma and EC-trauma approaches. These exclusions resulted in loss of some records retained by other approaches, with poisoning and suffocation being the most important. The same approaches lead to much lower numbers of records of the large diverse groups of injuries mentioned above.

### **4.3 Exclusion of adverse effects**

Exclusion of adverse effects with the EC-No AE approach eliminated records of events that differ in nature and etiology from most other injuries and, in addition, require different types of preventive measures. They are often presented separately from other external causes in injury tabulations.

## **4.4 Conclusions**

In deciding which approach to use for selection of injury hospitalization records the purpose of the injury tabulation should be considered. If it is to reflect occurrence of acute injury in a community or population then the DX-Comm approach seems most appropriate. Availability of external cause of injury codes in hospital separation records is another factor; if they are not (reliably) available, they clearly cannot be used. If they are available and the total burden of injury is of interest then an approach that includes some records retrieved with the EC-No AE approach, such as those for rehabilitation and convalescence, may be useful. It seems less appropriate to include records of injuries that were not severe enough to be principal diagnoses. Finally, for some purposes, it may be appropriate to include records of complications and adverse effects of medical care that would be retrieved using either or both of the DX-All or EC-All approaches.

In the absence of a standard approach to selecting injury hospitalization records, comparison of injury hospitalization information from different sources should be undertaken with caution. The approaches used to select the data should

be ascertained and taken into account. Useful comparison would be facilitated if a standard selection approach were identified and widely adopted.

## Acknowledgement

I am grateful to fellow members of the International Collaborative Effort on Injury Statistics for information about approaches to selection of injury hospitalization records and for helpful discussion.

## References

Aharonson-Daniel, L. (2006), personal communication.

Berry J.G. and J.E. Harrison (2006), "Hospital separations due to injury and poisoning. Australia 2001-02", *Injury Research and Statistics Series*. Number 26. (AIHW cat no. INJCAT 78), Adelaide, Australia: Australian Institute of Health and Welfare. pp 2, 94-97.

Canadian Institute for Health Information, (2006), "National/Ontario Trauma Registry Minimum Data Set (NTR/OTR MDS) Data Element List, for the 2003-2004 Fiscal Year", Appendix C, pp 17-18. [http://secure.cihi.ca/cihiweb/en/downloads/NTR\\_OTR\\_MDS\\_Data\\_Element\\_List.pdf](http://secure.cihi.ca/cihiweb/en/downloads/NTR_OTR_MDS_Data_Element_List.pdf) (accessed October 10, 2006).

Centers for Disease Control and Prevention. (1997) "Recommended framework for presenting injury mortality data.", *Morbidity and Mortality Weekly Report*, 46, (No. RR-14), pp 1-30.

Fingerhut, L.A., (2004), "International Collaborative Effort on Injury Statistics: 10 year review", *Injury Prevention*, 10, pp 264-267.

Injury Surveillance Workgroup (2003). "Consensus recommendations for using hospital discharge data for injury surveillance", Marietta (GA), United States of America: State and Territorial Injury Prevention Directors Association. p 8.

World Health Organization (1977), "Manual of the international statistical classification of diseases, injuries and causes of death, Ninth revision", *Volume 1*, Geneva: World Health Organization.

World Health Organization (2004a), "Manual of the international statistical classification of diseases, injuries and causes of death, Tenth revision", *Second edition, Volume 1*, Geneva: World Health Organization.

World Health Organization (2004b), "Manual of the international statistical classification of diseases, injuries and causes of death, Tenth revision", *Second edition, Volume 2*, Geneva: World Health Organization.