Non-referral of unnatural deaths to coroners and non-reporting of unnatural deaths on death certificates in Taiwan: implications of using mortality data to monitor quality and safety in healthcare

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Abstract

Background. Mortality data has often been used to monitor the quality of cardiac care.

Objective. To investigate the under-reporting of unnatural deaths in mortality data.

Method. All patients with a main discharge diagnosis of injury (ICD-9-CM code 800–999) who died in 2003 or 2004 were identified through record linkage between hospital discharge claims data and cause of death data in Taiwan. Percentages of unnatural deaths that had been referred to the coroner and in which injury-related information was reported on the death certificate were estimated.

Results. Of 4086 known or suspected unnatural deaths, only 57% (2346/4086) were referred to the coroner, and in 71% (2889/4086) injury-related information was reported on the death certificate. The percentages of referral and reporting were lowest for deaths related to complications in medical and surgical care. In deaths related to fracture of the femur and the effects of a foreign body, many doctors report injury-related information on the death certificate but do not refer the certification of cause of death to the coroner.

Conclusions. The sensitivity of using mortality data alone to detect known or suspected unnatural deaths varied according to the types of injury and external causes. Monitoring cause of death data linked with hospital discharge record data could provide a better system for discovering these unnatural deaths.

Keywords: cause of death, death certificates, forensic medicine, mortality, under-reporting

Mortality data have often been used to monitor the quality of cardiac care [1–3], surgery [4–6], performance of general practitioners [7–9] and medical errors [10–12] because it is complete, routinely available and standardized in providing cause of death information according to the International Classification of Diseases [13]. Manner of death (i.e. whether death is natural or unnatural) is one of the pieces of information reported on death certificates by certifiers. Unnatural deaths include death by accident, suicide, homicide, neglect, injury, poisoning, accidental overdose of a drug or a wrong drug given in error, misadventure to patients during surgical and medical care, adverse effects of medical or surgical care etc, and many unnatural deaths are related to the quality of healthcare and patient safety.

If a death is suspected or known to be unnatural, the certification of cause of death should be referred to the coroner or medical examiner, in accordance with the forensic system in place in the country in question [14,15]. Nevertheless, a certain number of unnatural deaths might not be referred to coroners, either unintentionally or intentionally. For example, a patient is admitted to hospital because of a head injury and dies from pneumonia 3 months later because of the patient’s long-term bed-ridden status. The attending physician might forget that the original cause of death was a traffic accident and unintentionally certify the cause of death as natural...
death without referral to the coroner. On the other hand, in
deaths of the elderly from proximal femoral fracture [16] or
deaths related to medical errors [17], many doctors might
intentionally not to refer the case to the coroner in order to
avoid an inquest, instead reporting these deaths as natural
deaths.

Some studies have used questionnaires consisting of ficti-
tious case histories to assess the ability of clinicians to recog-
nize deaths that require referral to the coroner [18–20]. The
limitations of these studies were the small sample sizes of
physicians surveyed and the inclusion of hypothetical situa-
tions that may not reflect real-world situations. Charles et al.
investigated the under-reporting of deaths to the coroner by
doctors in a real setting [21]. They retrospectively reviewed the
medical records of in-patients who died in two major public
hospitals in Victoria, Australia, and found that in only 22 of
the 58 (38%) cases meeting the coroner’s reporting criterion
had the doctors reported the death to the coroner. One limita-
tion of this study was the small number of deaths, which pre-
vented further stratification of under-reporting by cause of
death or injuries. The aims of this study are to estimate how
many suspected or known unnatural deaths were referred to
the coroner for cause of death certification and to investigate
whether injury-related information was reported on death cer-
tificates in Taiwan through record linkage between hospital
discharge claims data and cause of death data.

Methods

Record linkage

This study is a part of the Project of Improving the Quality
of Cause of Death Statistics undertaken by the Office of
Statistics, Department of Health of Taiwan. The project
obtained all hospital discharge claims data from 2003 from
the Taiwan National Health Insurance Bureau, which covers
more than 96% of the population [22]. All patients with a
main discharge diagnosis of injury (ICD-9-CM code 800–
999) were linked to cause of death data from 2003 and 2004
through an identification number, with 11,012 patients
linked in total. Some patients died during their hospital stay,
some within a few days of discharge from hospital and some
several months after discharge. The longer the interval
between the discharge date and the death date, the less likely
that death is related to injury or poisoning, and therefore
only those deaths that occurred within 3 days after discharge
from hospital were defined as known or suspected unnatural
deaths in this study.

The term ‘suspected’ is used because the final underlying
cause of death might not be injury for those patients whose
main discharge diagnosis was injury. For example, one
patient had a main discharge diagnosis of hip fracture due to
falls, but died from acute myocardial infarction 2 days after
discharge. The underlying cause of death might have been
found to be acute myocardial infarction after the coroner
had examined the deceased, but the decision as to whether
the deceased died a natural or unnatural death is the
responsibility of the coroner. Therefore, all ‘suspect’ or ‘pos-
sible’ unnatural deaths should be referred to the coroner for
final determination of the cause of death.

Analysis

There is an item on the death certificate that indicates
whether the certifier is a medical physician, a coroner or
another professional. This information was used to identify
whether the death was referred to the coroner. Using the
total known or suspected unnatural deaths as the denomi-
nator and the number of certifications by coroners as the
numerator, we calculated the percentage of unnatural deaths
that were referred to the coroner. We then calculated the per-
centage of unnatural deaths in which injury-related infor-
mation (ICD-9 codes 800–999 or E800–E999) had been
reported on the death certificates. These two percentages
were then presented by characteristics of the deceased, length
of stay in hospital, place of death, level of hospital, type of
injury and external cause of death. The place of death infor-
mation was taken from the details recorded on the death cer-
tificates. The level of hospital was according to accreditation
levels and includes academic medical centers, regional hospi-
tals and district hospitals, based on the capacity and volume
of the services provided. District hospitals have fewer beds
and services compared with regional hospitals and medical
centers.

Results

Of 4086 known or suspected unnatural deaths, only 57%
(2346/4086) were referred to coroners for cause of death
certification, and in 71% (2889/4086) injury-related infor-
mation was reported on the death certificate. The percen-
tages differed by the characteristics of the patient and the
level of the hospital (Table 1): women had lower percentage
than men; the percentages decreased with age; the longer the
length of stay, the lower the percentages; and the percentages
of those who died at home were lower than that of those
who died in hospital. The percentages varied greatly by type
of injury (Table 2) and external cause of death (Table 3).

The percentages for both referral and reporting were rela-
tively high for deaths related to fracture of the skull and
internal injury. For deaths related to fracture of the femur
and the effects of a foreign body, many doctors reported
injury-related information on the death certificate but did not
refer the certification of cause of death to the coroner. Both
proportions were low for deaths related to complications in
medical and surgical care. For complications affecting a
specific body system (such as infection or pulmonary embo-
lim after surgery), physicians were found to be less likely
(7%) to report injuries on death certificates; on the contrary,
for complications particular to certain specific procedures
(such as perforation of the auricle by a cardiac catheter),
physicians were more likely (14%) to report injuries on death
certificates (Table 2).
For the deaths which had E-codes of discharge diagnoses, the highest proportions for both referral to the coroner and reporting of injury were found to be in deaths from transport accidents. For deaths from accidental poisoning and accidents caused by machinery, physicians were more likely to report injuries on death certificates but were less likely to refer cases to the coroner. We found that the proportions varied greatly if analysed by type of accidental fall: for falls from one level to another (many of these being occupational injuries) the proportions were relatively high (56 and 70% for referral to coroner and including injuries on death certificates, respectively); however, for falls on the same level with femoral fracture (many of these patients being elderly with osteoporosis), only 2% were referred to the coroner by physicians (Table 3). Of the 312 deaths in which the main discharge diagnoses were complications in medical or surgical care (ICD-9 codes 996–999), only three-fifths (190/312) had E-codes reported in the claims data, and none of these had been coded as misadventure to patients during medical and surgical care (E870–E876).

**Discussion**

Our findings indicate that about three-tenths of known or suspected unnatural deaths within the period studied were not reported and were hidden in natural death categories in mortality data in Taiwan. Non-referral of unnatural deaths to coroners and non-reporting of unnatural deaths on death certificates was most apparent in deaths related to complications (or misadventure) in medical and surgical care. Using record linkage data, unreported hidden deaths could be identified and monitored.

**Strengths and weaknesses of this study**

One of the strengths of this study was the use of national population-based record linkage data to estimate the under-referral and -reporting of unnatural deaths in routine mortality data; another was the use of a strict definition of unnatural death. We confined the cases used to only those in which the date of death was within 3 days of discharge from hospital. It is very unlikely that these deaths were all owing to natural causes. The law requires that if there is ‘any doubt or suspicion’ of a possibility of unnatural death, the case ‘should be’ referred to the coroner [14,15].

One of the limitations of this study was that we did not review the detailed information contained in medical records in order to determine whether death really was unnatural or not. This study is by no means a validity study; we did not intend to use the discharge main diagnosis as the gold standard in verifying the reporting of the underlying cause of death.
Table 2  Numbers and percentages of unnatural deaths that were referred to the coroner for cause of death certification and in which injury-related information was reported on death certificates, by types of injury, in Taiwan, 2003

<table>
<thead>
<tr>
<th>Types of injury (ICD-9-CM N-code)</th>
<th>Unnatural deaths No.</th>
<th>Referred to coroner No. (%)</th>
<th>Reported injury No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture of the skull (800–804)</td>
<td>600</td>
<td>529 (88)</td>
<td>572 (95)</td>
</tr>
<tr>
<td>Intracranial injury (850–854)</td>
<td>1629</td>
<td>1078 (66)</td>
<td>1224 (75)</td>
</tr>
<tr>
<td>Spinal cord injury (805,806,952,953)</td>
<td>84</td>
<td>36 (43)</td>
<td>44 (52)</td>
</tr>
<tr>
<td>Fracture of the femur (820,821)</td>
<td>295</td>
<td>22 (7)</td>
<td>156 (53)</td>
</tr>
<tr>
<td>Other fracture (807–818,822–829)</td>
<td>117</td>
<td>62 (53)</td>
<td>79 (68)</td>
</tr>
<tr>
<td>Internal injury (860–869)</td>
<td>222</td>
<td>184 (83)</td>
<td>197 (89)</td>
</tr>
<tr>
<td>Open wounds (870–897)</td>
<td>43</td>
<td>20 (47)</td>
<td>17 (40)</td>
</tr>
<tr>
<td>Effects of a foreign body (930–939)</td>
<td>62</td>
<td>4 (6)</td>
<td>21 (34)</td>
</tr>
<tr>
<td>Burns (940–949)</td>
<td>150</td>
<td>91 (61)</td>
<td>124 (83)</td>
</tr>
<tr>
<td>Poisoning (960–989)</td>
<td>382</td>
<td>204 (53)</td>
<td>287 (75)</td>
</tr>
<tr>
<td>Complications of medical and surgical care (996–999)</td>
<td>312</td>
<td>1 (0.3)</td>
<td>40 (13)</td>
</tr>
<tr>
<td>Complications particular to certain specific procedures (996)</td>
<td>215</td>
<td>1 (0.5)</td>
<td>30 (14)</td>
</tr>
<tr>
<td>Complications affecting specific body systems (997)</td>
<td>30</td>
<td>0 (0)</td>
<td>2 (7)</td>
</tr>
<tr>
<td>Other complications (998, 999)</td>
<td>67</td>
<td>1 (1.4)</td>
<td>8 (12)</td>
</tr>
<tr>
<td>Others</td>
<td>190</td>
<td>115 (61)</td>
<td>128 (67)</td>
</tr>
</tbody>
</table>


Table 3  Numbers and percentages of unnatural deaths that were referred to the coroner for cause of death certification or in which injury-related information was reported on death certificates, by external cause, in Taiwan, 2003

<table>
<thead>
<tr>
<th>External cause (ICD-9-CM E-code)</th>
<th>Unnatural deaths No.</th>
<th>Referred to coroner No. (%)</th>
<th>Reported injury No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport accidents (E800–E848)</td>
<td>1437</td>
<td>1255 (87)</td>
<td>1374 (96)</td>
</tr>
<tr>
<td>Accidental poisoning (E850–E869)</td>
<td>109</td>
<td>50 (46)</td>
<td>77 (71)</td>
</tr>
<tr>
<td>Misadventure to patients during medical and surgical care (E870–E876)</td>
<td>0</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Surgical and medical procedures as the cause of abnormal reaction at the time of the procedure (E878–E879)</td>
<td>193</td>
<td>3 (2)</td>
<td>21 (11)</td>
</tr>
<tr>
<td>Accidental falls (E880–E888)</td>
<td>830</td>
<td>268 (32)</td>
<td>440 (53)</td>
</tr>
<tr>
<td>Falls from one level to another (E880–E884)</td>
<td>265</td>
<td>149 (56)</td>
<td>185 (70)</td>
</tr>
<tr>
<td>Falls on the same level (E885, E886)</td>
<td>462</td>
<td>100 (30)</td>
<td>213 (46)</td>
</tr>
<tr>
<td>With femoral fracture</td>
<td>145</td>
<td>3 (2)</td>
<td>75 (52)</td>
</tr>
<tr>
<td>Without femoral fracture</td>
<td>317</td>
<td>97 (31)</td>
<td>138 (44)</td>
</tr>
<tr>
<td>Falls, other and unspecified (E887, E888)</td>
<td>103</td>
<td>19 (18)</td>
<td>42 (41)</td>
</tr>
<tr>
<td>Accidents caused by drowning, suffocation or foreign bodies (E910–E915)</td>
<td>72</td>
<td>27 (38)</td>
<td>45 (63)</td>
</tr>
<tr>
<td>Accidents caused by machinery (E916–E927)</td>
<td>71</td>
<td>47 (66)</td>
<td>61 (86)</td>
</tr>
<tr>
<td>Other and unspecified accidental causes (E928)</td>
<td>81</td>
<td>39 (48)</td>
<td>43 (53)</td>
</tr>
<tr>
<td>Adverse effects in therapeutic use (E930–E949)</td>
<td>9</td>
<td>2 (22)</td>
<td>2 (22)</td>
</tr>
<tr>
<td>Suicide (E950–E959)</td>
<td>257</td>
<td>163 (63)</td>
<td>208 (81)</td>
</tr>
<tr>
<td>Homicide (E960–E969)</td>
<td>35</td>
<td>29 (83)</td>
<td>20 (57)</td>
</tr>
<tr>
<td>Intent undetermined (E980–E989)</td>
<td>57</td>
<td>28 (49)</td>
<td>40 (70)</td>
</tr>
<tr>
<td>Other external causes</td>
<td>31</td>
<td>12 (39)</td>
<td>25 (81)</td>
</tr>
<tr>
<td>No external causes reported</td>
<td>904</td>
<td>423 (47)</td>
<td>533 (59)</td>
</tr>
</tbody>
</table>

aICD-9-CM, International Classification of Disease, Ninth Revision, Clinical Modification; E-code, External cause code.
death on the death certificate. Johansson and Westerling clearly indicated that some of the main discharge diagnoses were the same as the underlying cause of death, some were complications of the underlying cause of death and some were just symptomatic diagnoses or other competing causes of death [23,24]. Nevertheless, when the main discharge diagnosis is injury and the date of death is within 3 days of discharge, this points to a high level of ‘doubt or suspicion’ of a possibility of unnatural death and the case ‘should be’ referred to the coroner.

Interpretations in relation to other studies

The quality of injury coding in hospital discharge records is relatively good compared with other diagnoses according to previous evaluation studies [25–29], but the overuse of non-specific E-codes in discharge records is a problem that is mentioned in all evaluation studies. For example, many computerized hospital discharge data lacked information about the circumstances of falls or the status of injured persons in motor vehicle traffic injuries. Other errors included late effects of injury misclassified as acute injury and under-reporting of undetermined intent. We believe that these artifacts also exist in discharge records in Taiwan. Another limitation of this study was the incompleteness of E-code reporting for insurance claims. Only three-quarters (3182/4086) of all deaths had E-codes assigned; therefore, interpretation of results from E-codes should be cautious in this study.

Our study indicates a higher rate of referral to the coroner (57%) than the study by Charles et al., which specified the referral rate as 37%. One possible explanation for this difference is that different criteria were used in defining the denominators used when calculating the percentage of cases referred. Both studies showed that the older the deceased the lower the referral or reporting rates. As suggested by Charles et al., the cause of death may be less certain among elderly patients, who tend to suffer from multiple conditions that mask the effects of trauma [21].

Previous population-based record linkage studies in Sweden and the UK also revealed under-reporting of certain causes of death [24,30]. The Oxford record linkage study showed that, of those patients with a main admission diagnosis of intracranial injury who died within four weeks of hospital admission, in only 64% was the intracranial injury mentioned on the death certificate; 25% reported a fractured neck of the femur, 18% another fracture of the femur and 38% poisoning by drugs [30]. A hospital-based study revealed that, of 92 patients with a fracture who died within 28 days of hospital admission, inquests were held in only 22 cases (23%) and the fracture was recorded on the death certificate in only 23 cases [16]. In our study, higher percentages of reporting intracranial injury (75%) and femoral fracture (52%) on the death certificate were noted.

Why did the clinicians not refer these known or suspected unnatural deaths to the coroner? One explanation is that the clinicians did not know in what circumstances they should refer cases to the coroner [18–20]. Survey studies have indicated that some clinicians seem to believe that deaths resulting from accidents are reportable only if the accident occurs in suspicious circumstances. Deaths that result from road traffic accidents and domestic accidents involving fire were usually reported; industrial accidents and domestic accidents in which elderly people had fallen were often not reported, particularly if a long time had elapsed between the accident and death [18]. Our study also revealed that the longer the length of stay in hospital the lower the percentages of referral and reporting.

It has been proposed that mortality data is used to improve quality and safety in general practice [7, 9] and to audit adverse events [31]. Nevertheless, there are many difficulties present in the use of death certificate data to audit or monitor quality or malpractice [32,33]. The present study also showed very low referral and reporting rates for those deaths with a main discharge diagnosis of complications (or misadventure) in medical and surgical care. Furthermore, it is also very possible that the number of cases involving complications in medical and surgical care as the main discharge diagnosis is under-reported because medical care givers may not document some mistakes/misadventures in the medical records, and hence coders could not code complications (or misadventures) as there would be no relevant information documented.

One of the strategies used to improve the ability of a monitoring system to detect abnormal practice is to use additional information about the circumstances of death [7]. We suggest that hospital discharge data linked with cause of death data can be used to help identify many abnormal practices, because the discharge diagnosis is given by coders instead of doctors. The coders will use all the information available in medical records (e.g. admission notes, operation notes, progress notes and discharge summaries etc.) to assign discharge diagnosis codes. If other identifying tools, such as Patient Safety Indicators, which use inpatient administrative data to identify potential patient safety concerns and were developed by the Agency for Healthcare Research and Quality [34], were used and linked to mortality data, even more unreported deaths would be identified.

In conclusion, the sensitivity of using cause of death data alone to detect known or suspected unnatural deaths varied according to types of injury and external causes, and was relatively poor for those deaths related to complications in medical and surgical care. Using hospital discharge record data linked with cause of death data could provide a better monitoring system for discovering these unnatural deaths.

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