Strategies for improving the quality of cause of death data in hospitals

April 2018

Improving death certification and mortality coding

Resources available from the University of Melbourne, Bloomberg Philanthropies Data for Health Initiative

CRVS development series

The CRVS development series, generated through the Initiative, form a lasting archive of concise and easily accessible evidence and knowledge on strengthening CRVS systems. The content is based on a combination of technical knowledge and country experiences, as well as the scientific literature. The series are intended to stimulate debate and ideas for in-country CRVS policy, planning and capacity building, and promote the adoption of best practice to strengthen CRVS systems world-wide.

CRVS technical outcome series

This series focuses on filling a range of scientific knowledge gaps and offering new tools, methods, findings and approaches for CRVS systems and data improvement. The series has a strong empirical focus. It reports on works in progress, particularly for large or complex technical initiatives, and on specific components of projects that may be of more immediate relevance to stakeholders.

CRVS resources and tools

Capacity-building resources and tools are designed to influence and align CRVS processes with established international or best-practice standards and to help countries improve their systems. These resources, which are used extensively in the Initiative's training courses, aim to change practice and ensure countries benefit from such changes by developing critical CRVS capacity among technical officers and ministries.

CRVS country perspectives

CRVS country perspectives describe the capacity-building experiences and successes of strengthening CRVS systems in partner countries, including fellowship reports. The series describes the state of CRVS systems improvement in partner countries and lessons learned, and provides a baseline for comparison over time and between countries.

CRVS action guides and summaries

Many papers from the development and technical outcome series have accompanying action guides or summaries, which provide a succinct overview of key points and, in the case of action guides, a suggested way forward for countries.

Suggested citation

University of Melbourne. *Strategies for improving the quality of cause of death data in hospitals.* CRVS development series. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, University of Melbourne; 2018.

Contents

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Abbreviations

AIDS	acquired immuno deficiency syndrome
COD	cause of death
CRVS	civil registration and vital statistics
D4H	Data for Health
HIV	human immunodeficiency virus
ICD	International Statistical Classification of Diseases
MCCOD	medical certification of cause of death
MMR	medical records review
MRN	medical records number

Key terms

Cause of death:	refers to 'all those diseases, morbid conditions or injuries which either resulted in or contributed to death and the circumstance of the accident or violence which produced any such injuries' (Twentieth World Health Assembly, 1967).
Clinical record:	physician's contribution to the medical record, focussed on clinical diagnoses, signs and symptoms.
Medical record:	contains all the information about a patient generated as part of a hospital admission and stay.
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, 1994).
Verbal autopsy	is a structured interview carried out with family members and/or caregivers of the deceased to elicit signs and symptoms and other important information which can be used to assign a probable underlying cause of death.

Key points

- Countries need accurate, continuous, complete and up-to-date mortality data to prioritise and drive decisions for evidence-based health policy and planning, health service delivery, and implement cost-effective and equitable population health programs.

- Many countries rely on health facilities to capture accurate mortality statistics; thus, hospitals are frequently at the frontline of cause of death data collection.

- Physicians often have limited to no training in medical certification of cause of death, which results in inaccurate certification. This means that health planners in some countries cannot always confidently rely on the mortality statistics generated from hospital-certified deaths.

- The Bloomberg Philanthropies Data for Health Initiative (D4H) suggests eight strategies to improve the quality of cause of death data, aimed at three different levels:

  - National and regional strategies

    - establish a national stakeholder group or committee

    - introduce the International Form of Medical Certificate of Cause of Death

    - improve or introduce coding of medical certificates

  - Medical education and training strategies

    - develop training curricula and materials

    - implement a targeted training program

  - Hospital strategies

    - establish clinical audit committees

    - measure and monitor the quality of certification

    - improve medical records systems.

- The strategies outlined are useful for ministry of health staff, hospital administrators and managers, medical society officers, medical education leaders, and physicians. They will also be of interest to stakeholders involved in planning and strengthening civil registration and vital statistics systems, as they provide overall guidance on the steps required in improving hospital data.

- Improving the quality of cause of death data in hospitals 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.

Improving death certification and mortality coding

Strategies for improving the quality of cause of death data in hospitals

This *CRVS development series* paper outlines the importance of accurate medical certification of cause of death, and provides eight strategies that hospitals can implement to improve the accuracy and consistency of cause of death data drawn from medical records. The strategies outlined will be useful for ministry of health staff, hospital administrators and managers, medical society officers, medical education leaders, and physicians. They will also be of interest to stakeholders involved in planning and strengthening civil registration and vital statistics systems, as they provide 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.

- **Medical certification of cause of death**
- **Challenges related to certification practices in hospitals**
- **Strategies for improving the quality of cause of death data**
    - **National mortality committee**
    - **International Form of Medical Certificate of Cause of Death**
    - **Mortality coding**
    - **Training curricula and materials**
    - **Targeted training**
    - **Clinical audit committee**
    - **Quality assurance**
    - **Medical records systems**
- **Summary**

Medical certification of cause of death

Cause of death data is used to monitor population health and implement effective programs and policies.

Population-level mortality data are derived from accurate and reliable cause of death (COD) information. This information is used by countries to plan and monitor the health of their populations, study disease distribution and emerging or neglected health problems, and address health inequities. In hospital settings, the information entered by physicians on medical death certificates is a critical source of such data.

When a patient dies in a hospital or health facility, a medical certificate of COD should be completed. Specifically, the WHO International Form of Medical Certificate of Cause of Death, often referred to as the 'medical death certificate' or simply 'death certificate' (see **Annex 1**), should be used. The medical death certificate is usually completed by the physician who attended to the patient or a physician who is familiar enough with the patient's medical history to confidently ascertain the COD.[1]

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1   Lomas HD, Berman JD. Diagnosing for administrative purposes: some ethical problems. Social Science and Medicine 1983; 17:241-244.

To certify a death, the physician must first identify the disease or injury leading directly to death, and then trace back the sequence of events to determine the **underlying cause of death**. The causes of death recorded on the certificate include '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'.[2] Other diseases or conditions contributing to death are entered in a second part of the form.

Challenges related to certification practices in hospitals

> The logic required to complete a medical certificate of cause of death is different to that used when making clinical decisions.

The process of medical certification of cause of death in hospitals is not without its challenges in low-, middle- and high-income countries alike.[3] For example, a study on a selection of hospitals with high inpatient death rates in the United States found that 46% of reviewed medical death certificates were completed incorrectly.[4] Similarly, in 2010, about 24% of deaths in South Africa were reported as being due to ill-defined or unknown causes, resulting in suboptimal COD information for planning purposes.[5] The physicians who complete death certificates are often not properly trained in medical certification practices and procedures. To fill in a medical death certificate correctly, the physician must first identify the disease leading directly to death and then trace the sequence of events back to the underlying COD (**Figure 1**). This is quite different from the logic that the physician applies to making clinical diagnoses and therapeutic decisions, which are the basis for patient management. Furthermore, while it is not difficult to teach physicians how to certify, it is difficult to have them sustain the practice long-term. This, along with the high turnover of junior physicians, indicates a need for continuous training within hospitals and health facilities.

Figure 1 Example of a completed medical certificate of cause of death

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	*Renal failure*	*1 year*
		b	Due to: *Nephritic syndrome*	*3 years*
		c	Due to: *Diabetes mellitus*	*20 years*
		d	Due to:	
2 Other significant conditions contributing to death (time intervals can be included in brackets after the condition)				

2 World Health Organization. Mortality theme issue: glossary. *Bulletin of the World Health Organization 2006; 84:161-256.*

3 Rampatige R, Mikkelsen L, Hernandez B, Lopez AD. Systematic review of statistics on causes of deaths in hospitals: strengthening the evidence for policy-makers.
Bulletin of the World Health Organization 2014; 92:807-816.

4 Lloyd J, Janapour E, Angell B, et al. Using national inpatient death rates as a benchmark to identify hospitals with inaccurate cause of death reporting – Missouri, 2009–2012. *Morbidity and Mortality Weekly Report 2017; 66:19-22.*

5 Burger EH, Gronewald P, Rossouw A, et al. Medical certification of deaths in South Africa – moving forward. *South African Medical Journal 2015; 105:27-30.*

Physicians are often required to complete medical death certificates for patients they have very limited medical information on.

It is also assumed that the medical certificate of cause of death 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, however even within the hospital setting, physicians required to complete a medical death certificate may have had very limited time with the patient prior to death, or were unable to complete the necessary tests due to limited diagnostic resources (access to equipment, capacity to process results, etcetera).

These all result in the incorrect medical certification of cause of death, and also indicate a lack of broader appreciation among physicians, medical training bodies and hospital management of the legal, ethical and public health significance of proper certification.[6] Therefore, the collection of cause of death data and accurate medical certification must be framed as integral parts of patient care and be part of the continuing learning program of physicians. As such, medical professional bodies, medical teaching and learning bodies, and national civil registration and vital statistics (CRVS) committees, along with other key actors, should be united in emphasising the importance of COD data in driving improvements in health.

Improving death certification and mortality coding

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6   Dash, SK, Behera BK, Patro S, et al. Accuracy in certification of cause of death in a tertiary care hospital – a retrospective analysis. *Journal of Forensic and Legal Medicine 2014; 24:33-36.*
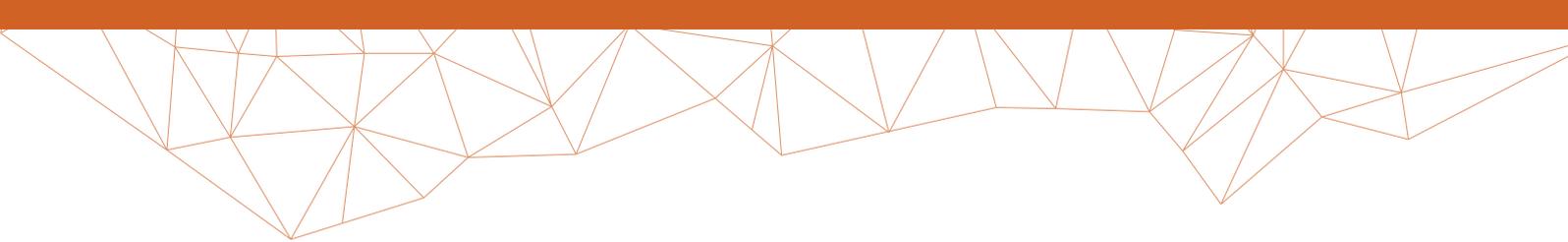
Strategies to improve the quality of cause of death data in hospitals

The Bloomberg Philanthropies Data for Health (D4H) Initiative is working with sixteen countries and two cities to increase the registration of births and deaths, improve the quality of cause of death information at hospitals, apply verbal autopsy (VA) to better understand probable COD in communities, and to produce high-quality data sets and data analysis skills for policy and program analysis.[7] Based on broad experiences of the D4H Initiative, eight key strategies are recommended to improve the quality of COD data in hospitals. These strategies can be grouped into three main levels of action:

- National and regional strategies
    1. establish a national stakeholder group or committee
    2. introduce the International Form of Medical Certificate of Cause of Death
    3. improve or introduce coding of medical certificates
- Medical education and training strategies
    4. develop training curricula and materials
    5. implement a targeted training program
- Hospital strategies
    6. establish clinical audit committees
    7. measure and monitor the quality of certification
    8. improve medical records systems.

Level 1: National and regional strategies

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

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7   For more information on these BD4H interventions, see https://crvsgateway.info/library

Improving death certification and mortality coding

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 organizations, 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:

1. Coordinate, monitor, and ensure there is alignment of interventions aimed at improving mortality and cause of death information with government priorities, policies and strategies.

2. Assist in producing valid, reliable, relevant, timely, and accurate mortality information to improve the quality of patient care and provide evidence-based decision making.

3. Provide leadership on matters related to improving mortality and cause of death information.

4. Support strengthening of inter-agency mechanisms for reporting of deaths and cause of death.

5. Support relevant line ministries to ensure improved processes for the timely information and data sharing, including interoperability among existing and developing information technology systems.

6. Promote policy reform and development in line with international best standards for mortality and cause of death information.

7. Create a national plan for certification improvement.

8. Establish standards for certification training as part of continuing medical education.

9. Consider requirements for including certification quality as a reportable quality metric for hospitals.

Introduce the International Form of Medical Certificate of COD

The quality and availability of cause of death statistics are influenced by the legislation, or lack thereof, mandating their collection. In some countries, there is no compulsory registration of deaths, and thus absent or incomplete mortality statistics. In other countries, the registration of death is mandatory, but specifying the COD may not be. If a country has legislation requiring that deaths and cause of death be registered, the use of the International Form of Medical Certificate of Cause of Death may not be part of the regulation or, if it is, its use is often not enforced.
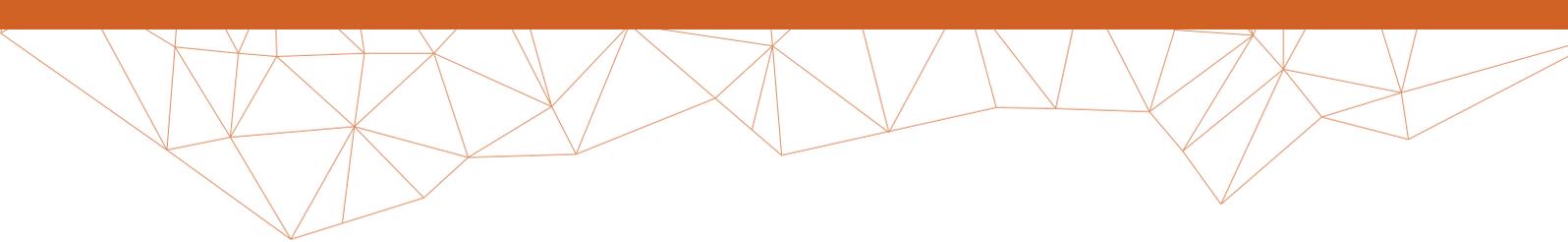
In countries where the use of a medical death certificate is supported by legislation, an important first step for hospitals is to implement and consistently use the International Form of Medical Certificate of Cause of Death (**Annex 1**). The International Form requires physicians to describe the sequence of causal events leading to death in a standardised manner, and allows for mortality data to be coded according to the rules of the International Statistical Classification of Diseases, 10th Revision (ICD-10).

By using this international standardised death certificate, COD data collection will immediately and significantly improve. When all hospitals within a country use the same standardised tool, the data become comparable and easily aggregated to be analysed at the national level for policy and planning. Hospitals in countries that do not yet have legislation regarding the recording of COD can lead by example by introducing such practices, allowing them to operate at the international standard as well as being the impetus for change in their countries.

Improve or introduce coding of medical certificates

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 process of translating diagnoses from text to alphanumeric codes for the storage, retrieval and analysis of data is known as clinical coding.[8]

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.

Clinical coding allows individual cause of death data to be aggregated and analysed to produce national mortality statistics.

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, and finally

■   train coders.

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8   University of Melbourne. *Intervention: Mortality coding.* CRVS summaries. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, the University of Melbourne; 2017.

Automated coding software can reduce errors and improve the timeliness of mortality statistics.

Alternatively, some countries may wish to automate their coding. Iris is an automatic system for coding multiple causes of death and for the selection of the underlying cause of death 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), and

■ improve international comparability.

While the literature on use of Iris is limited, early studies show promise. In Brazil, for example, Iris was able to automatically code the underlying COD in 94% of death certificates,[9] and a study in France showed 92% of deaths could be automatically coded. The remaining certificates required an experienced mortality coder to select the UCOD.[10]

Level 2: Medical education and training strategies

Because physicians are the ones who collect cause of death data, it is essential they have the understanding and skills needed to ensure the data is as accurate and complete as possible. Two strategies are needed to ensure physicians are trained and remain vigilant in their practice.

Develop training curricula and materials

Education provided to medical students is often inadequate and lacks a public health focus.

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

■ knowledge of the importance of medical certification of COD 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 of COD provided to medical school students is inadequate, and most students only receive minimal training in their final years.[11] 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. This can affect the information that physicians collect on COD certificates.[12]

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 physicians.

Implement a targeted training program

The introduction of the International Form of Medical Certificate of Cause of Death alone is not enough to improve the quality of data on cause of death. Physicians must be formally trained on how to use it and understand how to correctly medically certify the sequence of events leading to death.

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9   Martins R, Buchalla C. Automatic coding and selection of causes of death: an adaptation of Iris software for using in Brazil. *Revista Brasileira de Epidemiologia 2015; 18(4):883-93.*

10 Lamarche-Vadel A, et al. Automated comparison of last hospital main diagnosis and underlying cause of death ICD10 codes, France, 2008-2009. *BMC Medical Informatics and Decision Making 2014; 14:14-44.*

11 Walker S, Rampatige R, Wainiqolo I, Aumua A. 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, Australia: Health Information Systems Knowledge Hub, University of Queensland; 2011.

12 Rampatige R, Mikkelsen L, Gamage S, Peiris S. *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, Australia: Health Information Systems Knowledge Hub, University of Queensland; 2009.

Hospital administrators must prioritise training for both junior and senior physicians in medical certification. Education and training on certification will be fundamental for improving the accuracy of death certification.[13] Education should focus on providing hands-on experience in completing medical death certificates (for junior physicians and interns), and refresher training on certification rules and significance (for experienced practising physicians). Improvements in death certification will be underpinned by the medical community's understanding of the importance of this task and the obligation physicians have towards their patients for recording their deaths correctly. Throughout the certification capacity-building process, statements like '**we owe it to the dead to record their passing with accuracy**' should be used to remind physicians of their responsibility. It should be emphasised that accurately determining the underlying cause of death is an essential medical duty that contributes to crucial data that are the cornerstone for improving a population's health.

The hospital clinical audit committee should advocate for the training of junior physicians, and use the results of audits to demonstrate the need for and target refresher training in certification for more experienced physicians. Additionally, they can monitor improvements in quality of COD data after training sessions, which would validate the efficacy of training on data quality and demonstrate the need for continual training.[14]

Training of trainers

Given the scale of training required (both in terms of absolute numbers of physicians, and the need for regular refresher courses), a '*training of trainer*' model is one feasible, sustainable option. Preferably, trainers will be experienced physicians with the ability to adjust training methods to different audiences and circumstances. **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.

Table 1 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 COD 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	-	-	-	-	-	+++

COD – cause of death; MoH – Ministry of Health

13 Pillay-van Wyk V, Bradshaw D, Groenewald P, et al. Improving the quality of medical certification of cause of death: the time is now! *South African Medical Journal 2011:* 101;626.

14 University of Melbourne. *Training and education on medical certification of cause of death: Effective strategies and approaches.* CRVS development series.
Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, the University of Melbourne; 2018.

Improving death certification and mortality coding

Levtel 3: Hospital strategies

Hospitals are the frontline of cause of death 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

Supportive policies and procedures on certification are an important aspect of improving the quality of mortality data.

World-wide, hospitals usually follow a set of national standards (often embedded in law and policy) that assure nationally consistent, high-quality training and assessment services for hospital patients, workers, volunteers and visitors. Internal and external (or independent) audits will then usually be done to assess the implementation and quality of these standards within the hospital. The purpose of these hospital audits is to review evidence of the hospital's ongoing compliance with continuing registration requirements, and to confirm the hospital is achieving optimal patient care, safe working conditions, and quality training and assessment outcomes for all hospital staff. The ongoing audits or reviews can also identify weaknesses, gaps, and opportunities for hospital management to improve on.

Individual hospital policies and processes that are nested within broader national quality frameworks and strategies, however, have a direct impact on the cause of death data collected. Hospital administrative and management culture, for example, play an important role in ensuring accurate medical certification. If hospital administrators are unaware of the importance of medical certification, and place pressure on physicians to complete death certificates as quickly as possible, physicians may struggle to complete death certificates accurately.[15] This will result in an organisational culture that fails to promote accurate and reliable cause of death reporting, which has a detrimental impact on national mortality data.

To make sustainable improvements in the quality of cause of death data, hospital management should create a clinical audit committee (and/or subcommittee, depending on hospital context) dedicated to implementing and improving the medical certification of cause of death. The role of the committee or subcommittee should include:

■ Introducing the International Form of Medical Certificate of Cause of Death and ensuring that staff comply with its use.

■ Ensuring physicians and other relevant hospital staff receive adequate training (including refresher training) on how to correctly medically certify COD.

■ Establishing a regular audit cycle for clinical records and medical certificates, including the development of standard operating procedures. Auditing should start after the standardised death certificate is introduced and physicians are adequately trained.

■ Ensuring that clinical audit activity is meeting various requirements as set out by the national CRVS stakeholder group or committee (such as the national CRVS committee), and is in line with international best practice.

■ Ensuring that there are effective processes and systems in place to enable healthcare professionals to participate in clinical audits.

■ Developing a system for reporting and disseminating results from the audit process, internally and externally.

15 University of Melbourne. Reducing barriers to the accurate medical certification of cause of death. CRVS development series. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, the University of Melbourne; 2018.

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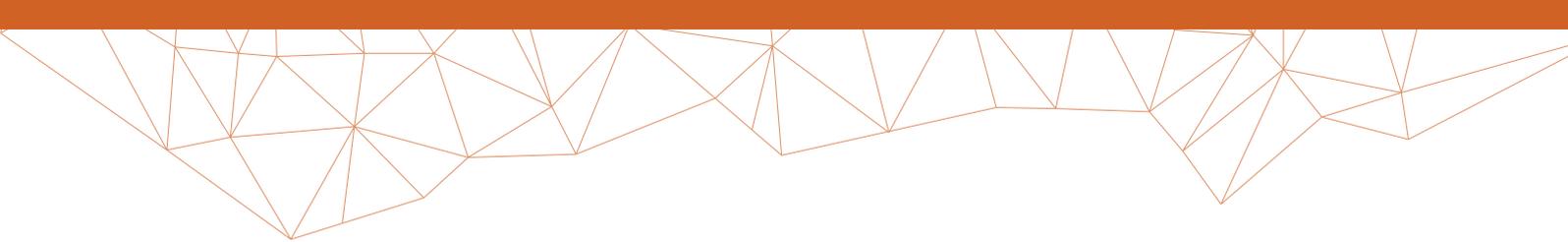
- Ensuring that clinical audits lead to measurable benefits for staff and patients, including the allowance for extra training if needed.

- Monitoring and evaluating quality of clinical records, including quality of cause of death reporting, and linking these to the requirements for the hospital's overall accreditation process(es).

- Reviewing the systems of clinical governance, monitoring that they operate effectively and that action is being taken to address any areas of concern.

- Developing certification training strategies for junior physicians and more experienced practising senior physicians.

Measure and monitor the quality of medical certification

There are two aspects in measuring and monitoring the quality of medical certification of cause of death:

- Assessing if medical certificates have been correctly completed by physicians.

- Reviewing the medical and clinical records to determine whether the correct underlying cause of death has been recorded.

Assessing medical certificates

Measuring the quality of certification requires an assessment of whether the medical certificates have been correctly filled in by the physician. Medical certificates should be reviewed by experienced coders or physicians who have been trained to evaluate medical certificates. The reviewer should not deal directly with the physician who wrote the certificate – instead, the reviewing physician's identity can be kept anonymous by allocating them an identity number known only to hospital audit administration.

The results should then be reported to the clinical audit committee. If the underlying COD on the medical certificate of death needs to be revised, the committee should ask the certifying physician to correct and re-issue the medical certificate. The remainder of the data should be checked to monitor quality and to feed back into training programs.

The University of Melbourne's medical certification of cause of death assessment tool can be used as a framework for assessing medical certificates.[16] This tool is designed to assess the quality of death certification practices by checking for common errors in death certificates, meaning it can then be used to assess the quality of death certification as part of routine assessment, or to assess the training needs of physicians.

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 physician's contribution to the medical record, and focuses on clinical diagnoses, signs and symptoms. An important part of assessing the quality of medical certification is to ask whether the clinical record contained within the medical record justifies the assigned underlying COD. In other words, is there sufficient information in the medical record to make a diagnosis and, in the opinion of trained reviewers, if the underlying COD is the correct diagnosis.

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16 University of Melbourne. *Assessing the quality of death certificates: Rapid tool.* CRVS resources and tools. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, the University of Melbourne; 2018.

To ensure that in-hospital deaths are clearly documented, periodic validation of hospital records is crucial.[17] COD information audits should be simple and cost-effective, and contribute to improved health planning and management within the hospital itself.[18, 19]

Points to cover in the review of medical and clinical records include:

- Whether the admission notes and discussion of differential diagnosis[20] are complete.

- Whether the results of any investigations are in the record, including visual inspection during surgical procedures and results from tissue biopsies.

- Whether the physicians drew the appropriate conclusions.

- Whether the medical certificate of cause of death was filled out completely and correctly.

- Whether the record contains comments on the course of the illness in hospital in relation to diagnosis.

- Be simple and cost-effective.

- Provide useful ways of monitoring the quality of mortality information.

Specifically, audits to identify shortcomings in certification can guide educational interventions to improve COD reporting. An audit performed at a United Kingdom hospital in 2007 found that more than half of all death certificates across a four-month period contained errors and omissions, prompting the creation of an educational intervention.[19] After the educational intervention, a re-audit found that only 20% of death certificates contained these errors, showing that an audit process can result in improvements.[19]

Medical records reviews

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 underlying COD, i.e. whether there is sufficient information in the record to make a diagnosis and whether, in the opinion of trained reviewers, the underlying COD 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, and is referred to as a **medical records review** (MMR). A 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.[21] 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.

> Medical records reviews identify the degree of misclassification of cause of death at the individual level. They provide important data to estimate the true pattern of mortality in a country.

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. It is a powerful tool for advocacy and in analysing the quality of records and certification of cause of death. 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.

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17 Sutra S, et al. Evaluation of causes-of-death: which statistics should we rely on, hospital deaths or vital statistics? *Journal of the Medical Association of Thailand 2012*; 95:S262-273.
18 Weeramanthri T et al. An evaluation of an education intervention to improve death certification practice. *Australian Clinical Review* 1993; 13:185–189.
19 Selinger CP et al. A good death certificate: improved performance by simple educational measures. *Postgraduate Medical Journal* 2007; 83:285-286.
20 *Differential diagnosis* is the process of weighing the probability of one disease versus that of other diseases possibly accounting for a patient's illness.
21 Worster A, Haines T. Advanced statistics: Understanding medical record review (MMR) studies. *Academic Emergency Medicine* 2004; 11(2).

Improving death certification and mortality coding
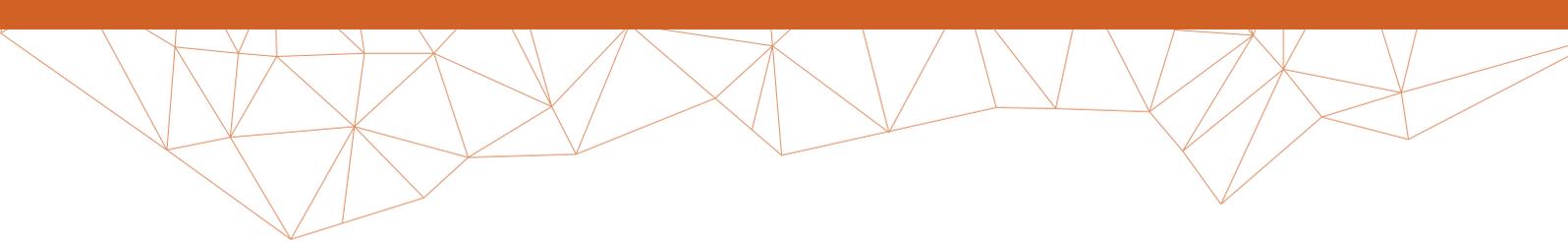
The misclassification matrices produced in a nationally representative study can be used to derive a series of correction factors that can be applied to routine cause of death data to estimate the probable true COD pattern in the study country. In Thailand, for example, cause-specific mortality fractions 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 causes, such as HIV/AIDS 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.[22] 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.

Improve medical records systems

The storage and retrieval of medical records is central to improving medical certification. Physicians need access to historical records to review the deceased's medical history and accurately assign a cause of death. When records cannot be retrieved easily, maintaining an accurate and complete clinical history becomes difficult, and this can adversely affect future COD data.

Improving medical record systems requires collaboration between government agencies, technical partners and funders.[23]

Key activities for improving medical records management may include:

Improving the management of medical records is a major intervention, and requires multi-stakeholder collaboration.

- Conducting a situation analysis to understand factors leading to poor medical records management.[24]

- Assessing the availability of physical storage for records.

- Developing a policy for the retention of records.

- Establishing a numbering system that facilitates retrieval and storage of records (e.g. 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).

When aiming to improve medical records systems, hospitals must consider space and human resources required for managing the system. Medical records systems are often already overloaded, and thus planners should consider this when implementing improvement plans. Paper-based systems should be well established and functioning smoothly before considering a transition to electronic records.

22 Rampatige R, Mikkelsen L, Hernandez B, Riley I, Lopez AD. Systematic review of statistics on causes of deaths in hospitals: Strengthening the evidence for policy-makers. *Bulletin of the World Health Organization* 2014; 92: 07-816.

23 World Health Organization. Medical records manual: a guide for developing countries. Geneva, Switzerland: WHO; 2002.

24 Teviu EAA, Aikins M, Abdulai TI et al. Improving medical records filing in a municipal hospital in *Ghana. Ghana Medical Journal* 2012; 46:136-141.

Summary

For countries to have accurate mortality data, hospitals must produce accurate cause of death information. Although hospitals are often at the frontline of cause of death data collection, physicians often have limited to no training in death certification. This results in inaccurate medical certification and subsequent poor-quality cause of death data. This *CRVS development series* paper provides eight, interrelated strategies that hospital management can implement to improve the accuracy and consistency of cause of death data drawn from medical records. Importantly, these strategies should be embedded within larger interagency frameworks for cause of death data strengthening in hospitals across countries.

Improving death certification and mortality coding

Annex 1 International Form of Medical Certificate of Cause of Death

Administrative Data (can be further specified by country)			
Sex	☐ Female	☐ Male	☐ 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?	☐ 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	☐ 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:

☐ 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

Improving death certification and mortality coding

Related resources and products

University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Library

https://crvsgateway.info/library

Assessing the quality of death certificates: Rapid tool. CRVS resources and tools.

Assessing the quality of death certificates: Guidance for the rapid tool.
CRVS resources and tools.

Intervention: Medical certification of cause of death. CRVS summaries.

Intervention: Mortality coding. CRVS summaries.

Reducing barriers to the accurate medical certification of cause of death by physicians. CRVS development series.

Training and education on medical certification of cause of death: Effective strategies and approaches. CRVS development series.

University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Learning Centre

https://crvsgateway.info/learningcentre

Topic 4: Cause of death in CRVS systems.

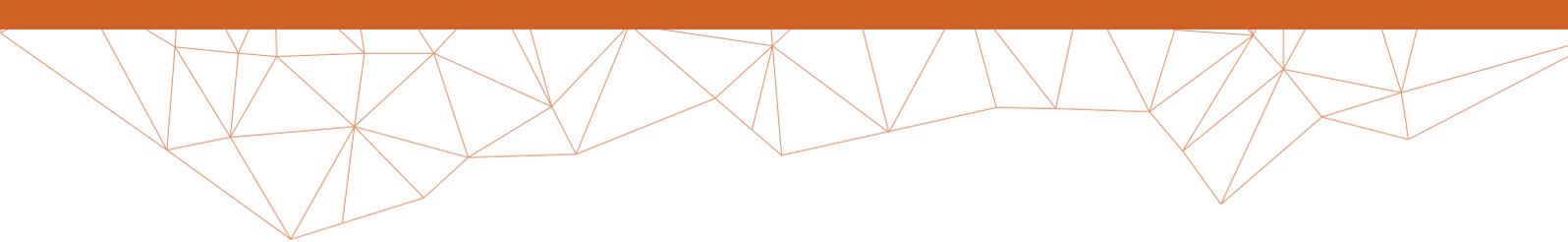Topic 6: CRVS tools – Medical certificate of cause of death assessment tool.

University of Melbourne, D4H Initiative, CRVS Knowledge Gateway: Courses

https://crvsgateway.info/courses

Analysis of Causes of (National) Deaths for Action (ANACONDA).

ICD-10 coding.

Medical certification of cause of death.

Further reading

Ajami S, Ketabi S, Sadeghian A, Saghaeinnejad-Isfahani S. Improving the medical records department processes by lean management. *Journal of Education and Health Promotion* 2015; 4:48.

Aung E, Rao C, Walker S. Teaching cause-of-death certification: Lessons from international experience. *Postgraduate Medical Journal* 2010; 86:143-152.

World Health Organization. *Medical records manual: A guide for developing countries.* Geneva, Switzerland: WHO; 2010.

World Health Organization. *International classification of diseases and related health problems, 10th revision. 5th ed*. Geneva, Switzerland: WHO; 2016.

Improving death certification and mortality coding

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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