IMPROVING CAUSE OF DEATH INFORMATION

Improving the quality of cause of death data in hospitals

CRVS development series 1
April 2017
About this series

CRVS developments

CRVS developments are the primary knowledge products of the Civil Registration and Vital Statistics Improvement Group, Bloomberg Philanthropies Data for Health Initiative at the University of Melbourne. Easily accessible, they collectively form a lasting repository of knowledge generated under the Bloomberg Philanthropies Data for Health Initiative based on in-country experience. They are intended to stimulate debate and promote the adoption of best practice in civil registration and vital statistics (CRVS) in partner countries and worldwide.

The series focuses on a range of knowledge gaps, new tools, methods and approaches, and raises and debates fundamental issues about the orientation, purpose and functioning of CRVS systems. Generally, they contain more detailed information than an academic paper, are written in less-academic language, and are intended to inform health system dialogue in and between countries and a range of development partners.

Other products available from the Civil Registration and Vital Statistics Improvement Group, Bloomberg Philanthropies Data for Health Initiative

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Country experiences describe the methods and findings of CRVS activities in partner countries implemented under the Bloomberg Philanthropies Data for Health Initiative. The series also reports on work in progress, particularly for large or complex initiatives, or on specific components of projects that may be of more immediate relevance to stakeholders.

The series serves to describe the state of CRVS systems in partner countries, and provides a baseline for comparison between countries and over time. It also provides a preliminary diagnostic analysis for use by countries in highlighting areas needing improvement.

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Capacity-building resources and tools are designed to assist countries improve their systems and to influence and align CRVS practice in countries with established international or best-practice standards. These products are being created and disseminated to help countries develop critical CRVS capacity among technical officers and ministries.

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Acronyms and abbreviations

COD cause of death
CRVS civil registration and vital statistics
ICD International Classification of Diseases
UCOD underlying cause of death
## CONTENTS

Acronyms and abbreviations .......................................................... iii
Executive summary ........................................................................... v

### Background

- Cause of death data ................................................................. 1
- Responsibilities ........................................................................... 1
- Medical certificates .................................................................... 2
- This report .................................................................................. 2

### National and regional strategies

- Establish a national stakeholder group or committee ................. 3
- Introduce the International Form of Medical Certificate of Cause of Death ..................................................... 3
- Code causes of death according to the International Classification of Diseases .................................................... 4

### Medical education and training strategies

- Develop training curricula and materials ................................. 5
- Train doctors ............................................................................. 6
- Train trainers ............................................................................ 6

### Hospital strategies

- Establish clinical audit committees ........................................ 7
- Measure and monitor the quality of medical certification .... 7
- Improve medical record systems ............................................. 9

### Annexes

- Annex 1: International Form of Medical Certificate of Cause of Death ................................................................. 10
- Annex 2: Medical certificate of cause of death assessment tool .................................................................................. 11
- Annex 3: Recommended framework for an initial clinical record review ................................................................. 12
- Annex 4: Selected findings based on reported misclassification matrices for causes of hospital deaths in four countries ........................................................................................................ 13

Bibliography .................................................................................. 15
Executive summary

Understanding the causes of death, and identifying patterns and aetiologies are important parts of any country’s healthcare system. Cause of death (COD) data are used to study the distribution of disease, to monitor and implement public health programs, and to help determine the allocation of resources. Ideally, analyses are based on the underlying cause of death (UCOD), which is recorded on the International Form of Medical Certificate of Cause of Death (often referred to as the ‘medical certificate’), published by the World Health Organization.

Unfortunately, the UCOD for hospital deaths is misclassified in many countries. This is often because doctors have not been trained in complete and accurate record taking, because their duties are seen to have ended with the death of the patient, or because they do not understand the fundamental importance of COD data in determining health policy and the allocation of resources.

This report provides guidance on how to improve the quality of COD data in hospitals. It will be useful for ministry of health staff, hospital administrators and managers, medical society officers, medical education leaders, and doctors. The report discusses three areas in which action can be taken to improve COD data: national and regional, medical education and training, and hospitals.

RECOMMENDED STRATEGIES TO IMPROVE CAUSE OF DEATH DATA IN HOSPITALS

Recommended national and regional strategies include:

- establish a national stakeholder group or committee to provide leadership and coordination between healthcare organisations, medical schools and government
- introduce the International Form of Medical Certificate of Cause of Death to standardise reporting and collect complete and accurate information
- code CODs according to the International Classification of Diseases to standardise reporting and allow comparison between hospitals, regions and countries.

Recommended medical education strategies include:

- develop training curricula and materials on accurate medical certification of cause of death for medical schools and continuing professional education
- train doctors throughout their career, using face-to-face, online and printed strategies and materials
- train trainers to ensure education is up to date and presented by knowledgeable and experienced people.

Recommended hospital strategies include:

- establish clinical audit committees to lead and monitor change within hospitals
- measure and monitor the quality of medical certification, including both assessing medical certificates to ensure completeness, and reviewing medical and clinical records to ensure accuracy
- improve medical record systems to ensure records can be easily retrieved.

Further information: mspgh.unimelb.edu.au/dataforhealth#resources
Background

Good patient care does not stop with death. Understanding the causes of death, and identifying patterns and aetiologies are important parts of any country's healthcare system. This report aims to ensure that healthcare systems can learn from each death by collecting accurate data and standardising reporting.

CAUSE OF DEATH DATA

Cause of death (COD) data are vital information collected by healthcare systems. It is used to:

- study the distribution of disease
- monitor and implement public health programs
- help determine the allocation of resources.

The accurate collection of COD data is an important step towards better population-level data, because many countries rely on hospitals and other health facilities for mortality statistics. Hospitals can also benefit from improved mortality statistics by seeing the causes of deaths in their facility, studying case fatality rates, or by analysing data by patient factors such as place of residence.

Analyses should be based on the underlying cause of death (UCOD), which is recorded on the International Form of Medical Certificate of Cause of Death (often referred to as the 'medical certificate') (see Annex 1).

The CODs recorded on the medical certificate are 'all those diseases, morbid conditions or injuries which either resulted in or contributed to death and the circumstances of the accident or violence which produced any such injuries' (World Health Organization 1967).

The UCOD is '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' (World Health Organization 2016).

RESPONSIBILITIES

It is important that the collection of COD data and the completion of the medical certificate are seen as integral parts of patient care.

Unfortunately, it is not uncommon for the clinical team to lose interest in the case if the patient dies. Consequently, key information may be omitted from the clinical record. In addition, it is often a junior doctor who is asked to complete the medical certificate, yet they may not be the one who attended the patient and may be the least equipped to establish the cause of death and write the certificate.

To emphasise the continuing responsibility of the medical community to recently deceased patients, we suggest the following slogan, which can be used in advocacy and training programs in hospitals:

We owe it to the dead to accurately record their passing.
MEDICAL CERTIFICATES

The medical certificate of COD is usually written by the doctor who attended the deceased patient or who is sufficiently familiar with the medical history of the patient to be confident of knowing the COD.

To fill in a medical certificate correctly, the physician must first identify the disease leading directly to death and then trace the sequence of events back to the UCOD. Other diseases contributing to death are entered in a second part of the form (Figure 1).

However, this process is quite different from the logic that the doctor uses to make clinical diagnoses, which are the basis for patient management. In addition, few doctors have been trained in medical certification. Because of these factors, there has been extensive misclassification of the UCOD in deaths reported by hospitals from all parts of the world (Rampatige et al. 2014a).

It is not difficult to teach doctors how to certify accurately, but it can be difficult to have them sustain the practice over the longer term. Also, because of the high turnover of junior doctors, there is a need for continuous retraining. Furthermore, because of the hierarchical nature of clinical hospital practice, unless senior doctors can be persuaded to actively support good certification practices, junior doctors will not change their behaviour.

Part of the role of medical professional bodies must be to stress the fundamental importance of UCOD data in determining health policy and the allocation of resources, and to convince doctors of the need for reform.

Figure 1: International Form of Medical Certificate of Cause of Death

<table>
<thead>
<tr>
<th>Frame A: Medical data: Part 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Report disease or condition directly leading to death on line a</td>
</tr>
<tr>
<td>b Report chain of events in due to order (if applicable)</td>
</tr>
<tr>
<td>c State the underlying cause on the lowest used line</td>
</tr>
<tr>
<td>d</td>
</tr>
<tr>
<td>2 Other significant conditions contributing to death (time intervals can be included in brackets after the condition)</td>
</tr>
</tbody>
</table>


THIS REPORT

This report provides guidance on how to improve the quality of COD data in hospitals. It will be useful for ministry of health staff, hospital administrators and managers, medical society officers, medical education leaders, and physicians. It will also be of interest to stakeholders involved in planning and strengthening civil registration and vital statistics systems, because it provides overall guidance on the steps required in improving hospital data.

The report discusses three areas in which action can be taken to improve COD data: national and regional, medical education and training, and hospitals.
National and regional strategies

Leadership should be taken at a national or regional level, to ensure that all stakeholders understand the importance of COD data and are supported in their own strategies to improve data collection. This section describes three key strategies that can be used to establish and promote national and regional leadership.

ESTABLISH A NATIONAL STAKEHOLDER GROUP OR COMMITTEE

Establishing a national stakeholder group or committee is one of the most important national strategies to implement.

A national stakeholder committee should include representatives of:

- data users – civil registry, statistics, ministry of health
- data collectors – hospitals, clinics
- organisations responsible for education and standards – medical schools, professional organisations, specialist training and accreditation organisations, continuing education organisations.

Committee members should not only represent opinions from within their organisations, they should be prepared to lead appropriate change within their organisation. Small working groups within the committee should be responsible for developing a national strategy for communication with the medical profession, and for monitoring and evaluation.

Although specific objectives of the committee will depend on country context and activities, the roles of the committee may include:

- providing leadership on matters related to improving mortality and COD information
- assisting in producing valid, reliable, relevant, timely and accurate mortality information to improve the quality of patient care and provide evidence-based decision-making
- promoting policy reform and development in line with international best standards for mortality and COD information
- coordinating, monitoring and ensuring there is alignment of interventions aimed at improving mortality and COD information with government priorities, policies and strategies
- strengthening interagency mechanisms for reporting of deaths and COD
- creating a national plan for certification improvement
- establishing standards for certification training as part of continuing medical education
- including certification quality as a reportable quality metric for hospitals
- establishing a national stakeholders group with broad representation and oversight
- establishing working groups to oversee the implementation of each of the interventions
- supporting relevant ministries and agencies to improve processes for timely information and data sharing.

INTRODUCE THE INTERNATIONAL FORM OF MEDICAL CERTIFICATE OF CAUSE OF DEATH

Standardising the form used to collect COD data will immediately and significantly improve data collection.

The International Form of Medical Certificate of Cause of Death, published by the World Health Organization, requires the doctor to describe the sequence of causal events that led to death, and by so doing establish the UCOD. If the medical certificate is not in use, then the country is unable to code UCOD.

The 2016 version of the medical certificate (see Annex 1) contains sections for recording additional details on other medical data relating to the death and for describing the manner of death, and standardised questions for recording information on foetal or infant deaths, and maternal or pregnancy-related deaths.
CODE CAUSES OF DEATH ACCORDING TO THE INTERNATIONAL CLASSIFICATION OF DISEASES

If the medical certificate is to be introduced into a country, then it is important to also introduce standardised mortality coding (Health Information Systems Knowledge Hub 2013).

The International Classification of Diseases (ICD) has been developed by the World Health Organization as the global standard classification of diseases, injuries, and other morbid conditions. The current edition is titled *International statistical classification of diseases and related health problems, tenth revision* (ICD-10):

- Volume I contains the structured classification of disease conditions that provides the basis for coding
- Volume II provides coding rules
- Volume III contains an index of disease conditions.

Hospitals can code and report on deaths in two ways:

- by coding medical certificates of COD (mortality coding)
- in the form of hospital death discharge data used to establish case fatality rates (morbidity coding).

Coding is an essential function to enable the use of mortality data. Discharge data do not usually use correct COD coding principles and are not suitable for public health purposes such as disease prevention.

It is therefore recommended that hospitals use ICD-10 to code medical certificates of COD.

Coding is mostly carried out in medical records departments or national statistics offices, and must be carried out by coders specifically trained in the coding of medical certificates. To ensure there are enough trained coders and that they are situated where they are needed, it will be important to:

- understand the flow of mortality data
- identify the coding workforce, including current training, qualifications and distribution
- develop a training or retraining strategy for mortality coders
- plan the optimal distribution of mortality coders within the overall context of hospital morbidity and mortality coding.

Alternatively, some countries may wish to automate their coding.

Iris is an automatic system for coding multiple CODs and for the selection of the UCOD according to the ICD-10 rules. The aims of Iris are to:

- provide a system in which the language-dependent aspects are separated from the software itself (to allow for modification by different countries)
- improve international comparability.

Although the literature on the use of Iris is limited, early studies show promise. In Brazil, for example, Iris was able to automatically code COD in 94 per cent of death certificates (Martins & Buchalla 2015), and a study in France showed 92 per cent of deaths could be automatically coded (Lamarche-Vadel et al 2014). The remaining certificates required an experienced mortality coder to select the UCOD.
Medical education and training strategies

Because doctors are the ones who collect COD data, it is essential that they have the understanding and skills needed to ensure the data are as accurate and complete as possible. Three strategies will be needed to ensure doctors are trained and remain vigilant in their practice.

DEVELOP TRAINING CURRICULA AND MATERIALS

Educational programs on medical certification of COD should aim to provide doctors with:

- knowledge of the importance of medical certification for public health policy and practice
- the necessary skills to complete a medical certificate
- the attitude that correct medical certification is an essential part of clinical practice.

In many countries, the training on certification of COD provided to medical school students is inadequate, and most students only receive minimal training in their final years (Walker et al 2011). As well as a lack of time dedicated to the topic, the medical curriculum is often taught from the viewpoint of legal or forensic medicine, rather than of the public health importance of the practice (Rampatige et al 2009). This can affect the information that doctors collect in COD certificates.

It is recommended that an up-to-date training component on medical certification of COD be developed and included in medical school curricula. It is also recommended that continuing education modules be developed and offered regularly as in-service training. Certification should be assessed as part of continuing medical education for practising doctors.

It is important that standard training material on COD certification are also developed. Training materials become templates for practice (i.e. the equivalent of standard operating procedures). Training materials may include:

- a manual for trainers
- a handbook for doctors
- case studies
- a set of PowerPoint slides for presentation at workshops.

Further information: A sample handbook for doctors on cause of death certification is available at: mspgh.unimelb.edu.au/dataforhealth/resources/cause-of-death-information
TRAIN DOCTORS

Training doctors in medical certification of COD and sustaining behavioural change is an extended exercise in capacity building. It is the responsibility of both medical schools (through undergraduate and postgraduate education) and of hospitals (through continuing education).

Research indicates that interactive or practical workshops and seminars are more likely to lead to sustained behavioural change compared with online learning or distributing printed materials (Aung et al 2010).

We recommend initial face-to-face teaching for medical schools and in-service training. However, online and printed materials should also be available for reference and to reinforce learning. Online learning may be appropriate for reaching wide numbers of physicians and for reinforcing face-to-face learning.

TRAIN TRAINERS

Education and training should be presented by trained and experienced trainers. It is therefore important that trainers are trained and supported with standard training materials.

Preferably, trainers will be doctors. They need the skill to adjust training methods to different audiences and circumstances. Table 1 indicates the need for different topic emphases according to the audience, including the specific, additional topics required for training of trainers.

Table 1: Indicative emphasis on training components for medical certification of deaths by audience

<table>
<thead>
<tr>
<th>Training component</th>
<th>Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MoH</td>
</tr>
<tr>
<td>Uses of UCOD data</td>
<td>+++</td>
</tr>
<tr>
<td>Principles of certification</td>
<td>+</td>
</tr>
<tr>
<td>Certification rules</td>
<td>-</td>
</tr>
<tr>
<td>Legal and ethical issues</td>
<td>-</td>
</tr>
<tr>
<td>National training strategy</td>
<td>+++</td>
</tr>
<tr>
<td>Quality assurance</td>
<td>-</td>
</tr>
<tr>
<td>Review and development of training strategies</td>
<td>-</td>
</tr>
<tr>
<td>Pre- and post-training assessments</td>
<td>-</td>
</tr>
<tr>
<td>Conducting workshops and seminars</td>
<td>-</td>
</tr>
<tr>
<td>Adapting training by target audience</td>
<td>-</td>
</tr>
</tbody>
</table>

MoH = ministry of health; UCOD = underlying cause of death
Hospital strategies

Hospitals are the front line of COD data collection. Their policies and processes have a direct impact on the data collected, and there are three strategies that hospitals can use to improve data accuracy and consistency.

ESTABLISH CLINICAL AUDIT COMMITTEES

To make sustainable improvements in COD certification in hospitals, we recommend the creation of clinical audit committees that oversee the quality of clinical records and of medical certification of COD, and relate these to requirements for training in medical certification of COD as part of accreditation processes.

Although a national strategy forms an important foundation, each hospital will also need to make a sustained cultural change to improve COD data collection. Clinical audit committees are vital to achieving this.

The roles of the committee may include:

- establishing a regular cycle of audit for clinical records and medical certification of COD, including standard operating procedures
- ensuring that clinical audit activity is meeting various requirements as set out by the national stakeholder group or committee, and is in line with international best practice
- developing a system for reporting and disseminating results from the audit process
- ensuring that there are effective processes and systems in place to enable healthcare professionals to participate in clinical audits
- ensuring that clinical audits are leading to measurable benefits for staff and patients
- reviewing the systems of clinical governance, monitoring that they operate effectively and ensuring that action is being taken to address any areas of concern.

MEASURE AND MONITOR THE QUALITY OF MEDICAL CERTIFICATION

There are two parts to measuring the quality of medical certification of cause of death:

- assessing whether the medical certificates have been correctly filled in by the doctor
- reviewing the medical and clinical records to determine whether the correct UCOD has been recorded.

Assessing medical certificates

Medical certificates should be reviewed by experienced coders or doctors who have been trained to evaluate medical certificates. The reviewer should not deal directly with the doctor who wrote the certificate. The results should be reported to the clinical audit committee. If the UCOD needs to be revised, the committee should ask the certifying doctor to correct and re-issue the medical certificate. The rest of the data should be checked to monitor quality and to feed back into training programs.

Further information: Medical certificate of cause of death assessment tool is available in Annex 2.
Reviewing medical and clinical records

The medical record contains all the information about a patient generated as part of a hospital admission and stay. The clinical record is the doctor’s contribution to the medical record, and it is focused on clinical diagnoses, signs and symptoms.

An important part of assessing the quality of the medical certification of COD is to ask whether the clinical record contained within the medical record justifies the assigned UCOD (ie whether there is sufficient information in the record to make a diagnosis and whether, in the opinion of trained reviewers, the UCOD is the correct diagnosis).

Doctors are trained in the initial evaluation of the patient but are not necessarily trained in the maintenance of good records or in the logic of the record, which should justify a series of diagnostic steps, as follows:

- patient admission to hospital
  - presenting symptoms
  - clinical history and physical examination

- provisional diagnoses
  - what possible conditions is this person suffering from?
  - what do we treat?
  - how do we investigate?

- main condition
  - what condition necessitated admission, or, if more than one condition, what condition was responsible for the greatest use of resources?
  - analysis of the use of resources; funding models
  - case fatality rate and mortality indexes

- UCOD (medical certificate)
  - disease prevention
  - public health policy and planning, including the prevention of future premature deaths because of certain causes.

Points to cover in the review of clinical records are whether the:

- admission notes and discussion of differential diagnosis are complete
- results of any investigations are in the record, including visual inspection during surgical procedures and results from tissue biopsies
- clinicians drew the appropriate conclusions
- record contains comments on the course of the illness in hospital in relationship to diagnosis.

Further information: A recommended framework for an initial clinical record review is available in Annex 3.
The assessment of the accuracy of UCOD should be based on pre-set diagnostic criteria and a misclassification matrix, which can be a powerful tool for analysing the quality of records and certification of UCOD (Rampatige et al 2013, 2014b). The development of the matrix is likely to require expert technical input.

A clinical record review and the development of a misclassification matrix may also be the necessary first steps to convince the ministry of health and the medical profession that poor quality of medical certification is a problem that needs to be addressed (Rampatige et al 2014a).

The misclassification matrices produced in a nationally representative study can also be used to derive a series of correction factors that can be applied to COD data to estimate the probable true COD pattern in the country. In Thailand, for example, cause-specific mortality fractions that had been corrected in this manner were applied to the numbers of registered deaths in 2005 – which had been adjusted for underreporting – to estimate the probable true pattern of COD in the country. For some CODs, such as human immunodeficiency virus infection/acquired immunodeficiency syndrome and ischaemic heart disease, the corrected numbers of deaths in the study were three to four times higher than the numbers recorded in the vital registration system – with huge implications for Thailand’s health policies (Rampatige et al 2014b). These measurements can be applied to assess accuracy of COD certification and coding before and after training, or as part of the ongoing monitoring of the quality of medical certification in hospitals.

Further information: Additional examples of misclassification matrices and findings from medical record reviews are provided in Annex 4.

IMPROVE MEDICAL RECORD SYSTEMS

The capacity to store and retrieve records is basic to continuing patient management and to correct diagnoses. When records cannot be retrieved easily or at all, maintaining an accurate and complete clinical record becomes difficult or impossible.

Improving medical record systems requires collaboration between government agencies, technical partners and funders (World Health Organization 2002). Key activities for improving medical records management may include:

- conducting a situation analysis to understand factors leading to poor medical records management (Teviu et al 2012, Ajami et al 2015)
- assessing the availability of physical storage for records
- developing policy for the retention of records
- establishing a numbering system that facilitates retrieval and storage of records (eg serial unit numbering, terminal three-digit filing)
- introducing a medical records number (MRN) if not in use
- introducing a master patient index based on the MRN (this should be an electronic system)
- defining tasks for records clerks in admissions, the wards and the medical record unit itself
- planning a system changeover to electronic records (this will need expert technical input).

Medical records systems are often overloaded and constrained by limitations of space and personnel. Upgrading record systems must also take these two factors into account. Although the introduction of electronic records is an attractive option, paper-based systems need to be well established before making the transition. Also, for many countries, paper-based systems will remain in place for many years.
Annex 1: International Form of Medical Certificate of Cause of Death

### Administrative Data (can be further specified by country)

<table>
<thead>
<tr>
<th>Sex</th>
<th>☐ Female</th>
<th>☐ Male</th>
<th>☐ Unknown</th>
</tr>
</thead>
</table>

| Date of birth | D D M M Y Y Y Y | Date of death | D D M M Y Y Y Y |

### Frame A: Medical data: Part 1 and 2

1. Report disease or condition directly leading to death on line a
2. Report chain of events in due order (if applicable)
3. State the underlying cause on the lowest used line
   - a
   - b Due to:
   - c Due to:
   - d Due to:

2. Other significant conditions contributing to death (time intervals can be included in brackets after the condition)

### Frame B: Other medical data

- Was surgery performed within the last 4 weeks? ☐ Yes ☐ No ☐ Unknown
- If yes please specify date of surgery D D M M Y Y Y Y
- If yes please specify reason for surgery (disease or condition)
- Was an autopsy requested? ☐ Yes ☐ No ☐ Unknown
- If yes were the findings used in the certification? ☐ Yes ☐ No ☐ Unknown
- Manner of death:
  - Disease
  - Assault
  - Could not be determined
  - Accident
  - Legal intervention
  - Pending investigation
  - Intentional self harm
  - War
  - Could not be determined
- If external cause or poisoning: Date of injury D D M M Y Y Y Y
- Please describe how external cause occurred (If poisoning please specify poisoning agent)
- Place of occurrence of the external cause:
  - At home
  - Residential institution
  - School, other institution, public administrative area
  - Sports and athletics area
  - Street and highway
  - Trade and service area
  - Industrial and construction area
  - Farm
  - Other place (please specify): ☐ Unknown
- Fetal or infant Death
  - Multiple pregnancy ☐ Yes ☐ No ☐ Unknown
  - Stillborn? ☐ Yes ☐ No ☐ Unknown
  - If death within 24h specify number of hours survived
  - Birth weight (in grams)
  - Number of completed weeks of pregnancy
  - Age of mother (years)
  - If death was perinatal, please state conditions of mother that affected the fetus and newborn
  - For women, was the deceased pregnant? ☐ Yes ☐ No ☐ Unknown
  - At time of death ☐ Within 42 days before the death
  - Between 43 days up to 1 year before death ☐ Unknown
  - Did the pregnancy contribute to the death? ☐ Yes ☐ No ☐ Unknown

Annex 2: Medical certificate of cause of death assessment tool

DEATH CERTIFICATE DETAILS

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Country:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hospital name:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Place of death:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Certifier:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reference no.:</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GENERAL DETAILS ABOUT THE DECEASED

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age at death:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age group:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender:</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A correctly filled death certificate has none of the following errors. Did the certificate have:

<table>
<thead>
<tr>
<th>Error type</th>
<th>Yes</th>
<th>No</th>
<th>Unsure due to illegible handwriting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Multiple causes per line</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Time interval between onset and death was blank</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Blank lines within the sequence/chain of events (not using consecutive lines)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Abbreviations used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Illegible hand writing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Incorrect/clinically improbable sequence of events leading to death</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. An ill-defined condition entered as the underlying COD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ If yes, was the ill-defined condition:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Impossible underlying cause (ie signs and symptoms)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Intermediate cause</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Mode of dying (ie respiratory arrest)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Unspecified causes within a larger death category (ie unspecified accident)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Other – specify:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Were there additional errors on the certificate?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ If yes, select all those that apply:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– For deaths due to external causes, additional details were missing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– For deaths due to neoplasms, additional details were missing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Changes/alterations made by any means other than drawing a line through the original text (ie using correction fluid)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– No units specified for the age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Other – specify:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Overall, was the medical certificate of COD correctly filled-in?
Annex 3: Recommended framework for an initial clinical record review

1. **Select hospital(s) to be reviewed**
   a. Determine scope of investigation
   b. Get agreement for hospital cooperation
   c. Census of available diagnostic facilities in included hospitals

2. **Select sample medical certificates**
   a. Determine sample size
   b. Determine the sampling method and identify the number of medical certificates to be included in the study
   c. Draw the sample of medical certificates from the vital registration database/hospital mortality register
   d. Retrieve corresponding medical records from the hospitals
   e. Validate the quality of ICD coding for the sample

3. **Develop standard diagnostic criteria (SDC) for major CODs**
   a. Set up a small expert group of physicians to develop SDC
   b. Decide which diseases to define criteria for
   c. Develop and pilot diagnostic criteria on sample

4. **Select physicians to re-diagnose COD**
   a. Provide training in COD certification

5. **Trace the relevant medical records**
   a. Decide on criteria to assess the quality of the records
   b. Decide on rules to determine which records can be used and which are too incomplete
   c. Reassess the sample size and losses because of poor or untraceable records
   d. Prepare a summary of medical records quality, availability and storage

6. **Review medical records**
   a. Design form for new medical certificate
   b. Establish COD using predefined SDC
   c. Develop a ‘new’ study medical certificate including identifying the UCOD
   d. Code the new COD according to ICD-10
   e. Check that coding is correct

7. **Compare the two CODs and analyse findings**
   a. Determine the extent of misclassification
   b. Draw up a misclassification matrix for all ages, both sexes (and by age and sex if numbers allow)
   c. Reassign the ill-defined causes based on the misclassification matrix
   d. Compare the new COD distribution of study cases with the original

8. **Write final report**
   a. Describe the study design and methodology
   b. Provide sample design and explanation
   c. Discuss findings and implications
   d. Propose improvement steps for COD certification, coding and medical records
Annex 4: Selected findings based on reported misclassification matrices for causes of hospital deaths in four countries

Source: Rampatige et al 2014b

CHINA
Rao et al have shown that ischaemic heart disease was undercounted in the official statistics by 31 per cent because of the systematic misclassification of true cases of ischaemic heart disease to stroke, diabetes, pneumonia or other forms of heart disease. Hepatitis deaths were found to be frequently misclassified to other liver diseases, and pneumonia was found to be excessively and often incorrectly selected from a list of respiratory diseases as the UCOD.

ISLAMIC REPUBLIC OF IRAN
Khosravi et al have found that the true COD pattern of the population was found to be considerably different from the pattern of causes reported by the vital registration system in the country. The ill-defined causes reported by the routine death registration system for many deaths among young and middle-aged adults were primarily reclassified, after review, to ischaemic heart disease, stroke and injuries. In half of the study sample, injury deaths had been classified as senility or unknown in the vital registration system – thus greatly underestimating the importance of external causes of hospital deaths. Ill-defined causes of death for people aged over 70 years were largely reclassified, after review, to ischaemic heart disease and stroke.

THAILAND
Pattaraarchachai et al also reported massive misclassification of major CODs. Cases of septicaemia – commonly reported in the vital registration system – were reassigned to cerebrovascular disease, human immunodeficiency virus infection/acquired immunodeficiency syndrome and pneumonia. Ill-defined causes were identified as true cases of ischaemic heart disease, other heart disease, chronic obstructive pulmonary disease or stroke. The study also found gross underdiagnosis of diabetes by the vital registration system.

SRI LANKA
Rampatige et al have revealed major misclassification errors in identifying deaths caused by vascular diseases or diabetes. Of the deaths caused by ischaemic heart disease, 30 per cent had been misclassified to diabetes or another heart disease, and 25 per cent of the deaths because of diabetes mellitus had been misclassified as various diseases of the circulatory system. An example of the misclassification matrix produced is in provided in Table 2.
Table 2: Misclassification of causes of death, all ages, both sexes combined, Colombo, Sri Lanka, 2012

<table>
<thead>
<tr>
<th>Vital registration</th>
<th>Diagnosis based on medical records review (no. of deaths)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagnosis</td>
<td>Certain infectious and parasitic diseases</td>
</tr>
<tr>
<td>Certain infectious and parasitic diseases</td>
<td>9</td>
</tr>
<tr>
<td>All cancers</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>3</td>
</tr>
<tr>
<td>Other diseases of the nervous system</td>
<td>2</td>
</tr>
<tr>
<td>Hypertensive diseases</td>
<td>4</td>
</tr>
<tr>
<td>Ischaemic heart diseases</td>
<td>2</td>
</tr>
<tr>
<td>Cerebrovascular diseases</td>
<td>0</td>
</tr>
<tr>
<td>Other heart diseases</td>
<td>1</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0</td>
</tr>
<tr>
<td>Chronic lower respiratory tract diseases</td>
<td>1</td>
</tr>
<tr>
<td>Other diseases of the respiratory system</td>
<td>0</td>
</tr>
<tr>
<td>Diseases of the liver</td>
<td>4</td>
</tr>
<tr>
<td>Diseases of the skin</td>
<td>0</td>
</tr>
<tr>
<td>External causes</td>
<td>3</td>
</tr>
<tr>
<td>All other causes</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
</tr>
</tbody>
</table>
Bibliography


The program partners on this initiative include: The University of Melbourne, Australia; CDC Foundation, USA; Vital Strategies, USA; Johns Hopkins Bloomberg School of Public Health, USA; World Health Organization, Switzerland.

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