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Improving Mortality Data Quality in Hospitals: Advocating for the Adoption of the WHO Standard Medical Certificate of Death in Nepal

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ABSTRACT

Background: Accurate mortality data is vital for public health planning and policy. In Nepal, non-standardized death certificates, often missing structured causal sequences and critical details, compromise data quality in the Civil Registration and Vital Statistics (CRVS) systems. Implementing the World Health Organization's (WHO) Medical Certificate of Cause of Death (MCCoD) could enhance accuracy, strengthen mortality statistics, and facilitate evidence-based public health interventions.

Methods: This retrospective study analyzed inpatient deaths occurring between 13 April 2024 to 15 December 2024. Demographic and clinical data were extracted from medical records. The leading causes of death were identified by analyzing International Classification of Diseases Eleventh Revision (ICD-11) coded data using the Digital Open Rule Integrated cause of death Selection (DORIS) tool. Additionally, the study assessed documentation errors, predominant causes of in-hospital mortality, and evaluated the accuracy of cause-of-death reporting in the Health Management Information System (HMIS).

Results: The study analyzed 564 death certificates and corresponding medical records. Chronic liver disease was the leading underlying cause of death (UCOD) accounting 11.17% of total deaths. No certificate was entirely error-free, with nearly all (99.9%) failing to document the time interval between symptom onset and death. Approximately 59% contained unclear abbreviations, while 99.7% listed multiple causes in a single line without proper sequencing. Only 2% followed a causal sequence as: immediate, antecedent, and UCOD. Additionally, inaccurately reported cardiopulmonary arrest as the UCOD in HMIS.

Conclusions: Hospital death certification remains critically substandard, undermining mortality data quality. Prioritizing WHO's MCCoD implementation and clinician training would significantly improve accuracy, supporting SDG targets for reliable cause of death reporting.

Keywords: Cause of death; DORIS Tools; ICD-11; MCCOD; mortality.

INTRODUCTION

Mortality data is essential for public health planning, disease surveillance, and policy formulation.[1,2] In Nepal, hospitals are the primary sources of mortality data, but in the absence of a nationally standardized death certificate, they use non-standardized formats. These often omit essential details like the sequence of events and contributing conditions, leading to frequent certification errors.[3] studies show that up to 50% contain significant inaccuracies, ill-defined causes, and sequences.[4,5] These errors compromise the quality and consistency of mortality data, ultimately weakening the Civil Registration and Vital Statistics (CRVS) system, the country's main source of mortality information.[6-8]

Globally, nearly 40% of deaths go unregistered, and only 8% in low-income countries have documented causes.[9] Inaccurate reporting distorts health data and policy.[9,10] WHO's standardized MCCoD reduces certification errors

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by up to 30%.[11-16] This study evaluates hospital death certification practices and applies DORIS tools to ICD coded data to identify UCOD, with the aim of improving data accuracy.

METHODS

A retrospective review of all death certificates was conducted at Bir Hospital, a tertiary care center in Kathmandu, over an eight-month period from 13 April 2024 to 15 December 2024 (2081/01/01 BS to 2081/08/30 BS). Established in 1889, Bir Hospital is Nepal's oldest and one of the busiest public hospitals, providing advanced medical and surgical care across multiple specialties. Annually, the hospital admits approximately 20000 patients, manages over 600000 outpatient visits, and handles more than 35000 emergency cases. With more than 900 inpatient deaths reported annually, Bir Hospital serves as a national referral center and plays a critical role in the country's healthcare system.

All inpatient deaths that occurring during the study period in the medical, surgical, and Intensive care units of Bir Hospital were included in the analysis. Deaths in the emergency department (ED), and brought-in-dead cases were excluded due to incomplete documentation and a lack of sufficient clinical details needed to establish a reliable cause of death.

Two versions of death certificates were analyzed. Older version: A certificate with minimal fields capturing only demographic data and a single cause of death entry. Modified version: A revised format incorporating limited elements from the WHO's MCCoD, including fields for immediate, antecedent, and contributory causes. Some clinicians recorded partial causal sequences on both forms, though neither adhered fully to the WHO standard. Table 1 presents a detailed comparison of the two formats with the WHO MCCoD.

Table 1. Comparative Summary of Existing Death Certificates and the WHO Standard Format.

Features	Older version	Modified version	WHO MCCoD
Demographics	Present but lacks details	Present but lack details	Present with complete details
Legal and Administrative details	Limited	Limited	Standard legal information provided
Causal Sequence (Part 1)	Single " cause of death field"	Only two lines available	Full structured Immediate to UCOD
Contributory Conditions (Part II)	Not Included	included	Clearly separated section
Onset of Disease/ Conditions (Time)	Not included	Not included	Clear separated section
ICD 11 Coding Compatibility	Not included	Not included	Fully compatible

Basic demographic information was extracted from the hospital's electronic medical records. Each mortality file was reviewed manually by the research team using a structured checklist to assess certification quality. The checklist evaluated : clarity and specificity of cause of death entry, accuracy of logical sequencing of the causal chain, inclusion of contributory causes, use of abbreviations, illegible handwriting, completeness of certifiers details such as name, designation, council number and signature. Two authors independently reviewed each death certificate using this checklist. The cause of death listed on the certificate was compared with the final diagnosis recorded in the patient's chart.

Errors were categorized based on WHO MCCoD quality guidelines. Major errors included listing mode of death, such as cardiopulmonary arrest, incomplete causal sequence, and use of ill-defined conditions in the death certificates. Misclassification was defined as any mismatch between the underlying cause of death stated on the certificate and the most probable clinical diagnosis based on the patient's documented hospital course.

All diagnoses were coded using the International Classification of Diseases and Related Health Problems (ICD-11) mortality coding rules. The Underlying Cause of Death (UCOD)is the disease or injury initiating the chain of events leading to death. For cases with multiple conditions, Selection Rules (SR) and Modification Rules were applied

to resolve ambiguities. . Ill-defined terms like "heart failure" or "natural causes" are not accepted as valid UCODs unless no other specific cause was documented .. ICD-11 codes were assigned to diseases and conditions.

To enhance the accuracy, the Digital Open Rule Integrated Cause of Death Selection (DORIS) tool was used. DORIS applies ICD-11-based algorithmic rules to select the most plausible UCOD from the recorded causal chain.

De-identified data were entered into Microsoft Excel and exported to R statistical software. R was used to generate summary tables and charts and to map ICD 11 diagnoses and corresponding Unique Resource Identifiers (URIs), ensuring compatibility with the DORIS tools. Results were summarized using descriptive statistics, percentages to quantify certification errors.

For comparison with national reporting, the UCOD from the analyzed certificates was matched with those reported to the Health Management Information System (HMIS) for the same period. Consistency was evaluated by comparing aggregated ICD-coded mortality categories across both sources.

This study was approved by the Institutional Review Board of the National Academy of Medical Sciences (IRB-NAMS 1093-2081/82). As the study involved secondary analysis of de-identified medical records without direct patient contact, individual informed consent was not required. Formal authorization to access hospital records was obtained from the Bir Hospital administration.

RESULTS

The study analyzed 564 death certificates, of which 238 (42.19%) were female and 326(57.81%) were male. The mean age at death was 57.29 ± 18.65 years, with the youngest and oldest deceased being 2 and 96 years old, respectively. A majority of deaths (84.23%) occurred in medical departments, including liver, gastroenterology, nephrology, chest, and clinical oncology, while surgical departments (16.48%), comprising general surgery, gastrointestinal surgery, neurosurgery, and burn units accounted for a smaller proportion. Deaths occurred at intensive care unit(ICU) were attributed to the respective admitting department and included within the medical or surgical categories accordingly. Of the total, 69.68% of deaths occurred after 48 hours of admission. Furthermore, the majority of the deaths (61%) occurred between 30-69 years, the age range defined as premature mortality by the Sustainable Development Goal (SDG) indicator.

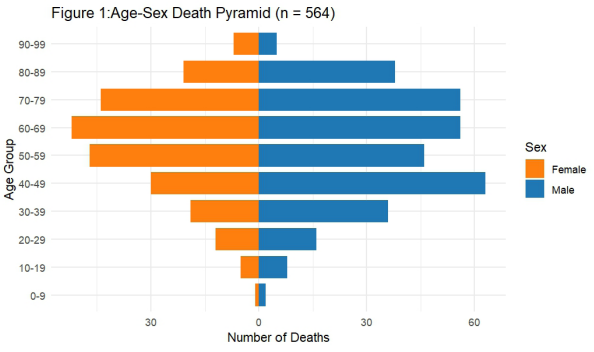

Figure 1. Age-Sex Death Pyramid. (n=564)

Table 2. Evaluation of common issues in the Completion of Death Certificates.

Item	Number	Percentage
certificates mentioning only modes of death (cardiopulmonary arrest, respiratory failure, cardiac arrest)	148	26.24
Abbreviation used (MI, COPD, etc.)	535	94.69
Multiple causes in a single line	483	85.63
Illegible handwriting	346	61.34
Unspecified neoplasms and neoplasms without mentioning sites	44	7.80

Analysis of the 564 death certificates revealed additional concerning patterns beyond those summarized in Table 2. The sample comprised 273 older certificates and 291 modified versions, mostly carbon copies. While 26.24% listed only modes of death, a 95% contained abbreviations, and 85.63% listed multiple causes in a single line. Only 24 certificates (4.3%) attempted any causal sequence description, with none documenting event onset. Notably, 58 certificates listed over five diseases or conditions in a single line, and seven documented as many as eight. Additionally, 26 injury-related deaths lacked documentation of external causes. Among 34 post-surgical deaths, establishing a direct causal relationship between the procedure and death was often challenging due to insufficient clinical detail. These findings demonstrate systemic deficiencies in certification quality.

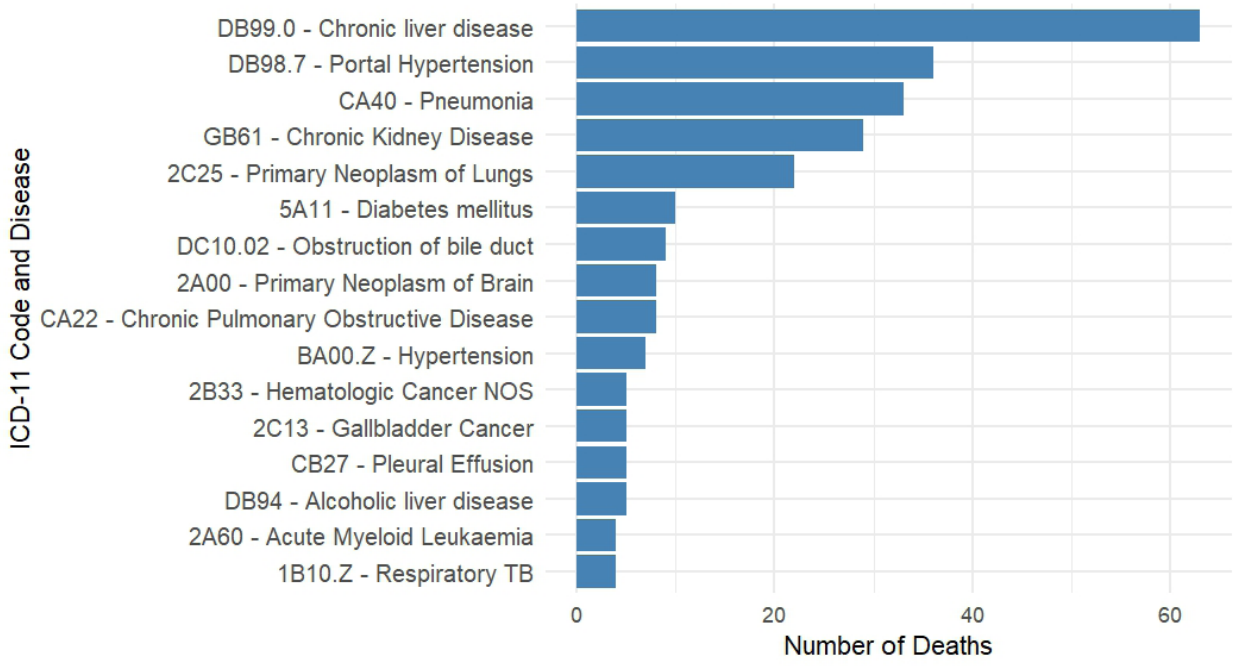

Figure2: Top 16 Underlying Causes of Death

The DORIS tool analysis identified chronic liver disease as the leading cause of mortality, followd by portal hypertension and pneumonia. Other prevalent conditions included, chronic kidney disease, Lung cancer, Diabetes mellitus, and COPD. The distribution highlights Nepal's high burden of chronic non-communicable disease, particularly liver-related. Notably, 71 cases listing only cardiopulmonary arrest "as cause of death all occurring within 48 hours of admission were excluded from DORIS analysis due to their classification as ill-defined causes under ICD-11 guidelines.

Table 3. Top 10 Reported Causes of Death in Hospital Mortality Data and Clinical Appropriateness.

Disease/Condition	Number(%)	Clinical Validation
Cardiopulmonary arrest	110 (19.50)	Non-specific terminal cause
Cardiac arrest	85 (15.07)	Immediate but not underlying
Shock	52 (9.22)	Mechanism of death, not a cause
Hypertension	45 (7.98)	Hypertension alone rarely causes death unless it leads to complications such as stroke, heart failure, or kidney failure. Without such sequelae, it is not a valid UCOD
Injury only, without mentioning details	26 (4.61)	Lacks a mechanism and a cause
Sudden death	37 (6.56)	Needs a specific underlying cause
Respiratory failure	35 (6.21)	Non-specific, often terminal event
Diabetes mellitus	21 (3.72)	Needs complications for causal linkage
Sepsis	28 (4.96)	Site and source are not specified

We analyzed the hospital-reported mortality data submitted in HMIS. In several cases, mortality coding rules were incorrectly applied to death data, and mortality coding guidelines were not strictly followed. As a result, 34% cases were reported as ill-defined conditions. Moreover, the hospital submitted only age and sex wise aggregated mortality data to HMIS, significantly limiting the reliability and utility of the data for public health analysis.

DISCUSSION

This study reveals critical gaps in the quality of mortality data at a major Nepalese tertiary hospital with 90 % of death certificates lacking complete and accurate documentation of the underlying cause of death (UCOD). These findings reflect ongoing challenges across LMICs where studies from India (60-95%) and Bangladesh (70-85%) similarly identify non-standard certification practices as a root causes.[17,18]

The lack of standardized death certification format, remains a major barrier to producing high- quality mortality data in Nepal. The current format does not support documentation of the full causal sequence of events leading to death, resulting loss of critical epidemiological information. In this study cardiopulmonary arrest, was incorrectly recorded as the UCOD in 11% of cases. Similar misclassification was reported in a scoping review from India, where up to 86% of certificates listed inappropriate causes.[5,19] The frequent use of abbreviations and listing multiple causes in single lines created ambiguity, while illegible handwriting introduced avoidable errors in data interpretation. These errors predominantly originate from three systemic gaps; insufficient clinician training in ICD protocols, absence of standardized certification templates and limited institutional oversight.

Disease of the digestive system emerged as the leading cause of death based on ICD 11 mortality coding rules, with liver disease as the predominant contributor. Although alcohol-related liver disease(ARLD) was not explicitly documented on any of the death certificates, clinical records revealed 16 cases with a history of long-term alcohol use (10–60 years). This discrepancy between certification practices and clinical reality emphasizes a systematic failure to capture modifiable behavioral risk factors, a phenomenon also reported in Indian and Brazilian studies where 40 -60% of ARLD cases were misclassified as generic cirrhosis. Centers for Disease Control (CDC), reported 23% global increase in ARLD mortality (2019-2020). It also ranked leading cause of alcohol-related deaths during that period.[20]

Neoplasms were another significant cause of death in this study, with lung cancers, particularly bronchial adenocarcinoma, small cell carcinoma, and squamous cell carcinoma being the most common. These findings align with a study conducted at a tertiary care hospital in Nepal, which reported 75.5% of lung cancer cases were non-small cell type, including adenocarcinoma and squamous cell carcinoma, while 24.5% were small cell carcinoma.[21,22]

Our findings reveal critical weaknesses in mortality data reporting at Bir Hospital, therby undermining its utility for public health decision-making. Although mortality data were routinely submitted to the HMIS, international coding rules were not rigorously applied, resulting in inconsistent classification of COD. Moreover, only aggregated mortality figures were reported with no individual level verification.[23] This limited the traceability, accuracy and utility of the data for guiding public health intervention. The issues reflect border systemic barriers within Nepal's HMIS framework. Nepal's HMIS faces critical barriers to producing reliable mortality data, including inadequate digital infrastructure, insufficient training in ICD-11 and MCCoD standards, and poor integration between clinical documentation and reporting systems. Similar challenges were observed in Sri Lanka and the Philippines, where investments in standardized digital platforms and coder training programs significantly improved data quality. Specifically, Sri Lanka's nationwide electronic death reporting reduced ill-defined causes by 58% while the Philippines implementation of automated coding tools enhanced accuracy by 72%.[24,25]

Hospital mortality data require improvements in death certification, completeness and digital integration to strengthen CRVS systems. Studies from Mexico and Nepal show that vague coding and weak certification limit data utility.[26,27] International frameworks also recommend standardized medical certification, data quality audits and electronic data capture across health facilities to strengthen CRVS.[28]

While the Ministry of Health and Population(MoHP) issued a directive on 2080/04/17 BS mandating death audits in all hospitals, the absence of uniform guidelines and training materials has constrained their effectiveness. Lessons from countries like Brazil and SriLanka demonstrate that systematic training, mandatory MCCoD adoption, and integration into CRVS systems can substantially improve data quality.

This study provides a comprehensive assessment of death certification practices at a multispecialty hospital, revealing critical gaps in mortality statistics. While hospital mortality data serves as an important marker of healthcare quality, our retrospective approach may be affected by documentation gaps, and the exclusion of maternal/ neonatal deaths limits generalizability to these key populations.

Prospective studies incorporating clinician training, audit feedback systems, and use of electronic tools could strengthen findings. Full implementation of

MCCoD standards, shown to reduce coding errors by 40% in Brazil's Unified Health System following nationwide adoption and improve timeliness of mortality reporting by 35% in Australia's Death Clearance project, would establish standardized certification practices essential for reliable mortality statistics.

In the context of Nepal, mortality data quality could be transformed through nationwide MCCoD implementation integrated with CRVS and HMIS systems. Such standardization would enhance data completeness and reliability, enabling accurate assessment of public health programs and monitoring progress toward national and global targets.

CONCLUSIONS

Accurate and complete mortality data is essential for tracking progress towards the SDG, particularly mortality indicator of SDG Goal 3, which focuses on improving the availability of high-quality health data, including cause of death information. However, the lack of standardized death certification at Bir Hospital, where over 90% of certificates lacked a properly recorded underlying cause of death, undermines Nepal's ability to generate reliable mortality statistics. Strengthening hospital-based mortality data systems through the adoption of WHO's MCCoD, integration with CRVS and HMIS, and institutional training not only enhances national health surveillance but also directly supports SDG monitoring and reporting frameworks.

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CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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