Correlates of undefined cause of injury coded mortality data in Australia

Kirsten McKenzie, Linping Chen and Susan M Walker

Abstract

The objective of this research was to identify the level of detail regarding the external causes of death in Australia and ascertain problematic areas where data quality improvement efforts may be focused. The 2003 national mortality dataset of 12,591 deaths with an external cause of injury as the underlying cause of death (UCOD) or multiple cause of death (MCOD) based on ICD-10 code assignment from death certificate information was obtained. Logistic regression models were used to examine the precision of coded external cause of injury data. It was found that overall, accidents were the most poorly defined of all intent code blocks with over 30% of accidents being undefined, representing 2,314 deaths in 2003. More undefined codes were identified in MCOD data than for UCOD data. Deaths certified by doctors were more likely to use undefined codes than deaths certified by a coroner or government medical office. To improve the quality of external cause of injuries leading to or associated with death, certifiers need to be made aware of the importance of documenting all information pertaining to the cause of the injury and the intent behind the incident, either through education or more explicit instructions on the death certificate and accompanying instructional materials. It is important that researchers are aware of the validity of the data when they make interpretations as to the underlying causes of fatal injuries and causes of injury associated with deaths.

Keywords (MeSH):

Mortality; Injury: Accidents: Statistical Data Analysis: Death Certificates: ICD-10: Australia; Clinical Coding

Introduction

Nationally and internationally, mortality data are key standardised indicators used to assess population health. Mortality data are coded according to the International Statistical Classification of Diseases and Related Health Problems (ICD) system, the international standard health classification for coding diseases and other health issues (World Health Organization [WHO] 1994). These ICD coded data enable the statistical aggregation and reporting of national mortality data in a standardised format for research purposes, education and management of health services.

In Australia, all coding of mortality data is performed in the Health and Vital Statistics Unit in the Australian Bureau of Statistics, using the information provided on death certificates by medical officers and coroners. The mortality coding process is largely automated, through the use of the Mortality Medical Data System (MMDS) (McKenzie et al. 2002). Deaths due to injury require some manual intervention, where additional external cause information, such as that available from coroners' and police reports, may be consulted to assist in the coding of the cause of an injury as the underlying cause of death (UCOD). The injury considered most likely to have been the most significant consequence of the external cause and all other conditions, including other documented injuries, are coded as multiple, or contributory, causes (MCOD). While the UCOD provides the fundamental causal information, the MCOD data provides a fuller picture of the death event as most deaths have multiple causes, particularly where the deceased person was elderly (Kreisfeld & Harrison 2007).

Detailed information regarding the causal and contributory factors surrounding an injury is required to facilitate injury prevention research; therefore the classification system used to code these data need to provide a high level of detail or specificity (Williamson et al. 2001). The ICD

External Causes of Morbidity and Mortality chapter (Chapter XX) describes the causes of injury, poisoning and adverse events, while Chapter XIX is used to capture detail about the injury, poisoning or other consequence of an external cause. However, there are a number of significant issues that reduce the utility of external cause coded data (Driscoll, Harrison & Langley 2004). Health classifications have been criticised for their lack of specificity in clinical terms and meaning, which impedes the use of routine data collections for specific and detailed clinical research (Iezzoni 1997; Jollis et al. 1993; MacIntyre et al. 1997; Geraci et al. 1997). ICD classifications are statistical classifications and therefore required to be sensitive and capable of capturing and aggregating all causal information encountered on death certificates. ICD classifications accomplish this through the use of residual codes. Sensitivity is increased by the use of residual categories such as 'other specified' disease and 'unspecified' disease codes. These residual categories contain clinical information that is heterogeneous because they may contain different (but related) causes of death which cannot be captured through the use of more specific codes.

Reliability of mortality statistics derived from death certificates depends on accurate and comprehensive documentation and the documentation of a plausible chain of events on the death certificate. Even where a coronial finding exists, documents do not always contain sufficient data to assign the most complete causes of death codes possible. Furthermore, there may be inconsistencies in the mortality coding process in cases where ICD rules and guidelines may be ambiguous or difficult to apply. Problem certificates, such as those with ambiguous causes, incomplete certificates and impossible causal sequences, require coders to query the information from the certifier to enable use of the most specific codes available for accurate coding. Due to the resources required for the querying process in Australia, querying is not generally performed for cases where the deceased was over the age of 75 years.

This paper identifies the level of detail regarding external causes of death in mortality data in Australia and investigates the correlates of external cause specificity in mortality data.

Methods

Subjects and sample selection criteria

National mortality data for deaths registered in 2003 were obtained from the Australian Bureau of Statistics (Note: data was provided in an unidentifiable format and ethical clearance was not required for this quality assurance study). Cases for analysis were selected if an ICD-10 external cause of injury (Chapter XX, codes V01-Y98) was assigned as either the underlying cause of death (UCOD) or multiple cause of death (MCOD) on the death certificate. Where external causes were recorded as a MCOD but not as the UCOD, the first external cause code in the MCOD was used for analysis.

Assessment of the quality of external cause of injuries data codes

To assess the quality of external causes of injury coded mortality data, proportional uses of residual ICD-10 codes assigned from death certificate information were measured as the dependent variable. Codes were classified as being either defined or undefined. Defined codes were characterised as those code categories with a specific external cause assigned, representing an homogeneous group at all code block levels. Undefined codes were the residual codes which include codes described as 'Other Specified', 'Unspecified' and 'Other and Unspecified'.

Independent variables within the mortality data that were investigated included the injury intent (i.e. accidental, intentional self-harm, assault and undetermined intent), whether the external cause was coded as the underlying cause of death or multiple cause of death, demographics of the deceased (age, sex, indigenous status), the Australian State or Territory in which the death was registered, and whether the death was certified by a doctor, coroner or government medical officer.

Statistical analysis

Associations between the independent variables listed previously with the quality of external cause of injuries data codes (defined/undefined code)

were examined using logistic regression models. In the process of modelling, both bivariate and multivariate logistic regression models were performed. Multivariate logistic analyses adjusted for age and sex and other potential confounding factors listed in the previous section were used to estimate the odds ratio of an undefined code for injury intent. Data were analysed using the SAS statistical software package version 9.1 (SAS Institute Inc. 2002).

Results

Descriptive

Of the total deaths for 2003 (N=132,292), an injury was coded on the death certificate for almost 10% of cases (n=12,591) (ICD-10 code range S00-T98). Of these, 5% of cases had more than one external cause coded (maximum=4). After excluding those cases with an external cause in the range Y35-Y98 (legal and war operations, complications of surgical/medical care, and sequelae), there were 9,733 subjects (77% of 12,591 subjects) included in the analysis. Codes were classified into major external cause code blocks as shown in Table 1. Accidents were the most common external cause of death, representing 73.7% of all external cause categories.

Table 1: Frequency of major intent and external cause code blocks

CAUSE OF INJURY	N	%
Intent		
Accidents	7174	73.7
Intentional self harm	2211	22.7
Assault	279	2.9
Undetermined intent	69	0.7
External cause code		
As UCOD	7224	74.2
As MCOD	2509	25.8
All injuries	9733	100.0

External causes as underlying or multiple cause of death

External causes of injuries were coded in the UCOD position in almost 75% of cases overall (n=7,224). For cases coded as being due to an accidental cause, two-thirds of cases had an external cause as the UCOD with the remaining one-third having an external cause as a MCOD code. Cases which were coded as being due to intentional self-harm or assault had an external cause as the UCOD for over 99% of cases.

In examining the specificity of codes across UCOD and MCOD positions, 11.5% of UCOD causes were assigned to undefined codes, while 54.4% of MCOD causes were assigned to undefined codes (See Table 2). Deaths coded as due to accidents showed significant differences in specificity across UCOD (16.6% assigned undefined codes) and MCOD (54.6% assigned undefined codes) positions (p value for Chi-Square test: <.0001), while intentional self-harm, assaults and cases of undetermined intent were largely assigned as UCODs. Therefore it was not feasible to compare UCOD and MCOD specificity for these latter intent blocks.

Odds ratio of use of an undefined code

Table 3 shows the odds ratio of use of an undefined code associated with external cause of death major code blocks, external causes coded as underlying or multiple causes of death, age, sex, indigenous status, state of death registration and death certifier using bivariate logistic regression analyses. There were significantly higher odds of a death certificate being assigned an undefined external cause code if the external cause was coded as an accident (compared with intentional self-harm), was a MCOD (compared to an UCOD), where the deceased was not Indigenous, where the death was certified by a doctor instead of a coroner, where the deceased was female and where the death was of an older individual.

Table 2: Specificity of UCOD and MCOD coded data by major intent code blocks

	UCOD				MCOD			
CAUSE OF INJURY	DEFINED		UNDEFINED		DEFINED		UNDEFINED	
	N	%	N	%	N	%	N	%
Intent								
Accidents	3899	83.4	774	16.6	1136	45.4	1365	54.6
Intentional self harm	2185	99.0	23	1.0	3	100.0	0	0.0
Assault	247	89.5	29	10.5	2	66.7	1	33.3
Undetermined Intent	65	97.0	2	3.0	2	100.0	0	0.0
All intent	6396	88.5	828	11.5	1143	45.6	1366	54.4

Table 3: Odds ratio of use of an undefined code in bivariate logistic regression models

INDEPENDENT VARIABLES	NUMBER SUBJECTS	% UNDEFINED E CODE	CRUDE OR (95% CI)[a]	P VALUE[b]
External cause major code blocks				
Accidents	7174	29.82	1.00	
Intentional self harm	2211	1.04	0.02 (0.016-0.04)	<0.01
Assaults	279	10.75	0.28 (0.19-0.42)	<0.01
Undetermined intent	69	2.90	0.07 (0.02-0.29)	<0.01
Position				
As UCOD	7224	11.46	1.00	
As MCOD	2509	54.44	9.23 (8.30-10.27)	<0.01
Indigenous status				
Not indigenous	9062	23.07	1.00	
Aboriginal or /and Torres Strait Islander	333	8.41	0.31 (2.21-0.45)	<0.01
Not stated	338	22.19	0.95 (0.73-1.23)	0.70
Certifier				
Doctor	3006	58.62	1.00	
Coroner/Government medical officer	6727	6.42	0.05 (0.04-0.05)	<0.01
State of registration				
State 1	3269	25.18	1.00	
State 2	2206	23.21	0.90 (0.79-1.02)	0.10
State 3	1990	22.66	0.87 (0.76-0.99)	0.04
State 4	720	19.03	0.70 (0.57-0.85)	<0.01
State 5	979	20.02	0.74 (0.62-0.89)	<0.01
State 6	285	14.04	0.49 (0.34-0.68)	<0.01
State 7	175	9.14	0.30 (0.18-0.50)	<0.01
State 8	110	17.27	0.62 (0.38-1.02)	0.06
Sex				
Male	6179	14.29	1.00	
Female	3554	36.89	3.51 (3.18-3.87)	<0.01
Death of age[c]	9730	22.54	1.07 (1.07-1.08)	<0.01

a OR (95% CI), odds ratio of undefined External cause code (95% confidence interval for estimate of odds ratio)

b Statistical significance of the odds ratio.

c Relative odds of undefined External cause code for each additional year of age (ie relative odds compared to preceding year)

Table 4 shows the results in the multivariate logistic regression model, which considered the independent contribution of all potential factors on the use of undefined codes. In Table 4, after adjusting for major external cause code blocks, use of the codes as an UCOD or MCOD, whether the death was certified by a doctor or coroner, age of the decedent, sex and indigenous status, in general the odds ratio of use of an undefined code was still statistically significant. There were significantly higher odds of a death certificate being assigned an undefined external cause code if the external cause was coded as an accident (compared to intentional self-harm with 0.16 (95%CI: 0.11-0.25) and Undetermined intent with 0.42 (95%CI: 0.10-1.78), was an assault with 2.39 (95%CI: 1.57-3.65) (compared to an accident), was a MCOD with 1.70 (95% CI: 1.48-1.95) (compared to an UCOD), where the death was certified by a doctor instead of a coroner or government medical officer with 0.24 (95%CI: 1.48-1.95). The results also indicated that odds of a death certificate being assigned an undefined external cause code were significantly different across the Australian States and Territories.

Discussion

This paper has examined the specificity of reported external causes of mortality data for deaths registered in 2003 in Australia. Comparing the specificity of coding across injury intent, it was evident that deaths due to intentional self-harm were less likely to be undefined than deaths coded as being due to an accident, while deaths due to assaults were more likely to be undefined than accidental deaths. As deaths certified by doctors were more likely to be coded to an undefined category than those certified by a coroner or government medical officer, this may help explain the different patterns of specifi-

Table 4: Odds ratio of use of an undefined code in multivariate logistic regression models

INDEPENDENT VARIABLES	NUMBER SUBJECTS	ADJUSTED[c] OR (95% CI)[a]	P VALUE[b]
External cause major code blocks			
Accidents	7174	1.00	
Intentional self harm	2211	0.16 (0.11-0.25)	<0.01
Assaults	279	2.39 (1.57-3.65)	<0.01
Undetermined intent	69	0.42 (0.10-1.78)	0.24
Position			
As UCOD	7224	1.00	
As MCOD	2509	1.70 (1.48-1.95)	<0.01
Certifier			
Doctor	3006	1.00	
Coroner/Government medical officer	6727	0.24 (1.48-1.95)	<0.01
State of death registration			
State 1	3269	1.00	
State 2	2206	1.25 (1.47-6.85)	<0.01
State 3	1990	1.13 (1.34-1.90)	<0.01
State 4	720	1.26 (1.64-2.92)	0.09
State 5	979	0.68 (0.54-0.85)	<0.01
State 6	285	0.38 (0.25-0.57)	<0.01
State 7	175	0.80 (0.43-1.49)	0.48
State 8	110	1.08 (0.57-2.05)	0.82

a OR (95% CI), odds ratio of defined E code (95% confidence interval for estimate of odds ratio)

b Statistical significance of the odds ratio.

c Odds ratios adjusted for all other variables in the table and age, sex, and Indigenous Status.

city across accidental deaths and deaths due to intentional self-harm as the majority of the latter deaths would be investigated and certified by a coroner.

Different patterns in the usage of undefined codes were evident across Australian States and Territories, suggesting that death certification documentation and specificity may differ across States and Territories.

Specificity was particularly problematic for causes assigned as MCOD rather than UCOD. This may be related to the other findings that deaths of elderly persons and deaths of females had significantly higher odds of being coded with an undefined code. It is this latter group, particularly the elderly females, who are likely to be certified as dying from a medical condition with a contributory injury and external cause documented on their death certificate. However, for this group, it is the medical condition that is likely to be coded as the underlying cause of death with the external cause generally coded as the multiple cause of death. Kreisfeld and Harrison (2007) identified that 80% of additional injury deaths (i.e. causes assigned as MCOD rather than UCOD) had been certified by a medical practitioner and very few additional injury deaths had been the subject of an autopsy. The results of this study are consistent with this finding given that the deaths certified by doctors were more likely to be coded to an undefined category than those certified by a coroner or government medical officer. Another possible explanation for the less specific code use when external causes are coded as MCOD, is that external causes which are only indirectly involved in the death of the person are not as well described or documented by certifiers or not queried by coders. The multivariate model differed to the bivariate models in the pattern and significance of the odds ratios. As such it is important to consider the multiple contributions of correlates of external cause specificity in mortality data.

Recommendations

Currently, there are no explicit instructions on the WHO-recommended international form of the death certificate to prompt certifiers for information related to the external cause, although there is some limited instructional material in the Cause of Death Certification in Australia publication (Australian Bureau of Statistics 2008). However certifiers may not be aware of the importance of complete documentation of such information Kreisfeld & Harrison 2007; Peach & Brumley 1998; Swift & West 2002; Smith & Hutchins 2001). To improve the quality of statistical data relating to external cause of injuries leading to or associated with death, certifiers need to be made aware of the importance of documenting all information pertaining to the cause of an injury, either through education or more explicit instructions on the death certificate and accompanying materials. It is important that researchers are aware of the validity of the data when they make interpretations as to the underlying causes of fatal injuries and causes of injury associated with deaths, and to accommodate for the possible under-representation or 'loss' of data to residual categories. It is also recommended that injury researchers utilise both underlying cause of death and multiple cause of death data when examining mortality statistics.

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Corresponding author:
Kirsten McKenzie *BSSc(Hons)(Psych),MPHAA, PhD*
Research Fellow
National Centre for Classification in Health
School of Public Health and Institute for Health and Biomedical Innovation
Queensland University of Technology
Victoria Park Road
Kelvin Grove QLD 4059
AUSTRALIA
Tel: +61 7 3138 9753
Fax: 61 7 3138 5515
email: k.mckenzie@qut.edu.au

Linping Chen *BMed, MPH*
Senior Research Assistant
National Centre for Classification in Health
School of Public Health and Institute for Health and Biomedical Innovation
Queensland University of Technology
Kelvin Grove QLD 4059
AUSTRALIA

Susan M Walker
BAppSc(MRA), GradDip(Public Health), MHlthSc
Associate Director
National Centre for Classification in Health
School of Public Health
Queensland University of Technology
Kelvin Grove QLD 4059
AUSTRALIA ■

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