

ICD-10 mortality coding and the NCIS: a comparative study

Leanne Daking and Leonie Dodds

Abstract

The collection and utilisation of mortality data are often hindered by limited access to contextual details of the circumstances surrounding fatal incidents. The National Coroners Information System (NCIS) can provide researchers with access to such information. The NCIS search capabilities have been enhanced by the inclusion of data supplied by the Australian Bureau of Statistics (ABS), specifically the ICD-10 Cause of Death codeset. A comparative study was conducted to identify consistencies and differences between ABS ICD-10 codes and those that could be generated by utilising the full NCIS record. Discrepancies between the two sets of codes were detected in over 50% of cases, which highlighted the importance of access to complete and timely documentation in the assignment of accurate and detailed cause of death codes.

Key Words (MeSH):

Mortality; Causes of Death; ICD-10; Data Quality; Coroners and Medical Examiners; Data Interpretation, Statistical

Introduction

The National Coroners Information System (NCIS) is the world's first national collection of coronial data (Driscoll, Henley & Harrison 2003; National Coroners Information System 2005b). Since its implementation in July 2000¹ to the end of 2006, this centralised repository of information has grown to over 121,000 coronial cases (National Coroners Information System n.d.). With a continually increasing collection of coronial information, the NCIS is a valuable resource for those investigating deaths and endeavouring to minimise hazards within the community (Driscoll et al. 2003; Kreisfeld 2006; National Coroners Information System 2005a). Approved users of the online system may search for information via coded or free-text data fields, as well as search and view full text documents attached to each case (National Coroners Information System 2005b). These may include a police summary of the events leading to the death, Autopsy Report, Toxicology Report and

Coronial Finding (National Coroners Information System 2005b).

In June 2005 additional information provided by the Australian Bureau of Statistics (ABS), was included and made available via a reciprocal agreement² for the exchange of data between the NCIS and the ABS, including access to the NCIS database and the provision of various ABS codesets including ICD-10 Cause of Death coding (National Coroners Information System 2005a; National Coroners Information System n.d.).

Data supplied by the ABS include (National Coroners Information System n.d.):

- cause of death information (ICD-10 mortality coding)
- geographical area of the deceased's residence (Australian Standard Geographical Classification codes).

Each of these codesets is a nationally and/or internationally recognised coding classification and adds another layer of value to the NCIS.

¹ Seven jurisdictions commenced submission on 1 July 2000 with Queensland commencing on 1 January 2001

² NCIS Annual Report 2005/2006

Purpose of study

The coding of case information onto the NCIS is primarily based on a version of the International Classification for External Cause Injuries (ICECI) and therefore does not include assignment of the cause of death or any injuries/conditions resulting in death to ICD-10 or ICD-10-AM codes (National Centre for Classification in Health 2004; World Health Organization 1993; World Health Organization n.d.-b). The ICD-10 Cause of Death codes available in the NCIS are provided by the ABS yearly, upon completion of the national cause of death data set (National Coroners Information System 2005b).

The purpose of this study was to review the ICD-10 codes provided by the ABS in order to ascertain the level of comparability to independent coding of data to ICD-10, based only on the information contained in the NCIS. Once the comparison was completed, the analysis would allow for further discussions between NCIS and ABS about any changes to practice that could maximise the completeness and accuracy of ICD-10 coding of Australian mortality data (Reinken 1997; Slovensky 2001).

The ABS data for 2000-2005 has been provided and is stored in the NCIS. It is these data (made available via a screen on the NCIS internet interface) which allow approved users to search for specific codes or combinations of codes in one or several of the ABS codesets (National Coroners Information System n.d.).

The data the NCIS uploads from the coronial courts in each jurisdiction³ is monitored via a rigorous quality assurance program (National Coroners Information System 2005a; National Coroners Information System 2005b). However, the comparability of the ABS ICD-10 codes to the NCIS dataset was to date unknown. Significant discrepancies between the ABS ICD-10 codes and the cause of death information on the NCIS could reduce user confidence in the accuracy and usefulness of both datasets.

It was hoped that the re-coding of a subset of NCIS cases utilising the skills of an independent coder, would assist in ascertaining the level of data reliability between NCIS and ABS

information and attempt to answer several questions including:

- Are the ICD-10 codes obtained via the ABS screen an accurate and consistent reflection of the NCIS coronial cases to which they are attached?
- If there is a large discrepancy between the independent coder and the ABS output, what are the size and type of discrepancies?

Comparison study data sources

The data compared in the study were extracted from two main sources:

- ABS Data (Codeset 1): ICD-10 codes resulting from ABS coding unit record files provided by the Registry of Births, Deaths and Marriages (BDM) and coronial files in each jurisdiction (Australian Bureau of Statistics 2006);
- NCIS Data (Codeset 2): Cause of Death (COD) data on the NCIS sourced from Autopsy/Post Mortem reports and confirmed by the coronial findings.

Relevant coding processes

Codeset 1 is the end result of reviews conducted by the Health and Vital Statistics Unit ABS, on unit records submitted by the BDM registries (Australian Bureau of Statistics 2006). These data are entered for automated computerised coding (Australian Bureau of Statistics n.d.). Often further information must be obtained by the unit's liaison officers before all case particulars can be processed. One such avenue utilised by the ABS when looking for this supplementary information is the NCIS (Australian Bureau of Statistics 2006). Others include the electronic generation of queries along with the actual viewing of hardcopy coronial records. Upon review, completion of all relevant case specifics are entered into the system and the automated cause of death coding process continues. The ABS utilises an Automated Coding System (ACS) known as the 'Mortality Medical Data System' (MMDS) which was developed by the National Centre for Health Statistics (NCHS) in the USA and applied in Australia from 1997 (Australian Bureau of Statistics n.d.).

Records may be rejected by the MMDS due to insufficient or contradictory information; often an issue for deaths resulting from an external cause. These cases require manual coding by the expert

³ For NCIS purposes States and Territories are referred to as Jurisdictions

ABS staff. When manual coding is undertaken, coders will consider available information, including that on the NCIS, for clarification. As a consequence, the mortality coding provided by ABS is a combination of both automatic and manually generated ICD-10 codes (Australian Bureau of Statistics n.d.).

ABS provides an output of ICD-10 codes for all deaths registered in Australia. Once this process is finalised and the results deemed public information, the ICD-10 codes for the coronial cases are isolated, linked to NCIS records via probabilistic matching, and sent electronically to the NCIS for inclusion in the database (Australian Bureau of Statistics 2006; Waller & Watts 2002).

Codeset 2 is the result of ICD-10 codes

generated directly from the COD data in the NCIS. Data in the Cause of Death data field on the NCIS are entered nationally by the coronial offices in each jurisdiction. Usually the field is an exact replication of the Medical Cause of Death assigned by the pathologist in the Autopsy/Post Mortem report. This is generally also confirmed as the Legal Cause of Death in the Coronial Finding (National Coroners Information System 2005b).

Methodology

The core of the study involved the independent re-coding of a random sample of NCIS cases extracted from 2000-2003 data and comparison to pre-assigned ABS ICD-10 codes.

Table 1: Data Utilised for ICD-10 Coding

ABS CODING	NCIS CODING
<p>SOURCES OF DATA</p> <ul style="list-style-type: none"> ▪ Registry of Births, Deaths and Marriages ▪ NCIS ▪ Coronial Officers (access to full coronial file if required) ▪ Cancer Registries ▪ Medical Practitioners (signing Death Certificates) ▪ Health Service Medical Records and certifiers through query action. 	<p>SOURCES OF DATA</p> <ul style="list-style-type: none"> ▪ Coding by coronial clerks based on contents of the full coronial file. Data fields include: <ul style="list-style-type: none"> ▪ Intent ▪ Activity ▪ Mechanism of Injury ▪ Object/Substances Producing Injury ▪ Mode of Transport, Counterpart, Context and Role of deceased in vehicle accidents ▪ COD as provided by Pathologist in Autopsy Report and confirmed in Coronial Finding. ▪ Documents attached to the NCIS: <ul style="list-style-type: none"> ▪ Autopsy Reports ▪ Coronial Finding ▪ Toxicology Report ▪ Police Circumstance
<p>RANGE OF CODES</p> <p>As per ICD-10 coding rules and standards:</p> <ul style="list-style-type: none"> ▪ Diseases/Conditions ▪ Injuries and External Cause codes reflecting: <ul style="list-style-type: none"> ▪ Intent ▪ Location ▪ Activity 	<p>RANGE OF CODES</p> <p>As per NCIS Data Dictionary.</p> <p>Coding utilising ICECI codesets include:</p> <ul style="list-style-type: none"> ▪ Intent ▪ Activity When Injured ▪ Mechanism of Injury ▪ Object/Substance Producing Injury ▪ Location ▪ Mode of Transport, Counterpart, Context and Role of Deceased for vehicle accidents.
<p>APPLICABLE TIMELINES</p> <ul style="list-style-type: none"> ▪ Dataset is produced annually, coding commences early in each calendar year. ▪ Data collection and coding are ceased to allow consolidation and release of data. ▪ Timelines have varied; 2005 data were released in March 2007 	<p>APPLICABLE TIMELINES</p> <ul style="list-style-type: none"> ▪ Dataset is a fluid collection, information is added commencing at notification of the death to the coroner, as the investigation into the death progresses and concluding with the coding of information confirmed in the Coronial Finding. ▪ Information may be amended, entered in or deleted from the NCIS up until the point of case closure, which is only permitted upon closure of the death investigation by the Coroner. ▪ Documents can be added at point of availability, including after closure of the case. ▪ Cases can be re-opened and amended if necessary; they are usually if the coronial case itself is re-opened.

The study involved four distinct phases:

- *Phase 1:* extraction of data and creation of comparison software
- *Phase 2:* re-coding of subset cases using COD statements as the basis, including verification of coder accuracy and consistency
- *Phase 3:* comparison of two codesets
- *Phase 4:* analysis of results.

Phase 1: Extraction of data

A representative subset of cases was identified. Only cases closed at the time of the extraction would be suitable for inclusion in the project. In addition only cases containing both an NCIS cause of death and ABS ICD-10 codes were eligible. Initial assessment concluded that 5% would be a significant representation of eligible cases; however due to time constraints, it was recognised that it would only be possible to analyse approximately 1,000 cases (or 2% of eligible cases). As such, the sample was revised to produce a more manageable number of cases for analysis.

Several macros were applied to all eligible cases to allow the random selection of cases for inclusion in the final analysis subset. In addition the primary COD statements were reviewed to ensure that the subset contained a reasonable array of deaths as it would be imprudent to have multiple cases with the same or similar causes of death when evaluating the allocation of ICD-10 codes. For example, the number of cases with a COD of ‘gunshot’ or ‘ischaemic heart disease’ was limited to ensure that the scope of the subset was representative of all cases reported to Coroners and therefore the NCIS.

The final subset of cases is outlined in Table 2.

An Access database was created allowing the display of information relevant for the coding process, including Case Type, Intent, COD Statements, Mechanism of Injury, Objects Producing Injury and a link to the live database so that Autopsy reports and Coronial Findings could be reviewed. For the initial phase of the project, all existing ABS assigned ICD-10 codes were concealed from the coders’ reference dataset.

Table 2: NCIS cases allocated ICD-10 Codes

Total Cases		1009		
CASE TYPE BREAKDOWN				
	TOTAL	% TOTAL		
Natural Cause Cases	318	31.52		
External Cause Cases	667	66.11		
Unknown Cause Cases	24	2.38		
JURISDICTION BREAKDOWN				
	NATURAL	EXTERNAL	UNKNOWN	TOTAL
NSW	37	116	1	154
VIC	44	133	10	187
QLD	32	104	4	140
SA	106	67	4	177
WA	61	153	1	215
TAS	6	20	0	26
ACT	16	45	2	63
NT	16	29	2	47
INTENT BREAKDOWN (EXTERNAL CAUSE CASES ONLY)				
Unintentional				348
Interpersonal Violence				23
Intentional Self-Harm				258
Legal Intervention				1
War & Civil Insurrection (includes Acts of Terror)				3
Adverse Events				10
Other				8
Unknown				40

**Phase Two: Case coding
Coding protocol**

The NCIS coder used the COD statements as the core reference for the re-coding of the NCIS dataset. Where necessary, more specific information for the allocation of the 4th character in the ICD-10 code was retrieved from the NCIS data fields and attached reports. Primarily this involved the use of the Mechanism of Injury and Object Producing Injury data fields as well as information provided in the Coronial Finding and comments section of the Autopsy reports. The study methodology stipulated that the coder could not utilise information regarding specific injuries contained in the Autopsy reports to expand the level of specificity in codes; that is, breaking ‘multiple injuries’ down to specific fractures and wounds. This did not exclude

utilising the information to determine injury explicit information such as degree of burns, which is rarely documented in the COD statement although often detailed in both the Autopsy report and the Coronial finding.

The COD statements usually provide adequate information for accurate coding of natural cause deaths. However external and unknown cause deaths typically require additional information regarding how the deceased was injured, as well as other information including where the injury and death occurred, the activity of the deceased at the time of injury, and even the roles of the deceased and others in the injury event. This additional information is crucial as it often provides the basis for 4th and/or 5th ICD-10 character coding, such as injury specificity, body regions involved, activity and place of occurrence.

Coding consistency

After a number of cases were re-coded, the skills of the independent coder were verified. Consistency between coders is a contentious issue with much of the literature pointing towards an approximation of 50% concordance between coders (McKenzie, Walker & Tong 2001).

In this instance the coder and the NCIS Quality Manager were each asked to code the same 54 cases. Results of this process are shown in Table 3.

Table 3: Independent Coder Comparison

Total number of cases compared:		54
Exact matches between re-coders:	33	61.1 %
Discrepancies between re-coders:	21	38.9 %

The two coders were found to be in complete concordance in 61.1% of cases. If the less vital discrepancies (such as 4th character and sequencing differences) are removed this rate increases to 72.2%. When viewed against much of the available literature, this appeared to be a high level of compatibility. It was therefore considered that the independent coder’s consistency and accuracy were of a reasonable standard.

Phase Three: Comparison and analysis

Upon completion of phase two, the Access database was amended to reveal the original ABS codeset. This allowed the coder to view the two

codesets side by side. To assist with the analysis a coding discrepancy classification was developed using a hierarchical system (refer Table 4 in the results section). The term ‘Exact Match’ was used for cases with 100% coding concurrence.

A comparison of the two codesets was completed and all differences noted and rated according to the discrepancy classification. If a string of compared codes was found to contain more than one difference, the discrepancy which had the highest level of difference was used. The higher the level of discrepancy (Level 1 being the most significant) the greater the disparity between ABS and NCIS coded information.

Results

Table 4: Coding Discrepancy Classification

Level	DESCRIPTION
1	All codes differ
2	First two codes differ, when three codes present
3	First code only differs
4	Second code only differs
5	Third code only differs (or is absent)
6	Only noted difference between codes is 4th digit
7	Only noted difference between codes is a 4th digit location identifier (codes W00 – Y34; except Y06._ and Y07._)
8	Same codes present in different sequencing order

Table 5: ICD-10 Coding Analysis Results

	Cases Re-coded	Exact Match	Discrepancy	%
Natural	318	228	90	28.30
External	667	207	460	68.97
Unknown	24	6	18	75.00
Total	1009	441	568	56.29

Natural Cause case analysis

Cases which are determined to be the result of natural causes may be reported to the Coroner in several scenarios. These include when a medical practitioner is not confident in assigning a cause of death, the cause of death is unknown or when reporting is mandatory under the coronial legislation (e.g. when a death occurs whilst the person is in care, or has had a recent anaesthetic

or where the identity of the person is unknown (Cordner & McKelvie 2006). A total of 318 deaths attributable to natural causes were re-coded. A simple breakdown via jurisdiction was applied to ensure a fair representation of cases.

A discrepancy rating analysis was performed and the differences between the ABS and independent re-coding found that 71.70% of the 318 re-coded cases were found to match exactly the data provided by the ABS. Only 28.30% of the cases were found to contain some form of level discrepancy. However, the differences noted predominately related to the higher levels of discrepancy (levels 1–5). This may suggest an issue with ambiguous COD statements and documentation causing difficulties in the assignment of ICD-10 codes, some examples of ambiguous statements include ‘Effects of fire’ and ‘Dissecting coronary artery’. Although such statements appear straightforward, for ICD-10 coding purposes they are not sufficiently descriptive and difficult to classify consistently with ICD-10. Appraisal of the statements by separate coders may result in inconsistent coding.

External Cause case analysis

Cases where death is caused by anything other than a natural disease process are classified as externally caused fatalities. These may be the consequence of assault, accident, complications of medical care, intentional self-harm or other external forces. In total 667 (3.79%) of the total applicable external cause related cases of death were re-coded.

The results shown in Table 6 illustrate that the exact match ratio between ABS and NCIS

re-coding was 29.84%. In other words, in 70.16% of cases there was a difference noted in the comparative string of codes. The most obvious differences evident in External Cause cases related to cases in the intent types of: ‘Intentional self-harm’, ‘Interpersonal Violence’, Adverse Effects or Complications of Medical or Surgical Care’ and ‘Other’. Together these four categories accounted for 248 cases or 53.22% of the discrepancies identified. Interestingly, the ‘Unintentional’ category accounted for 143 case errors (30.69%).

Investigation revealed some consistency in the identified differences between the two codesets for external causes of death, including:

- intent classification, especially for Intentional Self Harm cases
- sequencing of ICD-10 codes within the coding string
- allocation of location codes (4th and/or 5th characters)
- difference in allocation of location and/or activity codes (4th and/or 5th characters)
- coding of conditions or injuries not detailed in the COD statements.

Each of these discrepancy types is explained further under Discussion below.

Unknown Cause case analysis

Despite extensive coronial and forensic investigation, some reported deaths remain undetermined as either a natural or external cause of death. As can be seen in Table 7, discrepancies far outweigh exact matches; of the 24 Unknown Cause cases re-coded 75% were found to have comparative differences.

Table 6: External Cause ICD-10 Coding Analysis Results

	CASES RE-CODED	EXACT MATCHES	% MATCH	DISCREPANCY	% DISCREPANCY
Adverse Effects or Complications	10	2	20.00	8	80.00
Intentional Self-Harm	258	42	16.28	216	83.72
Interpersonal Violence	22	5	22.73	17	77.27
Legal Intervention	1	1	100.00	0	0.00
War & Civil Insurrection (Terrorism)	3	0	0.00	3	100.00
Other	8	1	12.50	7	87.50
Unintentional	343	143	41.69	200	58.31
Unlikely To Be Known	22	5	22.72	17	77.27
Total	667	199	29.84	466	70.16

Table 7: Unknown Cause ICD-10 Coding Analysis Results

	CASES RE-CODED	EXACT MATCHES	% MATCH	DISCREPANCY	% DISCREPANCY
Adverse Effects or Complications	0	0	0.00	0	0.00
Intentional Self-Harm	1	0	0.00	1	100.00
Interpersonal Violence	0	0	0.00	0	0.00
Legal Intervention	0	0	0.00	0	0.00
War & Civil Insurrection (Terrorism)	0	0	0.00	0	0.00
Other	0	0	0.00	0	0.00
Unintentional	5	2	40.00	3	60.00
Unlikely To Be Known	18	4	22.22	14	77.78
Total	24	6	25.00	18	75.00

Fourth character statistics

At its basic level, ICD-10 utilises three character alphanumeric codes. The first character is alphabetic, most letters uniquely representing a particular chapter⁴. The remaining characters are numeric representing specific diseases, conditions, aetiologies, anatomical locations, injuries or actions (World Health Organization 1993). Where applicable, a fourth character, positioned after a decimal point, is utilised to add specificity. For example V43 identifies an occupant of a car injured as a result of a collision with another vehicle; adding a fourth character of '5' (V43.5) indicates that the occupant was actually the driver of the vehicle in a traffic situation. The final character may provide more information regarding the disease or injury, information regarding the location of the incident, activity of the deceased at the time of injury, or even the role of the deceased in the injury or death event.

ICD-10 standards stipulate that the provision of fourth character codes is not mandatory for international reporting and comparison (World Health Organization 1993; World Health Organization n.d.-a). The inclusion of the character does provide users of the data with additional information, particularly for external cause codes, regarding the location at which the injury event occurred.

Although the specificity of the fourth character is valuable, researchers using the first three characters would still find cases of relevance to their query. The fourth character in an ICD-10

code is therefore not essential, but provides extra detail about the event.

By analysing the fourth character disparities (discrepancy levels 6 and 7) the following results were obtained:

- 1009 re-coded cases; 568 discrepancies identified
- 568 discrepancies; 194 attributable to fourth character absence or difference
- 194 fourth character variations; 157 (81%) location identifiers and 37 (19%) condition identifiers.

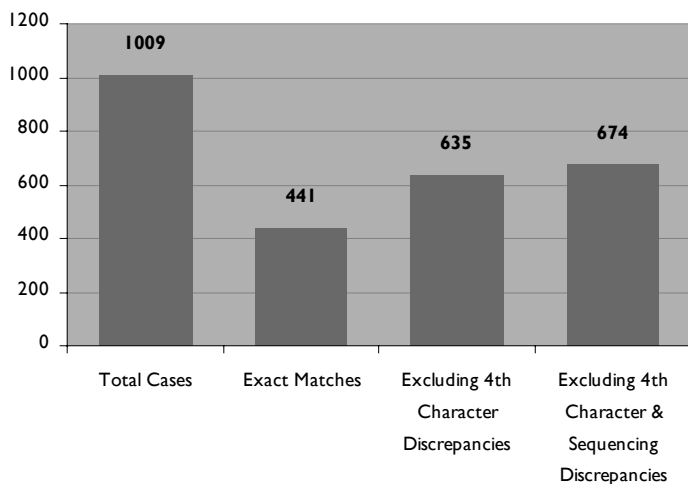
If the low level discrepancies regarding the NCIS and ABS ICD-10 codes were removed, the comparability of the two datasets is considerably improved. If discrepancies based on different sequencing of the coding are also excluded (discrepancy type 8), the overall comparability improves from 43.70% to 66.79%.

It is important to note that although removing the lower levels of discrepancy from the results increases the comparability rating, the manipulation of data in such a way must be undertaken with caution. If the data are more valuable to the researcher with a present and accurate fourth character, then the initial match rate of 43.70% should remain a basis for discussion.

Discussion

When viewing the results of this study it can be seen that there were a significant number of discrepancies between the two codesets, when examined at the most specific level. An exact match rate of 43.70% suggests that users may

4 ICD-10, Volume II

Figure 1: Exact Match adjustment analysis

not be retrieving the expected number of cases or specific information possible. However, it is acknowledged that while useful, many of the identified discrepancies related to small differences that would have little, if any impact on search results. An improved match rate of 66.79% when smaller discrepancies are omitted indicates a reasonable level of consistency between the two codesets.

The greatest disparities between the two codesets appeared to occur for external or unknown cause categories. Literature searches and communication with the ABS identified that many of these cases are unable to be processed by the automated coding system and subsequently manually coded by expert staff who utilise all available data (including the NCIS) as well as information not contained within NCIS.

Manual coding, although based upon strict rules and standards, does have an element of subjectivity which could explain many identified discrepancies (Chen et al. 2002; Dixon et al. 1998; Reinken 1997). At times the ABS coding staff may need to assign codes without sufficient information available, due to current coding deadlines within the ABS. This problem is primarily associated with the length of the coronial process and is not easily overcome (Australian Bureau of Statistics 2006; National Coroners Information System 2005b).

Some of the specific discrepancies are identified and discussed below.

The determination of intent in external cause cases affects ICD-10 coding, especially in relation to intentional self harm deaths.

Common differences involved ABS ICD-10 coding to accidental or unspecified intent codes (such as 'W76: Other Accidental Hanging and Strangulation') while the NCIS coding indicated intentional intent codes (such as 'X70: Intentional Self-harm by Hanging, Strangulation and Suffocation'). One explanation is that ABS coding is being undertaken before a final determination as to intent is made by a coroner; another may be the coding guidelines followed by the ABS coders. The WHO version of the ICD-10 defaults such cases to accidental in the absence of a statement of intentional self harm (World Health Organization 1993; World Health Organization n.d.).

Sequencing discrepancies (level 8) were most commonly found in relation to cases where there were multiple injuries resulting from the same event. ABS codes for the majority of external cause cases were sequenced with the primary COD or injury coded first, followed by the external cause code which explained the injury event; all other injuries received in the event were subsequently sequenced. The external cause is the underlying cause in such cases. NCIS coding sequenced all injury codes in order (as per COD statement, assuming they resulted from the same injury event) with the external cause code sequenced last in the string of codes, following ICD-10-AM coding standard 2001 which stipulates that 'External cause codes should be sequenced directly after the diagnosis code(s) to which they relate' (National Centre for Classification in Health 2004).⁵ ICD-10 provides no guidelines on the sequencing of external cause injury codes, other than the fact that they should be sequenced as the underlying cause of death (World Health Organization 1993).

The issue regarding the assignment of fourth character location identifier for categories W00 – Y34 (excluding Y06.– and Y07.–) resulted in a large number of discrepancies particularly in relation to the external and unknown cause of death subsets. As previously stated, fourth character assignment is not mandatory for international reporting and comparison. The main issue of concern was not the inclusion of the fourth character in the ABS coding but rather the

⁵ ICD-10-AM, Australian Coding Standards (ACS)

diversity in the allocation of the fourth character, which is indicative of inconsistency in coder practice rather than a policy or directive by ABS. It is acknowledged this information may not have been available for the case at the time coding was conducted by the ABS, although the assignment of '9 – Unspecified....' in these cases would have ensured more consistency in the codeset. In the majority of cases the relevant information was available within NCIS when the cases were re-coded.

The availability of or accessibility of related documentation can impact on the level of specificity in coding. Presumably differences are related to the disparity between the ABS coding deadlines and the closure of a coronial case including the release of relevant documents, such as the Coronial Finding (National Coroners Information System 2005b). Where documentation regarding cause and circumstances of death and clarification of intent are unavailable to coders, the resulting in ICD-10 codes are usually non specific (such as R98 – Unattended Death or the default accidental intent codes) providing little or misleading information to mortality data users.

Differences in the coding of the fourth and/or fifth characters also resulted in a number of discrepancies. For natural cause deaths the difference related to the identification of body region, typically between specified and unspecified. For external cause deaths the difference most commonly involved the identification of a specific location at which injury occurred.

Coding of additional conditions or injuries was most evident in the ABS ICD-10 codeset primarily as the study methodology restricted the independent coder from coding conditions or injuries not detailed in the COD. Often the source of the information was clearly the additional statement within the Autopsy report or Finding and not included in the COD. However, in some cases the source of the additional codes was not evident in information provided via the NCIS and it is assumed that in these cases the ABS sourced information directly from the hospital record, coronial file or other resources unavailable to the independent coder.

The allocation of totally different ICD-10 codes was identified in some cases. These discrepancies were unexplained in the majority of cases and are thought to be the result of differing interpretations of the behalf of the coders or additional documentation or information being sourced by ABS. They may also be the result of errors occurring during the probabilistic matching process of the ABS codeset to the NCIS and this issue is yet to be investigated.

Inconsistency in coding practices can occur; for example if the COD stated 'Multiple Injuries', ABS coding practice varied: T07 (multiple injuries) would be assigned for one case, while each individual injury was coded for another case. This explicit coding is based on information usually sourced from the autopsy report. The extent to which particular injuries are the ultimate cause of a death may not always be clearly stated in a final cause of death statement in an autopsy report and/or coronial finding (i.e. documentation may state 'multiple injuries' only). To determine the individual injuries sustained, the full autopsy report will need to be available for these cases, and the coder would need to be confident enough about the sequence and severity of injuries highlighted throughout the autopsy report to code the underlying and contributory injuries. As the methodology of the project required that the NCIS codes be based solely on the COD statements as detailed in the NCIS, this did not allow for the broadening of injury coding for any case. This may result in the variations detected when coding of multiple injury events if some ABS staff have used detailed material within the autopsy report to 'code out' all sustained injuries.

This inconsistency was also seen in relation to the specificity of location and multiple drug toxicity. This may be the result of documentation availability and accessibility but does result in inconsistency in coding practice and search results.

Coding based on a probable but unascertainable cause of death was evident in the ABS ICD-10 coding which often reflected the suggested cause of death rather than the final legal cause. However, during re-coding it was felt that this causative link was unproven as stated by the pathologist and/or Coroner and therefore should be coded as R98 (unattended death).

Deaths due to multiple drug toxicity generated issues such as sequencing fluctuations, coding of specific drugs not mentioned within reports attached to NCIS, and the assignment of 'intentional self-harm' without coronial determination.

The majority of natural cause deaths are automatically coded by the ABS (Australian Bureau of Statistics n.d.) and usually contains more timely documentation and less ambiguity, explaining the higher comparability between ABS and NCIS codes, with an exact match of 71.30%.

Despite the above discrepancies, and excepting occasional inconsistent coding practices, it is believed that the majority of coding discrepancies between the NCIS and ABS ICD-10 codes are due to a lack of complete information available at the time of ABS coding. The widely known adage 'garbage in = garbage out' also applies to mortality coding. The information produced by both organisations is only as good as the data they have available to it at the time of coding.

Issues identified throughout this study therefore include:

- standard of data and documentation available to mortality coders
- delays in receipt of information due to the lengthy Coronial process.

Recommendations

This study has highlighted some high level issues in the area of mortality coding. Improvement in accuracy, timeliness and consistency of ICD-10 mortality coding will in turn improve the value of mortality data available to researchers (Slovensky 2001). Some suggested measures that would enhance performance are as follows:

- continued liaison between NCIS, ABS, Coronial Offices and BDM to discuss and continually improve the level and timeliness of data about external cause deaths
- sustained representation of NCIS and ABS on committees such as the Australasian Mortality Data Interest Group, to remain at forefront of the mortality data realm
- NCIS to continue developing its Drug Module and National Police Form initiatives. Standardised documentation should assist consistent and accurate coding

- investigation by ABS of the feasibility of switching from ICD-10 to ICD-10-AM, which is more detailed, accommodates the inclusion of new conditions/diseases and embraces up to five characters, thereby providing greater specificity, especially for external cause coding. This would be a substantial undertaking and although NCIS would not be directly involved in the process it would be a highly interested party.

A further study regarding the consistency of the ABS ICD-10 codes and NCIS information should be considered in the future, either duplicating the methodology of this study or focusing on specific injuries or diseases to obtain further insight into the size and continuity of any coding discrepancies.

Limitations of the study

The time restriction placed upon this study was a significant limitation, resulting in only 1009 of the 2850 cases originally extracted being re-coded. The results gleaned from the study would have been more comprehensive had the larger sample been utilised and more time been available for the investigation of discrepancies.

The fact that the literature search yielded little insight into this particular area of study must also be seen as a restriction. Further liaison with the ABS expert coding staff, accompanied by a more comprehensive and far reaching literature search, would have been a beneficial addition.

It is recognised that many of the results from this study appear generalised. Specifics of examples are provided in the original findings, although inclusion for publication was not thought appropriate due to confidentiality and privacy issues.

Conclusions

The fact that both the NCIS and ABS have different yet important strengths as mortality data collections is not in dispute. Those investigating deaths reported to the Coroner now have access to two centralised repositories of information surrounding such cases. The results of this study, however, indicate that there is no guarantee that ABS assigned ICD-10 codes are directly comparable to ICD-10 codes that would be assigned using the full NCIS record once a coronial case

has been completed. Acknowledgment of this fact may be enough to alert researchers using the ABS ICD-10 codes to the fact that different levels of information about deaths (particularly external cause deaths) may be available via the NCIS. This study also highlights a problem in coding external cause deaths before all information is available. Subsequent information not available to ABS at the time of coding may assist in the coding of intent, case type and level of detail in assigned ICD-10 codes.

Finally, the coding of complex fatal events without clear, consistent source data is bound to result in various interpretations, subjective assignments and discrepancies of codes. Attempts should therefore be made to minimise this problem as much as possible.

References

- Australian Bureau of Statistics (2006). *Causes of death: Australia 2004. Cat. No. 3303.0*. Canberra, Australian Bureau of Statistics.
- Australian Bureau of Statistics (n.d.). *Automated cause of death coding using mortality medical data system (MMDS)*. Available at: <http://www.abs.gov.au/Websitedbs/c311215.nsf/20564c23f3183fdaca25672100813ef1/2f1b6d2f7b93e12cca25712f007c3c3f!OpenDocument> (accessed 24 April 2006).
- Chen, L. Walker, S. and Tong, S. (2002). The impact of the variation in death certification and coding practices on trends in mortality from ischaemic heart disease. *Australian Health Review* 25(4): 189-195 (accessed 5 April 2006).
- Cordner, S. and McKelvie, H. (2006). *Doctors and death: certificates and coroners*. Medical Practitioners Board of Victoria. Available at: <http://medicalboardvic.org.au/content.php?sec=42> (accessed 3 May 2006).
- Dixon, J., Sanderson, C., Elliott, P., Walls, P., Jones, J. and Petticrew, M. (1998). Assessment of the reproducibility of clinical coding in routinely collected hospital activity data: a study in two hospitals. *Journal of Public Health Medicine* 20(1): 63-69 (accessed 5 April 2006).
- Driscoll, T., Henley, G. and Harrison, J.E. (2003). *The National Coroners Information System as an information toll for injury surveillance*. Injury Research and Statistics Series Number 21. Adelaide, Australian Institute of Health and Welfare.
- Kreisfeld, R. Ed. (2006). *Injury Issues Monitor*. No 35, January 2006: Flinders University of South Australia, Research Centre for Injury Studies.
- McKenzie, K., Walker, S. and Tong, S. (2001). Assessment of the impact of the change from manual to automated coding on mortality statistics in Australia. *Health Information Management Journal* 30(3) (accessed 9 May 2006).
- National Centre for Classification in Health (2004) *The international statistical classification of diseases and related health problems, tenth revision, Australian modification (ICD-10-AM). Volumes 1-5*. 4th ed. Sydney, National Centre for Classification in Health.
- National Coroners Information System (2005a). *Annual Report 2004/2005*. Melbourne, National Coroners Information System.
- National Coroners Information System (2005b). National Coroners Information System coding manual and user guide, version 2.5, September 2005. Melbourne, Victorian Institute of Forensic Medicine.
- National Coroners Information System (n.d.). The National Coroners Information System. Available at: <http://www.ncis.org.au> (accessed 3 March 2007).
- Reinken, J. (1997). Quality issues in death statistics. *Australasian Epidemiologist* 4(1): 17-19 (accessed 1 May 2006).
- Slovensky, D.J. (2001). Quality management and clinical outcomes. In *Health information: management of a strategic resource*. 2nd ed. Abdelhak, M., Grostick, S., Hanken, M.A. and Jacobs, E. eds. Philadelphia, W.B. Saunders Company.
- Waller, G. and Watts, S. (2002). Quality activities for morbidity and mortality coding. *World Health Organization: Meeting of Heads of WHO Collaborating Centres for the Classification of Diseases 1-8*. Available at: http://www.aihw.gov.au/international/who_hoc/hoc_02_papers/brisbane56.doc (accessed 8 May 2006).
- World Health Organization (1993). *ICD-10: International Statistical Classification of Diseases and Related Health Problems - Tenth Revision*. Geneva, World Health Organization.
- World Health Organization (n.d.-a). *International Classification of Diseases (ICD)* [online]. Available at: <http://www.who.int/classifications/icd/en/> (accessed 10 April 2006).
- World Health Organization (n.d.-b) *International Classification of External Causes of Injury (ICECI)* [online]. Available at: <http://www.who.int/classifications/icd/adaptations/iceci/en/index.html> (accessed 3 March 2007).

Bibliography

- Australian Institute of Health and Welfare (n.d.). *Collection of mortality data*. Available at: http://aihw.gov.au/mortality/data/collection_data.cfm (accessed 3 May 2006).
- Dunn, C., Sadkowsky, K. and Brockway, I. Eds. (2006). *The AIHW mortality database documentation. Population Health Unit Technical Paper: Number 1*. Canberra, Australian Institute of Health and Welfare.
- MacIntyre, R. C., Ackland, M. J., Chandraraj, E. J. and Pilla, J.E. (1997). Accuracy of ICD-9-CM codes in hospital morbidity data, Victoria: implications for public health research. *Australian and New Zealand Journal of Public Health* 21(5): 277-282. Available at: Proquest (accessed 17 May 2006).
- National Center for Health Statistics (2007) Mortality data for the national vital statistics system. Hyattsville, MD: United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics [online]. Available at: <http://www.cdc.gov/nchs/about/major/dvs/about.htm> (accessed 26 May 2007).
- National Institute for Public Health and Environment, WHO Collaborating Center for the FIC in the Netherlands (2006) ICECI Bilthoven, Netherlands: National Institute for Public Health and Environment [online]. Available at: <http://www.rivm.nl/who-fic/> (accessed 26 May 2007)
- State Coroner's Office (2005). Submission to the Law Reform Committee of the Parliament of Victoria. Available at: <http://www.parliament.vic.gov.au/lawreform/> (accessed 18 May 2006).

Leanne Daking *BBus(Information Technology),
BHlthInfoManagement
Quality Manager
National Coroners Information System
57 – 83 Kavanagh Street
Southbank, Victoria 3006
AUSTRALIA
Phone: (03) 9684 4458
Mobile: 0403 370 596
Email: leanned@vifm.org*

Leonie Dodds *BHlthInfoManagement(Honours)
student
Health Information Management Program
School of Public Health, Division of Health Studies
La Trobe University
Bundoora Campus
Kingsbury Drive
Bundoora, Victoria 3086
AUSTRALIA*

Case Study 1

Deceased located in lounge room of home. Nil injuries were observed and medication of Mexloxican and Panamax were noted. Deceased had suffered a mild heart attack but had ceased taking heart medication. A GP review a week before death stated no issues of concern.

Family objected to autopsy. External examination revealed no evidence of external injury or trauma that may have contributed to death but pathologist stated that without an autopsy being performed the exact nature of the condition contributing to or resulting in death could not be identified.

The Legal Cause of Death was stated as:

I(a) Natural causes, probably ischaemic heart disease

ABS Coding:

I259 Chronic ischaemic heart disease, unspecified

NCIS Coding:

R98 Unattended death

Comment:

This case is an example of the coding of 'probable' conditions detailed but unsupported in the Legal Cause of Death.

Case Study 2

Deceased was a motorcycle rider who apparently lost control of his trail bike and drove into a tree. Ambulance attended but deceased was declared deceased at the scene.

Autopsy and Finding stated Cause of Death as:

Ia Multiple Injuries

Ib Motor Cycle Accident (Rider)

ABS Coding:

S711 Open wound of thigh

S065 Traumatic subdural haemorrhage

S066 Traumatic Subarachnoid haemorrhage

S273 Other injuries of lung

S361 Injury of liver or gallbladder

S360 Injury of spleen

S370 Injury of kidney

S378 Injury of other pelvic organs

V270 Motorcycle rider injured in collision with other nonmotor vehicle, driver involved in nontraffic accident

S420 Fracture of clavicle

NCIS Coding:

T07 Unspecified multiple injuries

V270 Motorcycle rider injured in collision with other nonmotor vehicle, driver involved in nontraffic accident

Comment:

It was clear that the specific coding submitted by the ABS was based on additional information detailed in the Autopsy Report including a summary of injuries as below:

- (i) lacerations, abrasions and bruises variously to the trunk, left arm, and left leg.
- (ii) a deep upward stab-like wound to the left thigh, passing behind the left hip joint, but with no identified equivalent tear in his trousers.
- (iii) small volumes of subarachnoid and subdural (surface) haemorrhage over the brain, with ventricular haemorrhage also noted. There was no macroscopic evidence of any parenchymal damage.
- (iv) severe bruising of the lungs.
- (v) a ruptured liver.
- (vi) a ruptured spleen.
- (vii) a ruptured left adrenal gland.
- (viii) a ruptured left kidney.
- (ix) a fractured left clavicle (collar bone).
- (x) severe fractures of the pelvis.
- (xi) lumbar (lower back) vertebral fractures, on the left side.
- (xii) numerous fractures to the ribs on the left side of the chest.

In addition to the above, the sternum (breast bone) was fractured in a manner consistent with attempted cardiopulmonary resuscitation (CPR).

The study methodology did not allow the NCIS coder to qualify specific injuries from supplementary data not detailed in the COD statements, thus creating this discrepancy in coding.

Case Study 3

Deceased was on a fishing trip and sharing a hotel room with friends. After consuming a substantial amount of alcohol the deceased left the hotel room, and was subsequently struck by a vehicle. The deceased was thrown onto the bonnet and then off to the roadway to the side of the vehicle.

The Toxicology report detailed a blood alcohol reading of 0.19 gram per 100ml in the blood and 0.23 gram per 100ml in the vitreous humour.

The Legal Cause of Death was stated as:

- I (a) Death due to severe trauma including fractures of a lower thoracic vertebra, fractures of both tibias and fibulas,
- I (b) Liver lacerations with internal haemorrhage and a cortical contusion

ABS Coding:

- T07 Unspecified multiple injuries
- V031 Pedestrian injured in collision with two- or three-wheeled motor vehicle, traffic accident

NCIS Coding:

- S221 Multiple fractures of thoracic spine
- S822 Fracture of shaft of tibia, without or without mention of fracture of fibula
- S361 Injury of liver or gallbladder
- S063 Diffuse brain injury
- V031 Pedestrian injured in collision with two- or three-wheeled motor

Comment:

The initial police summary did not give details of the injuries sustained by the deceased allowing for coding of multiple injuries; however the autopsy and finding both gave specifics on injuries within the Cause of Death statements that could be coded. It is feasible that the document was unavailable to ABS at the time of coding, allowing the NCIS coder access to more specific injury descriptions.

A response to Daking and Dodds

Tara Pritchard and Maryann Wood

The Australian Bureau of Statistics (ABS) encourages studies of this nature in order to fully expose the quality of different aspects of mortality coding through use of the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10)*. The ABS has an excellent relationship with the National Coroners Information System (NCIS) and without the valuable information and services provided by NCIS, would be unable to produce mortality data on external causes of death.

The ABS has some concerns regarding the methodology used for the study; specifically, it appears that some morbidity coding rules may have been applied for this study, for example for mortality coding in Australia no fifth characters are applied.

On 11 April 2007 the ABS published an information paper *External Causes of Death data quality, 2005* (Australian Bureau of Statistics 2007), in which a range of issues regarding the quality of ABS external causes mortality data are discussed. The ABS recommends that users of mortality data should avail themselves of the information contained within this paper in order to assist them in interpreting ABS mortality coding.

Daking and Dodds recommend continued liaison between a range of stakeholders involved in mortality statistics in order to improve the quality of external causes mortality data. The ABS fully supports this recommendation.

The timeliness, quality and comprehensiveness of information on the NCIS database are important factors affecting the quality of ABS external causes of death data. The ABS has commenced a major collaborative effort with coroners (and the NCIS team) to ensure that completed cases can be entered into the NCIS at the coroners' office more promptly. This collaboration is expected to continue over the next few years, with the aim of identifying and

addressing the issues (e.g. educational, operational or technical) of concern. Initial effort will be concentrated in those jurisdictions with the greatest delays and those most likely to produce improvements. It is likely that the issues will vary according to the jurisdiction, and progress will be faster in some jurisdictions than in others. This initiative will allow for a close working relationship with coroners, which will also facilitate ABS monitoring of completion rates and increase knowledge of contributing factors.

In 2005 the ABS commenced a program to develop better relationships with Registrars of Births, Deaths and Marriages (RBDMs), with the aim of increasing the quality of death statistics. This program has included a range of activities, including development of a national standard set of data items for collection of death statistics and provision of ABS assistance to RBDMs in areas such as form content and design. The program has had a number of successes, including delivery of data to the ABS in standard file formats.

The ABS would encourage the development of the NCIS Drug module and National Police form initiatives as a method of increasing the availability of timely data in a standard format. The importance of standard methods for collection of data and standard and visible metadata in supporting collection of data is an issue of a high priority to the ABS.

The ABS does not support the recommendation contained within this paper regarding an investigation into moving from use of ICD-10 to ICD-10-AM for ABS mortality statistics.

ICD-10 is used by the ABS to code causes of death. The International Classification of Diseases (ICD), produced by the World Health Organization (WHO), is the international standard diagnostic classification used to classify diseases and other health problems recorded on many types of health and vital records, including death certificates and hospital records (WHO 2007).

In 1994 the Australian Health Ministers Advisory Committee (AHMAC) established a committee to oversee the implementation of the tenth revision of the ICD in Australia. The ABS worked in conjunction with the Australian Institute of Health & Welfare (AIHW) and the National Reference Centre for Classification in Health (now known as the National Centre

for Classification in Health – NCCH) to ensure standard and appropriate implementation of the classification throughout mortality data collection processes. The ABS continues to work closely with NCCH to ensure correct and consistent interpretation of the classification by the ABS. The use of the ICD as the standard classification contributes greatly to the overall coherence of the ABS Causes of Death collection.

The Australian Bureau of Statistics processes data on around 140,000 deaths annually, using an automated coding system (ACS). The Mortality Medical Data System (MMDS) allows the classification of multiple causes of death in accordance with the current version of the ICD. This results in coding of every condition mentioned on a death certificate as contributing to the death. The ABS implemented the MMDS system during 1997, after considerable research and testing using ICD-9 (World Health Organization 1975) and the subsequent introduction from 1999 for ICD-10 (World Health Organization 2007). All deaths occurring within Australia, registered from 1 January 1997, have been multiple-cause coded in ICD-10.

The primary focus of mortality coding is to assign an underlying cause of death (UCOD). The underlying cause of death is defined as ‘...the disease or injury which initiated the train of morbid events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury’ (ABS 2006). When more than one condition is entered on the death certificate, the underlying cause is selected using the coding rules of the ICD-10.

ICD-10-AM is primarily a classification the purpose of which is to record, analyse, interpret and compare morbidity data. The ICD-10-AM has been developed to assist in assigning principal diagnoses and principal procedure codes to indicate the reason for a patient’s episode at a hospital or other health care facility. The classification is also used to assign codes for additional diagnosis and other procedures.

There are a number of important differences in the rules used for mortality coding as compared to coding for morbidity (ICD-10-AM). As an example of this, when considering sequence for mortality coding the main concern is understanding the sequence of events that led to the

death, that is assigning an UCOD. In contrast, when considering sequencing for morbidity coding it is important to identify the principle diagnosis and principal procedure. All other conditions that are coded for that episode of care are sequenced according to the level of severity of the conditions.

The ABS will continue to use ICD-10 as the classification for mortality statistics in line with international standards and the fundamental purpose of that particular classification.

Overall the ABS supports the views presented in the Daking and Dodds paper that the majority of differences encountered in coding will be due to differences in the timing of the coding activity and the known differences in consistency and concordance between individual coders. The ABS would support the undertaking of a future similar study, using an agreed methodology and coding standards, in partnership between the ABS and the NCIS.

References

- Australian Bureau of Statistics (2006). *Causes of Death: Australia 2004. Cat. No. 3303.0*. Canberra, Australian Bureau of Statistics.
- Australian Bureau of Statistics (2007). *External Causes of Death data quality, 2005. ABS Cat. No 3317.0.55.001*. Canberra, Australian Bureau of Statistics.
- World Health Organization (2007). *ICD-10 home page*. Available at: <http://www.who.int/classifications/icd/en/> (accessed 6 March 2007)
- World Health Organization (1975). *International Statistical Classification of Diseases and Related Health Problems, 9th Revision*, Geneva, World Health Organization.

Tara Pritchard (GradCertPublicAdmin)
Director, Health and Vitals Statistics Unit
Australian Bureau of Statistics
email: tara.pritchard@abs.gov.au

Maryann Wood BBus(HlthAdmin), MHSc(HlthInfoMan)
Assistant Director, Health and Vitals Statistics Unit
Australian Bureau of Statistics
email: maryann.wood@abs.gov.au ■

Comment from NCIS

The NCIS would like to convey its respect for the opinions and comments expressed by the ABS in regards to the article ICD-10 mortality coding and the NCIS: a comparative study by Leanne Daking and Leonie Dodds on pages 41-42 of this issue of the Journal.

We would also like to acknowledge the work initiated by the ABS to examine a range of issues relating to mortality coding. These include several identified in the NCIS Project Report, initially distributed to ABS mid 2006, and those discussed in the information paper External Cause of Death, data quality 2005 (ABS Cat. No 3317.0.55.001) released on 11 April 2007. As illustrated by the collaboration between the NCIS and ABS both organisations are striving to streamline the mortality coding process and the NCIS will continue to work to ensure that the coronial data stored by the NCIS is as timely and accurate as possible.

The results of the study identified certain inconsistencies between ABS and the independent coder, one of which related to the inconsistency in the application of coding standards, such as the allocation of fifth characters. NCIS acknowledges that for the purpose of assigning fifth character (and in some instances fourth character) the independent coder followed ICD-10-AM coding practices and standards. It is acknowledged that the allocation of the fifth character is not required for mortality coding and this was allowed for in some of the comparisons. However the inconsistency in the allocation of the fifth character within ABS coding practices (sometimes included, sometimes not) could be something that is examined in future. NCIS would welcome the opportunity to perform a subsequent study in partnership with the ABS pending funding and personnel availability.

Leanne Daking