Results of the ICE on Injury survey of injury death certification and vital statistics

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Introduction

It might be imagined that statistics on deaths from injury would be more comparable than deaths from diseases. The events leading to injury deaths are thought of as dramatic and so easily recognised and counted. However, ICE participants are well aware of idiosyncrasies in the data on injury mortality in their own countries not all of which are apparent to data users. Previous research has identified a number of problems in making comparisons of death rates between countries related to how the information is collected and processed.[1,2,3]

The laws governing certification and medico-legal investigation of 'unnatural' deaths or deaths from injury and poisoning vary considerably between countries.[2] This in turn gives rise to differences in the length of time before the death is registered[4] and the amount and quality of the information which the vital statistics office receives.[5] Coding the underlying cause of these deaths requires information about how the injury was sustained and the intent of any perpetrator as well as the nature of the actual injuries.[3] This information is not all easily encapsulated in the standard certificate of cause of death. Discussions between ICE participants highlighted many differences in these processes, which we thought could affect the apparent death rates from injury in our countries.

We decided to investigate the processes through which information on injury deaths was collected and processed to produce mortality statistics in countries participating in the Injury ICE. We drew up a questionnaire which covered certification, investigation, registration and coding of the causes of deaths from injury; inclusion and exclusion criteria for deaths, methods of deriving population denominators; and whether delays for investigation affected mortality rates through incomplete registration or insufficient information about the cause. This was amended after piloting in three countries and discussion at the ICE meeting in Amsterdam in 1998. Revised questionnaires were sent to ICE participants, who then had them completed by a representative of their national vital statistics agency or themselves.

Answers to questionnaires

Questionnaires were completed for 18 countries, including all 11 countries whose data were used in international comparisons recently published through the ICE[6] (ICE-1 countries). We present data from all 18 countries whenever possible, and from the eleven ICE-1 countries when comparisons with mortality statistics are made.

In all participating countries, the same national office produced statistics on deaths from injury and deaths from natural causes. All countries published total figures/had an annual publication based on the whole range E800-E999 [or ICD-10 equivalent].

These deaths were referred to as		'external causes'
or	of	'injury and poisoning'
or		'accidents and violence'

No countries yet specifically excluded deaths due to adverse effects or misadventure in medical/surgical care from their routine published rates. England and Wales have just begun including deaths coded to ICD-9 304 and 305.2-.9, drug dependence and drug abuse,[7] in their annual publication on deaths from injury and poisoning because most of these were found to be acute poisonings.

Death certificates

More than half the countries reported using a single certificate for all deaths, though some countries had several different certificates for different circumstances (Table 1. England and Wales have a total of 7).

Table 1

Death certificates	**All ICE countries**	**ICE 1 data countries**
One certificate for all deaths	10	4
More than one certificate	8	7

No countries had different certificates for different causes of death. However, three had different certificates for completion by coroners or medical examiners. This effectively means that many or most injury deaths in these countries are on special certificates (see 'who certifies?' below).

Table 2

Reason for different certificates	**Country (All ICE countries)**	**Number of countries**
Legal/who certifies	E&W, NZ, Norway	3
Area within country	Canada, USA, Australia	3
Old/new versions	France	1
Age	NZ, E&W, Australia-neonates	3

Certification: Who certifies injury deaths?

Only two countries reported both coroners and medical examiners – Canada and Norway (both exist in parts of the USA, but no breakdown of proportion certified by each was available from vital registration). Sweden reported forensic pathologists as the alternative certifiers to physicians. In other countries, only one or other system is in use for medico-legal investigation of cause of death. These three categories have been combined as 'coroner/medical examiner'.

Participating countries seem to fall into 4 groups as to who actually certifies deaths from injury (Table 3):

- All deaths certified by attending physician
- Mixed physician and coroner/medical examiner
- All or nearly all coroner/medical examiner
- Information not available

Table 3

Main Certification	Percentage of injury deaths certified by country	Physician	Coroner or ME
all physician			
	France	100	0
	Scotland	100	0
mixed			
	Norway	65	35
	Sweden	56	44
	Denmark	30	70
	Canada*	28	67
all/nearly all coroner/ME			
	New Zealand	11	89
	England & Wales	10	90
	Australia	5	95
	Netherlands	0	100
no information			
	Israel		
	6 CAREC countries		
	USA		

*Canada reports 4% certified by nurse

Who is responsible for referring deaths for investigation?

In only 3 countries (3/18 and 3/11) is there no legal responsibility on the attending physician to refer deaths for investigation. E&W is one of these, though in practice more deaths are referred to the coroner from doctors than from any other source there.

Table 4

	Responsible for referral	
	Yes	No
Attending physician	8	3
Registrar of deaths/registration office	7	4
Funeral director	2	9
Police	8	3
Other, responsible for investigation*	2	9

*common law responsibility on any person with knowledge of death that should be investigated in Canada and E&W

What proportion of injury deaths have autopsies? Does this vary depending on who certifies injury deaths?

Only eight countries could say the proportion of injury deaths that had been subject to autopsy. The estimate for Denmark was much lower than any other country, at only 3%. Three countries report about half these deaths have autopsies, and the remaining four report 70-90%. Surprisingly, there does not appear to be any clear relationship between who certifies injury deaths and the proportion which have autopsies, though only eight countries had information on both (Table 5). Scotland, where doctors certify all injury deaths, and the Netherlands, where they are all certified by a coroner/medical examiner, both report a 70% autopsy rate. Certifier and autopsy are related in England and Wales, where coroners cannot legally certify cause of death there unless they order an autopsy or hold an inquest. The number of inquests held without autopsy is extremely small.

Table 5

Country	**autopsy %**	**% certified by coroner or ME**
Denmark	3	70
New Zealand	48	89
Canada	51	67
Sweden	52	44
Scotland	70	0
Netherlands	70	100
Australia	88	95
England & Wales	90	90

Manner of death, or intent - source, recording and use

Eight of 18 countries have a specific space on the certificate for recording manner of death, intent or verdict. In 5 this is a list of intents (accident, suicide, homicide, etc.), with boxes to tick ('check box').

Five countries use the text sections on the cause of death narrative description of 'how the injury occurred' (see below), to record intent (Australia, E&W, France, NZ and Scotland). Of these, only France includes specific instructions to the certifying physician to state the intent (on the cause of death lines).

In seven countries intent is derived from a legal verdict on some or all injury deaths: Denmark, Norway, E&W, Scotland, Australia, NZ and Sweden. This may be recorded as free text or as a specified field. Altogether 11 countries report that they use either manner of death or a legal verdict in assigning the E-code.

Narrative description of 'how the injury occurred'

Ten of the 18 countries have a space for narrative description of how injury occurred (including 8 out of 11 ICE-1 countries). However, only 2 countries have it completed for all injury deaths. In some countries the variation is geographic, for example in Australia it is completed in some states and not others. In E&W coroners are only legally required to complete this section for accidental deaths.

Table 6

Country	Injury Narrative	Narrative complete	Narrative used for E-code	Narrative stored electronically	Narrative available for analysis
Belize	NO	NO	NO	NO	NO
Dominica	NO	NO	NO	NO	NO
Jamaica	NO	NO	NO	NO	NO
Saint Lucia	NO	NO	NO	NO	NO
Trinidad & Tobago	NO	NO	NO	NO	NO
France	NO	NO	NO	NO	NO
Israel	NO	NO	NO	NO	NO
Scotland	NO	NO	NO	NO	NO
Australia	YES	NO	YES	NO	NO
Norway	YES	NO	YES	NO	NO
Denmark	YES	NO	YES	YES	NO
Guyana	YES	NO	YES	NO	YES
Canada	YES	NO	YES	NO	YES
Sweden	YES	NO	YES	YES	YES
England & Wales	YES	NO	YES	YES	YES
New Zealand	YES	NO	YES	YES	YES
Netherlands	YES	YES	YES	NO	NO
USA	YES	YES	YES	YES	YES

The 10 countries with narrative all use it when it is present to assign the underlying cause E-code. Five countries (NZ, USA, E&W, Sweden and Canada) store this narrative electronically for at least some recent years and could make it available for analysis in the ICE.

Delays in registration or registration before all information is complete?

Deaths from injury usually have to be investigated by the police or other authorities. In some countries, the death can be registered before investigation is complete, with incomplete or missing information about cause. In others, the death cannot be registered at all until the investigation is complete. Either of these procedures may mean that injury mortality is underestimated in vital statistics, because the death has not been registered by the time the annual file is closed or because there is no indication that it was due to injury.

Table 7

What happens when deaths are being investigated?

Number of Countries (total=18)

	Registration is delayed		
death certification by:	No	Yes	Total
all physician	2	1	3
all/nearly all coroner/ME	1	3	4
mixed	1	3	4
No information	2	5	7
Total	6	12	

	Death is registered with unknown cause		
death certification by:	No	Yes	Total
all physician	2	1	3
all/nearly all coroner/ME	1	3	4
mixed	3	1	4
No information	6	1	7
Total	12	6	

	Death is registered with unknown cause			
		No	Yes	Total
Registration is delayed	No	2	4	6
	Yes	10	2	12
	total	12	6	

It appears that many participating countries do suffer either from delay or from some deaths being registered with no information on cause. Australia and England & Wales have both delays and unknown cause registrations. Israel and Scotland both manage not to delay registration; they use available information to code cause immediately, and can amend it later. The numbers of countries are small, but it seems that delay in registration is more likely when deaths have to be certified by a coroner or medical examiner.

Of the twelve countries that have delayed registration, half manage to include them in annual publications. In some cases the statistics are based on the year that the death is registered, so the annual figures will always be complete, but may include deaths that actually happened in the previous year or even earlier. In others, inclusion is possible because publication is delayed even longer than registration. In some countries annual figures are not published until two or three years after the end of the data year.

Six ICE countries do have some level of underestimation of injury mortality in their annual publications because they are missing some deaths registered too late for inclusion. However, three of these six do regularly publish updated figures for past years.

In addition, six of the twelve countries in which registration is delayed by investigation say that they can make updated data available for analysis in some circumstances.

Table 8

Number of countries	**Revised data available for analysis?**		
Late death included	NO	YES	Total
YES	6	3	9
NO	6	3	9

17 countries report that they can amend causes when later information comes in. Eleven of these can make amended cause data available for analysis in some circumstances. This includes four of the six countries that register deaths with an unknown cause before investigation is completed.

Table 9

Number of countries	**Amendments available for analysis**		
Death registered with unknown cause	NO	YES	Total
NO	5	7	12
YES	2	4	6
Total	7	11	18

Coding cause of death

Automated or clerical?

Only 4 countries attempt to code all injury deaths automatically – Australia, Scotland and the USA use the NCHS system (SuperMICAR, MICAR and ACME) and Sweden uses its own. Some Canadian provinces code deaths with the NCHS software, while others code clerically. England and Wales code injury deaths clerically because the NCHS software did not code coroner's inquest certificates consistently with previous practice[3,8]

Which ICD revision:

Most countries except Denmark were using ICD-9 from the late 1970s or early 1980s until very recently (or are still using it). Table 10 shows the years in which countries have implemented or plan to implement ICD-10.

Table 10

ICD-10 before 1999		ICD-10 from 1999	ICD-10 later than 1999	
Denmark	1994	France	Scotland	2000
Saint Lucia	1996	Guyana	Canada	2000
Belize	1996	Australia	England & Wales	2001
Dominica	1996	USA		
Trinidad & Tobago	1996			
Norway	1996			
Netherlands	1996			
Israel	1997			
Sweden	1997			

Only Denmark and New Zealand report using special national adaptations of the international classifications. Most countries report using all available information from death certification, including cause of death text, manner of death/ verdict and narrative to assign the E-code. Only three countries indicated any order of priority between these variables.

Inclusion and Exclusion criteria used in vital statistics

Population denominators

Four countries use population registers alone to calculate their resident population at risk of dying, 12 use estimates based on a census. Israel uses estimates based on both, and no information was available for Jamaica. We did not ask about methods used to estimate inter-censal populations or the accuracy of population registers.

No ICE country included any measure of the tourist or non-permanent population in their denominators. They all included military personnel as long as they were deemed to be 'resident' in the country.

Deaths included or excluded

All countries included all deaths of residents within the country. Five included deaths of non-residents within the country, and 11 excluded them (no information was available for Jamaica). Only three countries always included deaths of their residents abroad, if they were told about them. Which deaths are included appears to be related to the method of deriving the denominator population (Table 11).

Generally, those countries using population registers as the denominator include in the numerator deaths of residents only, excluding deaths of people visiting the country. All these countries, except Denmark, include deaths abroad of registered residents. However, information on these deaths may not always be complete. In particular, the causes of deaths abroad may be missing. This will tend to affect sudden unexpected deaths more than others, and so may underestimate injury mortality

Most countries that use census based estimates of the resident population at risk include all deaths which occur in the country, whether of residents or non-residents, in the numerator for calculating death rates. Clearly this means that they are including in the numerator deaths of population groups such as tourists who are not in the denominator. However, it is generally assumed that this is balanced out by excluding deaths of their own residents abroad. In fact it may under or over estimate injury death rates depending on the relative numbers of travellers to and from the country who die. Only if the number of travellers is large in relation to the resident population, for example a small country with a large tourist industry, is the effect likely to be significant. There is no apparent relationship between the size of the resident population of ICE countries and whether deaths of non-residents are included in mortality rates. Most countries can identify deaths of non-residents separately, so that it would be possible to re-calculate rates using residents only and measure this effect.

The USA and Israel are exceptions - they exclude both deaths of visitors in their country **and** deaths of their residents abroad. Canada includes some deaths of Canadian residents abroad – if 'the death occurs in a major U.S. State visited by Canadians'. This may tend to exaggerate injury mortality in Canada, particularly in relation to U.S. rates.

Table 11

Population method	Deaths included in national mortality rates			
	Occur in country			Occur outside country
	residents	tourists	military	residents who die abroad
Population register				
Denmark	yes	no	yes	no
Netherlands	yes	no	no	yes
Norway	yes	no	yes	yes
Sweden	yes	no	yes	yes
Population register and census based estimates				
Israel	yes	no	yes	no
Census based estimates				
Australia	yes	yes	yes	no
Belize	yes	yes	yes	no
Canada	yes	yes	yes	yes[1]
Dominica	yes	yes	yes	no
England & Wales	yes	yes	yes	no
France	yes	yes	yes	no
Guyana	yes	yes	yes	no
New Zealand	yes	yes	yes	no
Saint Lucia	yes	yes	yes	no
Scotland	yes	yes	yes	no
Trinidad & Tobago	yes	yes	yes	no
USA	yes	no	yes	no[2]

notes
[1]Deaths of Canadian residents 'in major U.S. States visited by Canadians' are included in mortality statistics.
[2]If the death of a U.S. resident abroad is registered in the USA it is included

What information about the cause of injury deaths, in addition to underlying cause E-codes, is available for further analyses?

Ten countries (9 of 11 ICE-1 countries) say that they have either a legal verdict or another indication of intent (manner of death check box or text), or both, stored electronically independent of the underlying cause e-code, and available for analysis.

Fourteen countries say that they have multiple cause codes, though in several the number of conditions coded is limited to four or five in total. These are useful for

investigating differences between countries in selecting the underlying cause from all the causes mentioned on the certificate. For example, Wet ICE[9] has used these data to explore differences in deaths from drowning.

Table 12

Country	Verdict	Manner of Death	Narrative	Autopsy	Multiple cause codes
Israel	No	No	No	No	No
Saint Lucia	No	No	No	No	No
Norway	Yes	Yes	No	Yes	No
Canada	Yes	Yes	Yes	Yes	No
Belize	No	No	No	No	Yes
Dominica	No	No	No	No	Yes
Jamaica	No	No	No	No	Yes
Scotland	No	No	No	No	Yes
Trinidad & Tobago	No	No	No	No	Yes
France	Yes	Yes	No	No	Yes
England & Wales	Yes	Yes	Yes	No	Yes
Australia	Yes	No	No	Yes	Yes
Denmark	No	Yes	No	Yes	Yes
Netherlands	No	Yes	No	Yes	Yes
Guyana	No	No	Yes	Yes	Yes
New Zealand	Yes	No	Yes	Yes	Yes
USA	No	Yes	Yes	Yes	Yes
Sweden	Yes	Yes	Yes	Yes	Yes
	Verdict	**Manner of Death**	**Narrative**	**Autopsy**	**Multiple cause codes**
Number of countries with item available	7	8	6	9	14

Though nine countries have some record of autopsy available for analysis, in most of these it is only whether an autopsy was performed, or whether information from it was used in certifying the cause of death. New Zealand and some parts of Australia have much more detail of autopsy findings available for analysis on some or all injury deaths.

Free text from the cause of death and /or description of how the injury occurred ('narrative') has been used in several countries to improve the detail or accuracy of their

own data (for example finding deaths from poisoning with a particular drug,[7] deaths where drowning was mentioned but not assigned as the underlying cause,[9] and cases where tractors[11] or machinery were mentioned). However, some research is needed on how best to use stored narrative information to improve comparability.

Where do we go from here?

We have shown that there are substantial differences in the ways in which injury mortality rates are arrived at in the countries participating in the ICE on injury statistics. We have not yet measured the size of these effects, or how far they might bias comparisons of injury mortality between countries.

The answers to our questionnaires suggest that we could calculate more comparable injury mortality rates across participating countries. Additional information, which we already collect in our national registration systems, could be used to extract comparable data sets in each country.

Recommendations on how the ICE on Injury could produce more comparable injury mortality rates for participating countries include:

Define a uniform set of inclusion and exclusion criteria for deaths

- All injury deaths which occur in the country
- Residents and non-residents identified separately
- [probably not possible to get data from all countries on deaths of their residents abroad]

Agree denominators – resident population

Improve completeness and accuracy

- Include deaths registered too late for inclusion in publications
- Use latest amended cause of death
- Identify 'unknown cause' deaths which may be injury deaths

Make use of additional variables which are available

- Manner of death/verdict
- Multiple cause codes
- Uses of Literal text and narrative text needs to be explored
- Autopsy

Recalculate comparable 'best estimates' for participating countries of

- Total injury mortality rates
- Mortality rates for specific mechanisms and intents
- Including deaths of resident population in home country only
- And including deaths of non-residents

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