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IMPROVING CAUSE OF DEATH INFORMATION

Improving the quality
of cause of death data
in hospitals

Technical Report 1
October 2016



About this series

Technical reports describe the methods and findings of CRVS activities in partner countries implemented under the 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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The series focuses on a range of knowledge gaps, new tools, methods and approaches, and raises and debates fundamental issues around the orientation, purpose and functioning of CRVS systems. Generally, working papers 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.

Resources and Tools

Capacity-building tools and guidelines are designed to influence and align civil registration and vital statistics practice in countries with established international standards.

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Acronyms and abbreviations

COD Cause of death

CRVS Civil registration and vital statistics

D4H Data for Health Initiative

ICD International Classification of Diseases

MoH Ministry of Health

MRR Medical record review

SDC Standard diagnostic criteria

UCOD Underlying cause of death

VA Verbal autopsy

Background

This document provides guidance on how to improve the quality of cause of death data in hospitals, and 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, as it provides overall guidance on the steps required in improving hospital data. This is an important step towards better population-level data, as many countries rely on hospitals and other health facilities for their mortality statistics. Hospitals themselves can also benefit from improved mortality statistics by seeing the distribution of facility deaths, studying case fatality rates, analysing data by place of residence of the decedent, and so on.


Cause of death (COD) data is 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 the Medical Certificate of Cause of Death (the *medical certificate*).

The causes of death 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 underlying cause of death 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).

It is assumed that the medical certificate of COD will have been written by a physician who attended the decedent during the terminal illness or who is sufficiently familiar with the medical history of the decedent to be confident of knowing the COD. In many countries these conditions pertain only to deaths in hospitals which, therefore, are the only detailed sources of information about COD. The most important alternative is a verbal autopsy (VA) interview, which is recommended for non-hospital deaths not attended by a physician.

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). This is quite different from the logic that the physician applies to making the clinical diagnosis, which is the basis for patient management. Because few physicians have been effectively trained in medical certification there has been extensive misclassification of the UCOD in deaths reported by hospitals from all parts of the world where the accuracy of hospital medical certificates has been studied (Rampatige, et al., 2014a). It is not difficult to teach physicians how to certify, but it is very difficult to have them sustain the practice over a longer term. Also, because of high turnover of junior hospital physicians, there is a need for continuous retraining. Furthermore, due to the hierarchical nature of clinical hospital practice, unless senior clinicians can be persuaded to actively support good certification practices, junior physicians will not change their behaviour. Part of the dialogue with 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 them of the need for reform.

Figure 1: International form of medical certificate of cause of death, Frame A: Medical data: Part 1 and 2 (World Health Organization, 2016)

Frame A: Medical data: Part 1 and 2				
1 Report disease or condition directly leading to death on line a Report chain of events in due to order (if applicable) State the underlying cause on the lowest used line			Cause of death	Time interval from onset to death
		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)		<hr style="border-top: 1px dashed black;"/>		

Should a patient die, it is not uncommon for the clinical team to lose interest in the case and consequently key investigations may be missing from the clinical record. The junior physician assigned the task of completing the medical certificate may not be the one who attended the patient and be the least well-equipped to establish the cause of death and write the medical certificate.

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

We owe it to the dead to record their passing with accuracy.

The interventions required to train physicians in medical certification of COD and to sustain behavioural change can be seen as an extended exercise in capacity building. It should be recognised that the training materials become templates for practice, ie the equivalents of standard operating procedures. We recommend that the heads of clinical units establish procedures for the monitoring of the quality of reporting COD information as outlined in this document.



National and regional strategies for improving COD data

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 needs to be broadly representative of data users (Civil Registry, Statistics, Ministry of Health) and of medical professional organisations relevant to the implementation of hospital improvements (bodies for specialist training and accreditation, bodies responsible for continuing medical education, medical schools and the hospitals themselves). Committee members should not only represent opinion from within organisations, they should themselves be agents of change. A small working group should be responsible for developing a national strategy for communication with the medical profession, and for monitoring and evaluation.

While specific objectives of the committee will depend on country context and activities, broad Terms of Reference may include:

- Coordinate, monitor, and ensure there is alignment of interventions aimed at improving mortality and cause of death information with government priorities, policies and strategies
- Assist in producing valid, reliable, relevant, timely, and accurate mortality information to improve the quality of patient care and provide evidence-based decision making
- Provide leadership on matters related to improving mortality and cause of death information
- Support strengthening of inter-agency mechanisms for reporting of deaths and cause of death
- Support relevant line ministries to ensure improved processes for the timely information and data sharing, including interoperability among existing and developing information technology (IT) systems
- Promote policy reform and development in line with international best standards for mortality and cause of death information
- Create a national plan for certification improvement
- Establish standards for certification training as part of continuing medical education
- Consider requirements for including certification quality as a reportable quality metric for hospitals.

Establish a national stakeholders group with broad representation and oversight

Establish working groups to oversee the implementation of each of the interventions

INTRODUCE THE INTERNATIONAL FORM OF THE MEDICAL CERTIFICATE OF COD

The International Form of the Medical Certificate of COD (medical certificate) requires the physician to describe the sequence of causal events that led to death and by so doing establish the UCOD. A revised version of the medical certificate was published in 2016 by the World Health Organization (see Annex 1), containing sections for recording additional details on other medical data relating to the death, description of the manner of death, and more standardised questions for recording information on foetal or infant deaths, and maternal or pregnancy-related deaths. If the International Form is not in use, then the country is unable to code UCOD. It follows that if the International Form is to be introduced into a country, then ICD-10 mortality coding should be introduced at the same time (Health Information Systems Knowledge Hub, 2013).

IMPROVE OR INTRODUCE MANUAL CODING, OR INTRODUCE AUTOMATED CODING (IRIS) OF MEDICAL CERTIFICATES

The International Classification of Diseases (ICD) has been developed by the World Health Organization (WHO) 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). The process of translating diagnoses from text to alphanumeric codes for the storage, retrieval and analysis of data is known as clinical coding.

Volume I of the ICD-10 contains the structured classification of disease conditions which provides the basis for coding; Volume II provides coding rules; and Volume III contains an index of disease conditions. Volume II sets out two different coding conventions. The first provides rules for the coding of the International Form of Medical Certification of COD; the second is for hospital discharges (including deaths), and sets out the rules for coding the main disease(s) that the patient was treated for. This is known as morbidity coding.

Note that there are two different ways that hospitals can code and report on deaths: 1) through coding of medical certificates of COD, in which case **mortality coders** need special training in the coding of medical certificates; and 2) in the form of hospital death discharge data used for establishing case-fatality rates (**morbidity coding**). Most reports on deaths from hospitals are based on discharge records and are morbidity coded: this is not consistent with correct cause of death coding principles and not suitable for public health purposes such as disease prevention.

Coding is an essential function to enable the use of mortality data, and is mostly carried out in medical records departments or national statistics offices. The best way to maintain communication between coders and physicians is through hospital clinical audit committees. In this respect there may be a trade-off between situating medical certificate coding centrally and in individual hospitals. Steps in the development of a strategy for coding include:

- Clarify the flow of mortality data
- Determine the ICD coding workforce: distribution, qualifications, training
- Develop a training/retraining strategy for mortality coders (international and national)
- Plan the optimal distribution of mortality coders within the overall context of hospital morbidity and mortality coding
- Train coders.

Iris¹ is an automatic system for coding multiple causes of death and for the selection of the underlying cause of death. The aim of Iris is twofold:

1. To provide a system in which the language-dependent aspects are separated from the software itself (to allow for modification by different countries).
2. To improve international comparability. Iris is based on the international death certificate provided by WHO in Volume II of the ICD-10 and the causes of death are coded according to the ICD-10 rules.

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

1 For more information, see <https://www.dimdi.de/static/en/klassi/irisinstitute/about-iris/>

Medical education strategies

DEVELOP TRAINING CURRICULUM

An educational program on medical certification of COD aims to provide physicians with knowledge of the importance of medical certification for public health policy and practice, the necessary skills to complete a medical certificate, and the attitude that correct medical certification is an essential part of clinical practice.

In many countries, the training on certification and COD provided to medical school students is considered inadequate, with most students only receiving minimal training in their final years (Walker, et al., 2011). As well as a lack of time dedicated to the topic, medical curriculum is often taught from the viewpoint of legal or forensic medicine, rather than on the public health importance of the practice (Rampatige, et al., 2009). To ensure the sustainability of any educational program, it is important that medical school curriculum be updated; in-service training is offered regularly; and certification is assessed as part of continuing medical education for practising physicians.

Hospital strategies

ESTABLISH CLINICAL AUDIT COMMITTEES

To make sustainable improvements in COD certification in hospitals, we recommend the creation of **clinical audit committees** that maintain continuing oversight of 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 is required, the level of intervention will need to be the individual hospital. Clinical audit committees are vital in helping to sustain the cultural change required in hospitals regarding improved certification of COD.

Broad Terms of Reference for such a committee may include:

- Establish a regular cycle of audit for clinical records and medical certification of COD, including standard operating procedures
- Ensure 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
- Develop a system for reporting and disseminating results from the audit process
- Ensure that there are effective processes and systems in place to enable healthcare professionals to participate in clinical audit
- Ensure that clinical audit is leading to measurable benefits for staff and patients
- Review the systems of clinical governance, monitoring that they operate effectively and that action is being taken to address any areas of concern.

TRAIN PHYSICIANS

While the literature is limited, available research indicates that interactive workshops and seminars with practicum are more likely to lead to sustained behavioural change compared to 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 for reinforcement of learning; online learning may also be appropriate for reaching wide numbers of physicians; potential trade-offs between intensity of learning and scalability should be considered. Teaching materials may include:

- Handbook for doctors on cause of death certification
- Workbook for training doctors on cause of death certification: case studies
- Accompanying set of power point slides for presentation at workshops.

The handbook is available at mispgh.unimelb.edu.au/dataforhealth

TRAINING OF TRAINERS

Preferably, trainers will be physicians. They need the skill to adjust training methods to different audiences and circumstances. This includes advocacy skills. Table 1 is indicative of the need for differential topic emphasis according to the audience, including the specific, additional topics required for training of trainers. Teaching materials should include a training of trainers manual, and accompanying materials.

Figure 2: Indicative emphasis on training components for medical certification of deaths by audience

Training component	Audience					
	MoH	Senior physicians	Junior physicians	Medical students	Educators	Trainers
Uses of UCOD data	+++	+++	+	++	+++	+++
Principles of certification	+	+++	+++	++	+++	+++
Certification rules	-	+	+++	+	+	+++
Legal and ethical issues	-	+++	+++	++	+	+++
National training strategy	+++	++	-	-	+++	+++
Quality assurance	-	++	+	+	+++	+++
Review and development of training strategies	-	-	-	-	-	+++
Pre- and post-training assessments	-	-	-	-	-	+++
Conducting workshops and seminars	-	-	-	-	-	+++
Adapting training by target audience	-	-	-	-	-	+++

MEASURE AND MONITOR THE QUALITY OF MEDICAL CERTIFICATION OF COD

There are two approaches to measuring the quality of medical certification of cause of death. The first is to determine whether the medical certificates have been correctly filled in by the physician, and the second involves review of the clinical record and determination of whether the correct UCOD has been recorded. A common finding from the clinical record review is that the records themselves are unsatisfactory. This in turn can and should lead to efforts to improve the quality of clinical records. We define the clinical record as the physician's contribution to the medical record, which contains all the information generated in the course of a hospital admission.

Medical record: contains all the information about a patient generated as part of a hospital admission and stay;

Clinical record: physician's contribution to the medical record, focused on clinical diagnoses, signs and symptoms

Have medical certificates been correctly filled out?

This question is best answered by experienced coders or physicians who have been trained to evaluate medical certificates. The assessment guide shown in Annex 2 requires the reviewer to identify any of the common errors encountered in medical certificates. It is not advisable for the reviewer to deal directly with the physician who wrote the certificate. The results should be reported to the clinical audit committee. If the UCOD needs to be reviewed, the committee should request the certifying physician to correct and re-issue the medical certificate. The rest of the data should be checked for plausibility and serve to monitor quality and to feed back into training programs.

More information on how to assess the quality of medical certification is included in 'Assessing the quality of death certification: Guidance tool', available at mospgh.unimelb.edu.au/dataforhealth

How can the quality of the physician contribution to the clinical record be improved?

Physicians are trained in the initial evaluation of the patient but are not trained in the maintenance of good records or in the logic of the record, which should justify a series of diagnostic steps. Diagnostic steps from the time of admission are shown in Box 1.

Box 1 The logic of the clinical record: Diagnostic steps in the course of a hospital admission

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 utilisation of resources; funding models
- Case fatality rate and mortality indexes

Underlying Cause of Death (Medical Certificate)

- Disease prevention
- Public health policy and planning including the prevention of future premature deaths due to certain causes

The fundamental question in the evaluation of the record is: does the record justify the series of clinical diagnoses culminating in the final diagnosis? The main condition (if ICD-coded in the hospital) is determined by the Medical Records Department and serves the purposes of administrators. Points to cover in the review are:

1. Completeness of the admission notes and of the differential diagnosis
2. Whether results of investigations are in the record and whether the clinicians drew the appropriate conclusions
3. Comment on the course of the illness in hospital in relationship to diagnosis
4. Diagnostic conclusions from visual inspection during surgical procedures and results from tissue biopsies.

Medical records review

An important part of assessing the quality of the medical certification of cause of death is to ask whether the clinical 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. This requires an assessment of the quality of the clinical record based on pre-set diagnostic criteria and leads to the development of a misclassification matrix. This is not a trivial exercise and is likely to require expert technical input. It involves re-training of the reviewing physicians in medical certification of COD and needs to set standards for clinical diagnosis and record review (Annex 3). It is a powerful tool for advocacy and in analysing the quality of records and certification of UCOD (Rampatige, et al., 2014b) (Rampatige, et al., 2013). A clinical record review and the development of a misclassification matrix may be the necessary first steps in the implementation of the intervention 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 be used to derive a series of correction factors that can be applied to routine COD data to estimate the probable true COD pattern in the study 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 COD, 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-fold higher than the numbers recorded in the vital registration system – with huge implications for Thailand’s health policies (Rampatige, et al., 2014b). Additional examples of findings from misclassification studies are provided in Annex 4. These measurements can be applied to assess accuracy of cause of death certification and coding before and after training, or as part of the on-going monitoring of quality of medical certification in hospitals.

A **medical record review** (MRR) refers to any study that uses pre-recorded, patient-focused data as the primary source of information to answer a specific research question. The sources of information may include: the clinical record (often made up of physician and nursing notes, diagnostic tests); ambulance call reports; administrative records; and/or databases (Worster & Haines, 2004). The purpose of most MRRs is to identify the degree of **misclassification** of cause of death at the individual level, by comparing the hospital or vital registration diagnosis with a reference diagnosis based on a review of the deceased’s medical records (Rampatige, et al., 2014b).



IMPROVE MEDICAL RECORD SYSTEMS

This is a major intervention in its own right and requires collaboration between government agencies, technical partners and funders (World Health Organization, 2002). The capacity to store and retrieve records is basic to continuing patient management and to correct diagnosis. When records cannot be retrieved easily or at all, maintaining an accurate and complete clinical record becomes difficult or impossible. Medical records systems are generally overloaded and constrained by limitations of space and personnel. To be practicable, upgrading of record systems must 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.

The World Health Organization has developed a manual on medical records management², which aims to help medical and health record workers in developing countries to develop and manage the medical record/health information service in an effective and efficient manner. It does not provide all the options for medical records management, but it does provide one option in each of the key areas for medical records management. Overall, key activities for improving medical records management may include:

- Conduct a situation analysis to understand factors leading to poor medical records management (Teviu, et al., 2012) (Ajami, et al., 2015)
- Assess the availability of physical storage for records
- Develop policy for the content, retention of records
- Establish a numbering system that facilitates retrieval and storage of records (ie serial unit numbering, terminal three-digit filing)
- Introduce a Medical Records Number (MRN) if not in use
- Introduce a Master Patient Index based on the MRN (this should be an electronic system)
- Define tasks for records clerks in admissions, the wards, and the medical record unit itself
- Plan a system changeover to electronic records (this will need expert technical input).

2 Available at <http://www.wpro.who.int/publications/docs/MedicalRecordsManual.pdf>

Summary

Cause of death (COD) data is 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 the Medical Certificate of Cause of Death (the *medical certificate*).

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. Because few physicians have been trained in medical certification there has been extensive misclassification of the UCOD in deaths reported by hospitals from all parts of the world where the accuracy of hospital medical certificates has been studied. It is not difficult to teach physicians how to certify, but to make the training sustainable it has to be integrated into the curricula of medical schools. Part of the dialogue with 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 them of the need for reform.

To make sustainable improvements in COD certification in hospitals, it is recommended to create a clinical audit committees in hospitals that maintain continuing oversight of 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. The other core interventions also proposed include: introducing the ICD and international form of medical certificate of cause of death; educating physicians on medical certification; measuring and monitoring the quality of medical certification; and improving or introducing manual or automated coding, depending on the current system.

The interventions required to train physicians in medical certification of COD and to sustain behavioural change can be seen as an extended exercise in capacity building. It should be recognised that the training materials become templates for practice, ie the equivalents of standard operating procedures. We recommend that the heads of clinical units establish procedures for the ongoing monitoring of the quality of reporting COD information as outlined in this document.



Bibliography

- Ajami, S., Ketabi, S., Sadeghian, A. & Saghaeinejad-Isfahani, S., 2015. Improving the medical records department processes by lean management. *Journal of Education and Health Promotion*, Volume 4, p. 48.
- Aung, E., Rao, C. & Walker, S., 2010. Teaching cause-of-death certification: Lessons from international experience. *Postgraduate Medical Journal*, Issue 86, pp. 143-152.
- Health Information Systems Knowledge Hub, 2013. *Introducing the International Statistical Classification of Diseases in countries: Guidelines for implementing cause-of-death certification, morbidity and mortality coding*. Brisbane: The University of Queensland.
- Lamarche-Vadel, A. et al., 2014. Automated comparison of last hospital main diagnosis and underlying cause of death ICD10 codes, France, 2008-2009. *BMC Medical Informatics and Decision Making*, Volume 14, pp. 14-44.
- Martins, R. & Buchalla, C., 2015. Automatic coding and selection of causes of death: an adaptation of Iris software for using in Brazil. *Revista Brasileira de Epidemiologia*, 18(4), pp. 883-93.
- Rampatige, R., Mikkelsen, L., Gamage, S. & Peiris, S., 2009. *Promoting the periodic assessment of the quality of medical records and cause of death data: lessons learned from a medical records study in Sri Lanka*, Brisbane: Health Information Systems Knowledge Hub, University of Queensland.
- Rampatige, R. et al., 2013. *Assessing the reliability of hospital-based cause-of-death statistics: Evidence-based guidelines for country application*, Brisbane: The University of Queensland.
- Rampatige, R. et al., 2014a. Hospital cause-of-death statistics: What should we make of them?. *Bulletin of the World Health Organization*, Issue 92, pp. 3-3A.
- Rampatige, R. et al., 2014b. Systematic review of statistics on causes of deaths in hospitals: Strengthening the evidence for policy-makers. *Bulletin of the World Health Organization*, Issue 92, pp. 807-816.
- Teviu, E. et al., 2012. Improving medical records filing in a municipal hospital in Ghana. *Ghana Medical Journal*, 46(3), pp. 136-141.
- Walker, S., Rampatige, R., Wainiqolo, I. & Aumua, A., 2011. *Improving cause of death certification practices in the Pacific: findings from a pilot study of the World Health Organization web-based ICD training tool*, Brisbane: Health Information Systems Knowledge Hub, University of Queensland.
- World Health Organization, 1967. *The Twentieth World Health Assembly*. Geneva, World Health Organization.
- World Health Organization, 2002. *Medical records manual: A guide for developing countries*, Geneva: World Health Organization.
- World Health Organization, 2015. *International classification of diseases and related health problems, 10th revision*. 5th ed. Geneva: World Health Organization.
- Worster, A. & Haines, T., 2004. Advanced Statistics: Understanding medical record review (MRR) studies. *Academic Emergency Medicine*, 11(2).

Annex 1: International form of medical certificate of cause of death (WHO 2016)

Administrative Data (can be further specified by country)																	
Sex	<input type="checkbox"/> Female				<input type="checkbox"/> Male				<input type="checkbox"/> Unknown								
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 Report chain of events in due to order (if applicable) State the underlying cause on the lowest used line			Cause of death										Time interval from onset to death				
	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?								<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> 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?								<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Unknown			
If yes were the findings used in the certification?								<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Unknown			
Manner of death:															
<input type="checkbox"/> Disease			<input type="checkbox"/> Assault				<input type="checkbox"/> Could not be determined								
<input type="checkbox"/> Accident			<input type="checkbox"/> Legal intervention				<input type="checkbox"/> Pending investigation								
<input type="checkbox"/> Intentional self harm			<input type="checkbox"/> War				<input type="checkbox"/> Unknown								
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:															
<input type="checkbox"/> At home		<input type="checkbox"/> Residential institution			<input type="checkbox"/> School, other institution, public administrative area				<input type="checkbox"/> Sports and athletics area						
<input type="checkbox"/> Street and highway		<input type="checkbox"/> Trade and service area			<input type="checkbox"/> Industrial and construction area				<input type="checkbox"/> Farm						
<input type="checkbox"/> Other place (please specify):								<input type="checkbox"/> Unknown							
Fetal or infant Death															
Multiple pregnancy								<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Unknown			
Stillborn?								<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> 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?								<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Unknown			
At time of death								<input type="checkbox"/> Within 42 days before the death							
Between 43 days up to 1 year before death								<input type="checkbox"/> Unknown							
Did the pregnancy contribute to the death?								<input type="checkbox"/> Yes		<input type="checkbox"/> No		<input type="checkbox"/> Unknown			

Annex 2: Medical certificate of cause of death assessment tool

This tool is designed to assess the quality of death certification practices through checking for the presence of common errors in death certificates. This can be used to assess the quality of death certification as part of routine assessment, or to assess the training needs of doctors in designing cause of death certification training. This tool can also be used to evaluate the effectiveness of death certification training.

This tool should be used in conjunction with the following documents, available to download at mspgh.unimelb.edu.au/dataforhealth/resources:

- Assessing the quality of death certification: Guidance Tool
- Assessing the quality of death certification: Instructions for the online assessment tool
- Assessing the quality of death certification: Excel spreadsheet

GENERAL INSTRUCTIONS

Country	Relates to the country where the death was certified.
Hospital name	Name of hospital (or health facility) where the certificate was completed.
Place of death	For example, hospital, other health facility, home, or other. Insert 'not recorded' if unknown.
Certifier	For example, doctor or other. Insert 'not recorded' if unknown.
Reference no.	If the death certificate has a medical record or patient number, insert it here. If not, leave blank.
Age at death	Age of the deceased at death. Remember to include units (hours, days, months, years). Insert 'not recorded' if unknown.
Age group	Based on the age at death, select from: 0 – 28 days; 29 days – <1 year; 1 – 4 years; 5 – 14 years; 15 – 44 years; 45 – 64 years; 65 – 84 years; 85+ years.
Gender	Male or female. Insert 'not recorded' if unknown.
Error types	Detailed instructions on how to assess the quality of the death certificate against each error type are provided in the document 'Assessing the quality of death certification: Guidance Tool'.

The assessment tool

DEATH CERTIFICATE DETAILS

Country:	
Hospital name:	
Place of death:	
Certifier:	
Reference no.:	

GENERAL DETAILS ABOUT THE DECEASED

Age at death:	
Age group:	
Gender:	

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

Did the certificate have:

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

CHINA

Rao et al. have shown that ischaemic heart disease was undercounted in the official statistics by 31% 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 underlying cause of death.

ISLAMIC REPUBLIC OF IRAN

Khosravi et al. have found that the true cause-of-death 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 at an age of ≥ 70 years were largely reclassified, after review, to ischaemic heart disease and stroke.

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% had been misclassified to diabetes or another heart disease and 25% of the deaths due to diabetes mellitus had been misclassified as various diseases of the circulatory system. An example of the misclassification matrix produced is in provided in Annex 5.

THAILAND

Pattaraarchachai et al. also reported massive misclassification of major causes of death. 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 under-diagnosis of diabetes by the vital registration system.

Sourced from (Rampatige, et al., 2014b).

Annex 5: Misclassification of causes of death, all ages, both sexes combined, Colombo, Sri Lanka, 2012

Diagnosis based on medical records review (no. of deaths)																
Vital registration diagnosis	Certain infectious and parasitic diseases	All cancers	Diabetes mellitus	Other diseases of the nervous system	Hypertensive diseases	Ischaemic heart diseases	Cerebrovascular diseases	Other heart diseases	Pneumonia	Chronic lower respiratory diseases	Other diseases of the respiratory system	Diseases of the liver	Diseases of the skin	External causes	All other causes	Total
Certain infectious and parasitic diseases	9	3	1	0	0	0	0	2	0	1	0	1	0	2	4	23
All cancers	1	34	1	0	0	2	3	0	0	4	0	2	0	0	3	50
Diabetes mellitus	3	3	34	1	4	22	9	1	3	2	0	3	1	1	7	94
Other diseases of the nervous system	2	0	0	3	0	2	0	0	1	0	1	2	0	0	0	11
Hypertensive diseases	4	0	2	0	12	9	10	0	1	3	0	1	0	0	2	44
Ischaemic heart diseases	2	0	9	0	2	54	5	3	1	5	0	4	0	1	3	89
Cerebrovascular diseases	0	1	1	1	2	1	17	1	0	1	1	1	0	0	1	28
Other heart diseases	1	4	3	0	2	17	4	21	1	4	1	3	1	0	8	70
Pneumonia	0	1	1	2	0	1	1	0	9	2	0	0	0	0	6	23
Chronic lower respiratory diseases	1	1	1	0	0	7	1	1	1	13	0	0	0	0	2	28
Other diseases of the respiratory system	0	1	1	1	0	1	1	0	1	0	3	2	0	1	3	15
Diseases of the liver	4	2	2	1	2	2	0	3	0	1	0	39	1		3	60
Diseases of the skin	0	1	0	0	0	1	0	0	0	0	0	1	0		1	4
External causes	3	3	3	0	2	3	0	1	0	1	0	2	0	1	5	24
All other causes	2	2	3	2	1	5	3	2	1	1	0	3	0	0	14	39
Total	32	56	62	11	27	127	54	35	19	38	6	64	3	6	62	602

Sourced from (Rampatige, et al., 2014b).

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 **DATA FOR
HEALTH INITIATIVE**



Australian Government
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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.

Civil Registration and Vital Statistics partners:



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