Journal of Health Informatics in Africa

Accuracy of Cause-of-Death Classification in Ghana: Evidence from the 2023 District Health Information Management System (DHIMS II)

Basil Tungbani [1]*, Mosidi Sarah Nhlapo [2]

[1] Ghana Statistical Service, Accra, Ghana
[2] United Nations Economic Commission for Africa, Johannesburg, South Africa

Background and Purpose: Accurate and reliable cause-of-death (COD) data are essential for informing public health policy, tracking epidemiological trends, and allocating health resources. In Ghana, institutional mortality data captured through the District Health Information Management System II (DHIMS II) provide critical insights into disease burden and health system performance. However, the utility of these data is limited by inconsistencies in medical certification, coding practices, and data completeness. This study aims to identify the leading causes of institutional deaths in Ghana in 2023 and assess the quality of ICD-11 coding, with the findings expected to help strengthen cause-of-death reporting systems and improve the accuracy of health data in Ghana.

Methods: The study analysed the 2023 mortality data recorded in the DHIMS II, covering 30,397 institutional deaths after excluding records with missing age data. The dataset was cleaned, retaining cases with estimated ages to preserve demographic patterns. The ANACOD3 tool was used to assess the completeness, specificity, and quality of causes of the data, with a focus on identifying garbage codes and misclassified entries. Ethical approval was obtained from the Ghana Health Service.

Results: Non-communicable diseases accounted for 57.4% of institutional deaths, followed by communicable conditions (36.6%) and injuries (3.8%). Gender-specific patterns revealed differences in the leading causes of death. The quality assessment showed a high frequency of ill-defined underlying causes and invalid ICD-11 codes, with over 30% of the records classified as garbage codes, and incomplete records were also prevalent.

Conclusion: Significant gaps in COD data quality compromise its utility for health planning in Ghana. Addressing deficiencies in certification, coder training, and diagnostic infrastructure is crucial for improving mortality data accuracy and supporting evidence-based health interventions.

1 Introduction

Accurate and reliable mortality data are fundamental for understanding disease patterns, informing public health interventions, and improving health outcomes [1]. In Ghana, institutional mortality data, particularly those derived from health facilities, offer valuable insights into the burden of diseases and help guide national strategies to reduce preventable deaths [2]. However, the utility of these data depends largely on the accuracy and completeness of cause-of-death reporting [3]. The transition to the International Classification of Diseases, 11th Revision (ICD-11), presents a significant opportunity to enhance cause-of-death attribution by offering a more detailed and standardized classification system [4]. Nonetheless, challenges such as inconsistencies in coding practices, data entry errors, and limited technical capacity within health facilities in Ghana continue to undermine the reliability of institutional mortality statistics.

Beyond technical limitations, demographic and geographic disparities significantly affect mortality reporting. Research has shown that variations in the reporting and quality of mortality data are influenced by factors such as geographic location, socioeconomic status, and access to healthcare services [5]. In urban areas, where access to healthcare infrastructure is relatively better, mortality data tend to be of higher quality but often remain incomplete; conversely, rural and marginalised populations often face barriers that contribute to underreporting or misclassification of deaths. Recognising and addressing these disparities is crucial to producing mortality data that truly reflects the health realities of all population groups.

*Corresponding author address: Corresponding author address: Ghana Statistical Service, Finance Drive, P.O. Box GP 1098, Accra, Ghana. Email: basil.tungbani@statsghana.gov.gh
 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

Ghana, located in West Africa, had a population of 30.8 million as of 2021, with rapid urbanisation driving demographic shifts; approximately 56% of the population now resides in urban areas, concentrated in cities like Accra, the economic and administrative capital [6]. This urban transition has introduced new public health challenges, particularly the rising burden of non-communicable diseases alongside persistent communicable diseases, which are reflected in national mortality patterns.

The District Health Information Management System (DHIMS) serves as the main platform for capturing institutional mortality data in Ghana. Despite its importance, the DHIMS faces several challenges, including underreporting, misclassification of causes of death, and limited adherence to ICD coding standards [7]. These issues compromise the accuracy and usability of mortality data for healthcare planning and resource allocation.

Against this backdrop, the present study seeks to identify the leading causes of death captured through Ghana's DHIMS, assess the quality and consistency of ICD-11-coded mortality data, and explore the main challenges affecting its reliability. Using the World Health Organisation's Anacod3 tool, which applies ICD-11 algorithms to evaluate data quality, the study will examine coding consistency, completeness, and demographic variations in mortality reporting. It aims to answer two key research questions: (1) What are the major causes of death recorded in Ghana's health facilities? and (2) What challenges affect the accuracy and reliability of ICD-11-coded mortality data? Addressing these questions will help strengthen mortality surveillance systems by improving data quality, consistency, and reporting processes, thereby enhancing the effective use of mortality data for evidence-based health policy and planning in Ghana.

2 Materials and methods

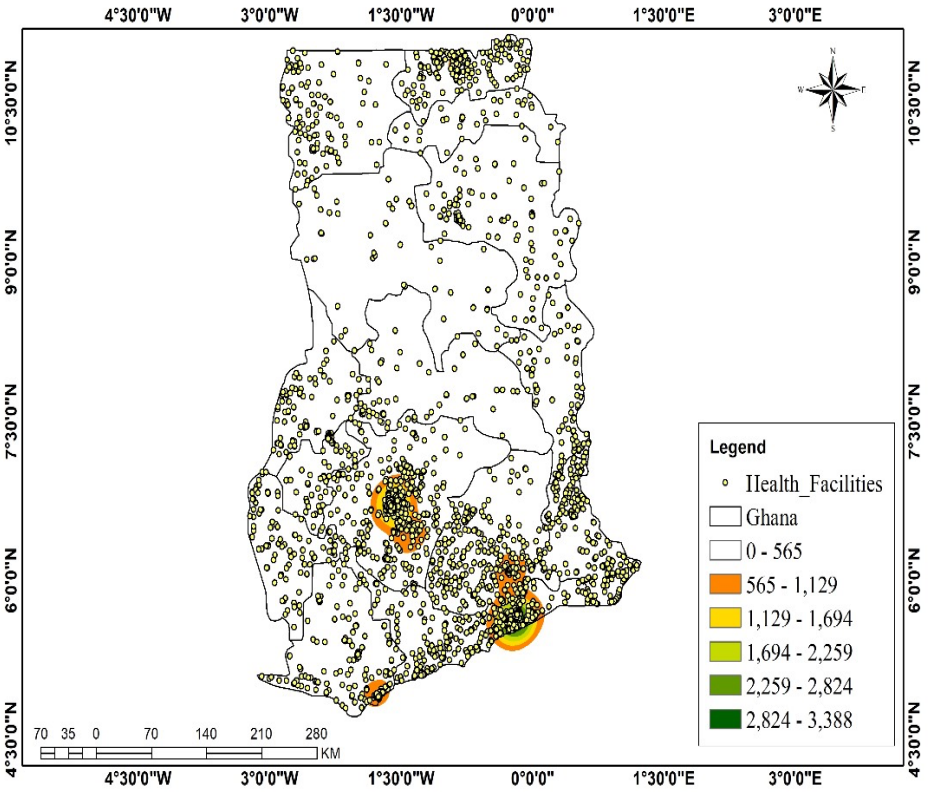
This study utilises institutional mortality data extracted from the Ghana Health Service's (GHS) District Health Information Management System II (DHIMS II) to assess the quality of cause-of-death reporting. DHIMS II serves as the central digital repository for health facility-based data across Ghana, enabling real-time reporting and monitoring of key health indicators [8]. It is designed to systematically capture health information from government health facilities systematically, thereby allowing for structured documentation of disease burdens at national, regional, and district levels [8].

The dataset analysed in this study comprises deaths reported in 2023, representing approximately 150,000 deaths captured in DHIMS II that occurred within health facilities across the country. No comparison was made with pre-ICD-11 data, as the study focused exclusively on data collected under the ICD-11 classification framework. Pre-ICD-11 data were not included because differences in diagnostic criteria, coding structures, and classification standards between ICD-10 and ICD-11 could lead to inconsistencies and limit comparability. However, the available data used for the analysis were from 2023, given the timing of the data request and the transition to the ICD-11 system. Since the implementation of DHIMS II in 2012, the system has enabled the collection of comprehensive health data from 3,757 public health facilities across the country, covering all three levels of healthcare delivery, namely, primary, secondary, and tertiary [9]. Primary healthcare facilities include Community-Based Health Planning and Services (CHPS) compounds and health centers, which provide basic preventive and curative services at the community level. Secondary healthcare facilities such as district and regional hospitals offer more specialised care, including emergency services and inpatient treatment. Tertiary healthcare facilities, including teaching hospitals like Korle-Bu Teaching Hospital and Komfo Anokye Teaching Hospital, deliver advanced medical care, specialised surgeries, and research-based healthcare interventions.

By capturing data across all levels of healthcare delivery, DHIMS II ensures broad population coverage and supports in-depth analysis of mortality statistics and health system performance. Figure 1 illustrates the geographic distribution of health facilities from which the mortality data used in this analysis were collected. It shows a higher concentration of health facilities in Ghana's southern regions than in the north, with major urban centres such as Accra, Kumasi, and Sekondi-Takoradi each hosting more than 565 health facilities. This distribution highlights notable regional disparities in healthcare infrastructure.

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

Figure 1. Geographic distribution of health facilities in Ghana



Source: GIS data 2025

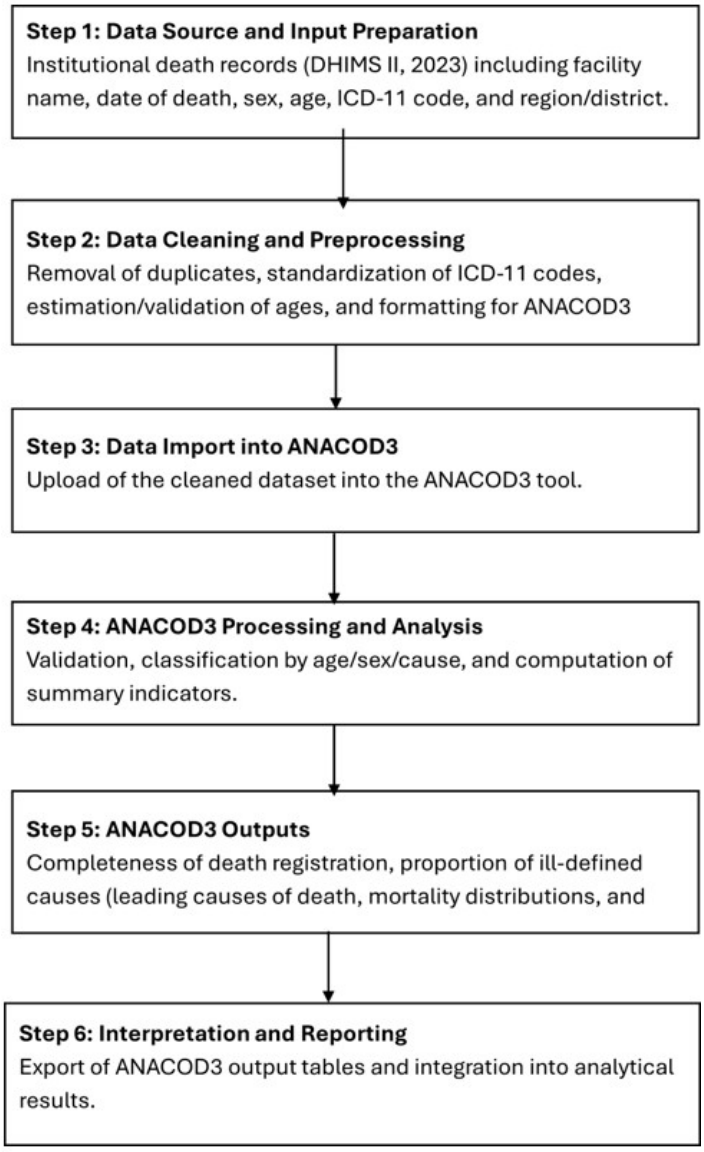
Mortality records used in this study were coded using the World Health Organization's (WHO) 11th Revision of the International Classification of Diseases (ICD-11), which provides enhanced specificity, greater compatibility across health systems, and improved integration with electronic health records [4]. The dataset contained key variables, including age, sex, estimated age (as determined by health practitioners where the actual age was unknown), and the underlying cause of death.

Before analysis, the dataset was carefully cleaned and pre-processed, ensuring that all relevant cases were retained. For records where actual ages were missing but estimated ages were available, the estimated ages were used in place of the missing values. In total, 3,468 estimated ages were assigned and included in the analysis. Including these estimated ages was important to preserve the completeness of the dataset, reduce potential bias from missing data, and allow for a more accurate and meaningful interpretation of mortality patterns across age groups.

The assessment specifically examined the quality of age and sex variables, the extent of missing data, and the presence of estimated ages, with a focus on identifying their distribution across different regions, districts and health facilities. It also involved detecting duplicate entries and correcting erroneous disease codes. Data cleaning procedures followed ICD-11 standards and included the correction of formatting issues and removal of records missing critical information, except for those with estimated ages, which were retained. Below is a flow chart illustrating the process of data processing and analysis using ANACOD3.

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

Figure 2. Flow Chart for the Data Processing and Analysis Using ANACOD3



Source: Authors' construct 2025

Out of an initial 37,990 death records, 5,580 were deemed incompleteness in the data, these were excluded from the analysis, resulting in a final analytical sample of 30,397 cases. Subsequently, the cleaned dataset was analysed using the ANACOD3 tool, a World Health Organisation (WHO) tool designed to facilitate the analysis and quality assessment of mortality and cause-of-death (COD) data. ANACOD3 was chosen for its robust capacity to assess internal consistency, evaluate data quality, and determine comparability with international mortality trends [10]. The tool conducts diagnostic checks by benchmarking input data against global estimates such as those from the Global Burden of Disease (GBD) Study produced by the Institute for Health Metrics and Evaluation (IHME) [11].

One of ANACOD3's core functions is to evaluate the plausibility of COD data by examining the distribution of deaths across three broad categories: Group I (communicable diseases, including maternal, neonatal, and nutritional conditions), Group II (non-communicable diseases, e.g. cancer, heart diseases,

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

diabetes), and Group III (external causes and injuries, e.g. accidents, homicide, suicide etc). These groupings help assess whether the observed mortality patterns reflect Ghana's epidemiological transition, characterised by a gradual shift from communicable to non-communicable diseases as leading causes of death. Furthermore, ANACOD3 assesses the quality of cause-of-death (COD) data by identifying the proportion of deaths classified under "garbage codes" terms referring to deaths with vague, insufficiently specified, or unusable causes. The tool uses this measure as a key quality indicator, as a garbage code proportion exceeding 10% can significantly distort the interpretation of mortality patterns and the true burden of disease.

To facilitate targeted improvements, ANACOD3 organises garbage codes into thematic "packages" that highlight systemic weaknesses in diagnostic and coding practices [10]. This structure enables health systems to pinpoint specific areas for intervention, thereby enhancing the overall accuracy and utility of mortality data for health planning and policy formulation. In this context, describing the codes as good or poor refers to the degree of accuracy and specificity in the cause-of-death information. Good-quality codes accurately capture the true underlying cause of death, whereas poor-quality or garbage codes represent vague, ill-defined, or incomplete information that reduces the reliability of mortality statistics.

2.1 Ethical Considerations

Given the sensitive nature of mortality data, the study adheres to strict ethical standards, including ensuring data confidentiality, anonymisation of personal identifiers, and compliance with national and institutional data protection guidelines. A formal request for data was submitted to the Ghana Health Service to undertake this study, and the required mortality data were provided by the Policy, Planning, Monitoring and Evaluation Division (PPMED). All data were anonymized to ensure confidentiality and compliance with Ghana's data protection standards.

3 Results

This section presents the results based on analyses conducted using the ANACOD3 tool. The cleaned dataset, comprising 30,397 deaths recorded in 2023, was classified according to the Global Burden of Disease (GBD) framework embedded within ANACOD3, which organizes causes of death into broad, comparable categories to facilitate the interpretation of mortality patterns and disease burden. The first part of this section presents findings on the distribution of mortality across the population, while the latter part examines issues related to the quality of cause-of-death data.

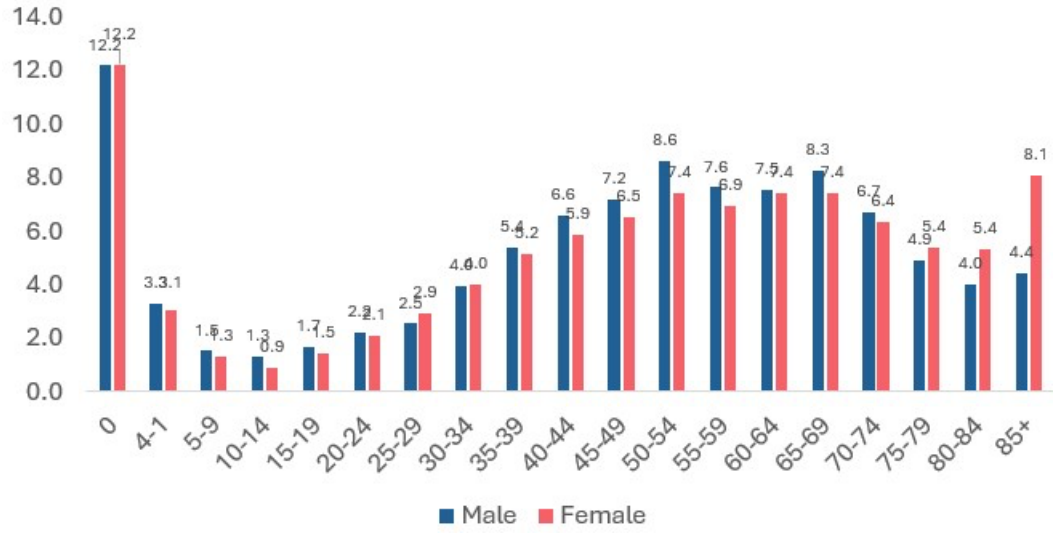
3.1 Distribution of deaths by sex and age groups

The data on the percent distribution of deaths by age group and sex below reveal important demographic and health-related patterns (Figure 3). The highest proportion of deaths occurs at age 0 for both males and females (12.2%), indicating significant infant mortality. Following infancy, the proportion of deaths decline sharply in early childhood and remains relatively low through age 10–14, reflecting lower vulnerability during these ages. In adolescence and early adulthood (ages 15–29), mortality gradually increases, with a slight peak among females aged 25–29 (2.9%), which is associated with maternal health-related causes during the reproductive years.

From age 30 onwards, mortality increases steadily, with a more pronounced rise among males than females. Between the ages of 30 and 69, male deaths consistently exceed female deaths, peaking at 8.6% for males aged 50–54 compared to 7.4% for females in the same age group. Among older adults (ages 70 and above), the share of deaths remains high, but a shift is observed where female mortality surpasses male mortality in the oldest age groups. Particularly in the 85+ age category, 8.1% of all female deaths occur compared to only 4.4% of male deaths.

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

Figure 3. Percent distribution of deaths by sex and age groups

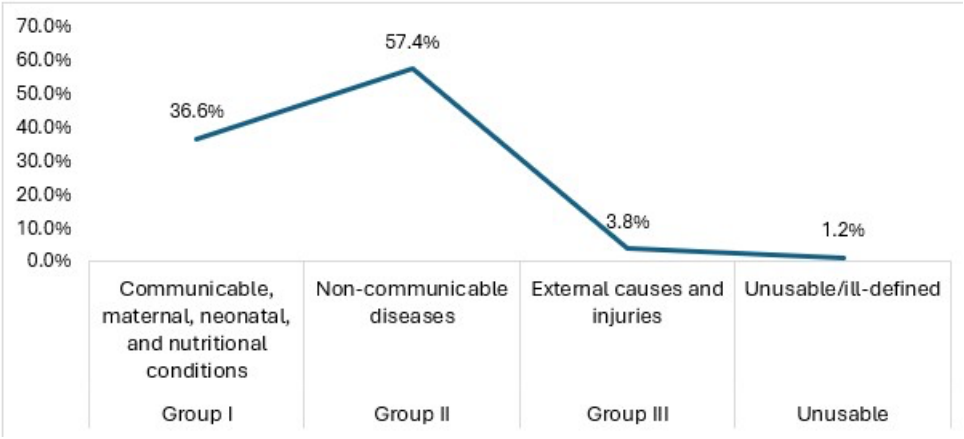


Source: DHIMS 2023

3.2 Distribution of Deaths by Major Cause-of-Death Categories Based on GBD Classification

The World Health Organisation (WHO) and the Global Burden of Disease (GBD) Classifications classify deaths into three major cause-of-death groups: Group I (Communicable, maternal, neonatal, and nutritional conditions), Group II (Non-communicable diseases), and Group III (Injuries and external causes). Additionally, 1.2 percent of deaths were classified under unusable or invalid cause-of-death codes (often referred to as 'garbage codes'). The distribution of deaths by major cause-of-death groups is shown in Figure 4.

Figure 4. Percent distribution of deaths due to communicable (Group I), non-communicable (Group II) and injuries (Group III) in 2023



**Excludes 1.2% Ill-defined causes of death*
Source: DHIMS 2023

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

The analysis of institutional mortality data reveals distinct patterns across the three major cause-of-death categories. Each group contributes differently to the overall mortality burden, with varying implications for public health priorities and intervention strategies.

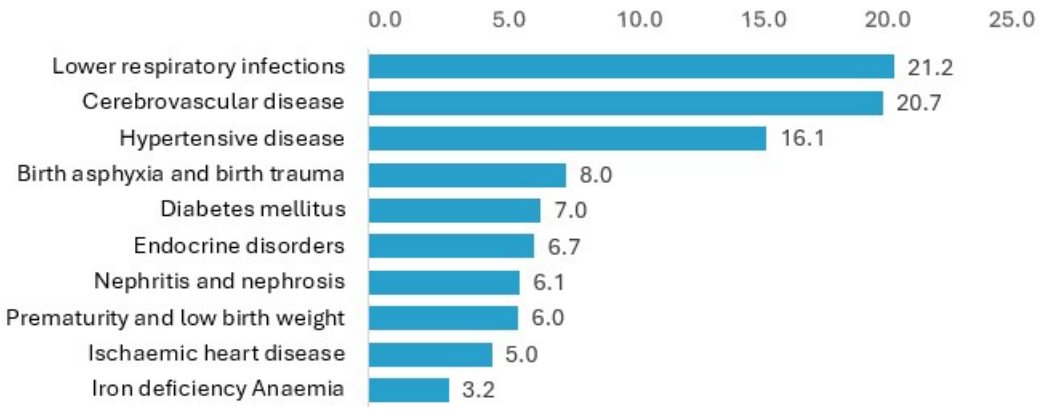
It is observed that non-communicable diseases (NCDs) accounted for the largest proportion of recorded deaths at 57.4%. Communicable diseases represented 36.6% of all deaths, making it the second leading category. Although its share is lower than that of NCDs, this group still poses a significant threat. Injuries and external causes, including road traffic accidents and violence, accounted for 3.8% of total deaths. Although this represents a relatively small proportion, these causes exert an impact on specific subpopulations, particularly young adults, males, and urban residents underscoring the need for focused injury prevention and safety intervention.

3.3 Distribution of the Top 10 leading causes of death

Figure 5 presents the distribution of the top ten leading causes of death in Ghana for the year 2023. Among them, lower respiratory infections accounted for the highest share, contributing 21.2% of the total. This was followed by cerebrovascular disease at 20.7% and hypertensive disease at 16.1%.

Other contributions were as follows: birth asphyxia and birth trauma (8.0%), diabetes mellitus (7.0%), endocrine disorders (6.7%), nephritis and nephrosis (6.1%), prematurity and low birth weight (6.0%), ischaemic heart disease (5.0%), and iron deficiency anaemia, which represented the smallest proportion at 3.2%.

Figure 5. Distribution of the Top 10 leading causes of death



Source: DHIMS 2023

Perinatal conditions such as birth asphyxia and birth trauma featured prominently, accounting for 894 deaths (8.0%). Chronic conditions, including diabetes mellitus (781 deaths; 7.0%), endocrine disorders (751 deaths; 6.7%), nephritis and nephrosis (684 deaths; 6.1%), and ischaemic heart disease (558 deaths; 5.0%), continue to contribute significantly to the mortality burden. Additionally, prematurity and low birth weight were responsible for 678 deaths (6.0%), highlighting persistent challenges in neonatal health. Though lower in absolute numbers, iron deficiency anaemia caused 364 deaths (3.2%), reflecting ongoing nutritional and public health concerns.

These findings underscore the double burden of disease in Ghana, where communicable diseases such as lower respiratory infections coexist with a rising prevalence of non-communicable diseases (NCDs), including cardiovascular conditions and diabetes.

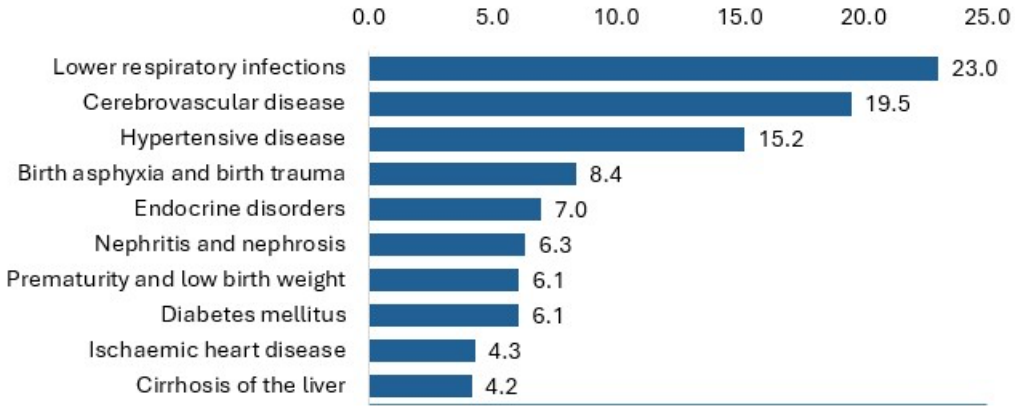
3.4 Distribution of the Top 10 leading causes of death by sex

The results for leading causes of death by sex are shown in Figures 6 and 7. Lower respiratory infections accounted for the largest share of male deaths, with 1,311 deaths (23.0%), highlighting the significant

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

burden of infectious diseases among men. Cerebrovascular disease followed as the second leading cause, contributing 1,110 deaths (19.5%). Hypertensive disease ranked third, with 865 deaths (15.2%). Birth asphyxia and birth trauma were responsible for 477 deaths (8.4%), ranking fourth.

Figure 6. Distribution of the Top 10 leading causes of death for males



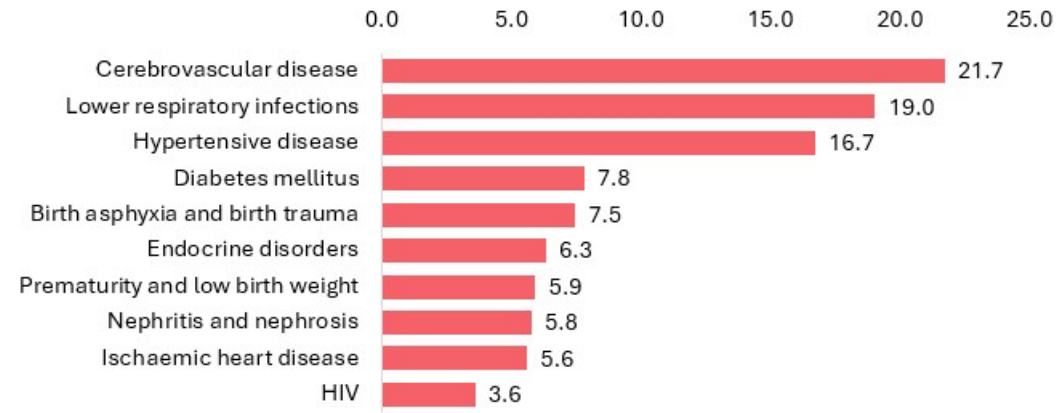
Source: DHIMS 2023

Other notable causes include endocrine disorders (397 deaths; 7.0%), nephritis and nephrosis (361 deaths; 6.3%), and prematurity and low birth weight (346 deaths; 6.1%), indicating that both congenital and metabolic conditions are substantial contributors to male mortality.

Diabetes mellitus, which caused 345 deaths (6.1%), points to the rising prevalence of lifestyle-related illnesses, potentially driven by urbanization, poor dietary habits, and sedentary behaviour.

Figure 7 presents the top ten leading causes of death among females. A total of 5,628 female deaths were recorded from these leading causes.

Figure 7. Distribution of the Top 10 leading causes of death for females



Source: DHIMS 2023

In contrast to the male profile, cerebrovascular disease emerged as the leading cause of death among females, with 1,214 deaths (21.6%). This emphasizes the growing burden of non-communicable diseases (NCDs). Lower respiratory infections, which ranked first among males, were the second most common cause among females, accounting for 1,065 deaths (18.9%).

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

Hypertensive disease was the third leading cause, contributing to 935 deaths (16.6%), underscoring widespread issues with blood pressure management, awareness, and access to antihypertensive care. This aligns with the general trend of increasing NCD-related mortality among women in the country.

Diabetes mellitus, a key lifestyle-related chronic condition, accounted for 436 deaths (7.7%), placing it fourth. This suggests rising exposure among women to metabolic risks such as poor diet, obesity, and physical inactivity. Birth asphyxia and birth trauma resulted in 417 deaths (7.4%), while endocrine disorders were responsible for 354 deaths (6.3%), and prematurity and low birth weight accounted for 332 deaths (5.9%). Nephritis and nephrosis contributed 323 deaths (5.7%), and ischaemic heart disease caused 314 deaths (5.6%), further confirming the significant role of chronic kidney and cardiovascular diseases in female mortality. Rounding out the top ten, HIV/AIDS was responsible for 201 deaths (3.6%).

4 Quality Assessment of Cause-of-Death Data in DHIMS II

This section presents an assessment of the quality of cause-of-death data recorded in Ghana's 2023 District Health Information Management System II (DHIMS II), focusing on evaluating data completeness, specificity, and adherence to international coding standards. The ANACOD3 tool revealed that the completeness of the 2023 DHIMS II mortality data was approximately 10%. In addition to completeness, the assessment examined the specificity of cause-of-death coding.

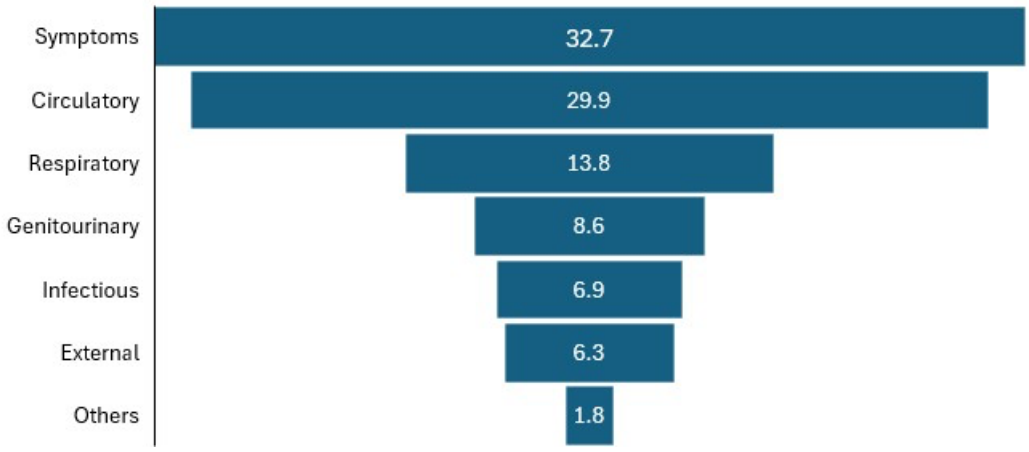
4.1 Data Quality Issues

4.1.1 Ill-defined causes and quality concerns.

The utility of mortality statistics in informing health policy critically depends on the quality of medical certification and the accuracy of cause-of-death (COD) coding [3]. A key aspect of this process is the identification of the underlying cause of death, defined as the disease or injury that initiated the sequence of events directly leading to death. When the underlying cause is inadequately specified or misclassified, the resulting data loses its value for public health monitoring and intervention planning.

As part of the ANACOD3 quality assessment, the dataset was evaluated for the presence of ill-defined or unusable causes of death commonly referred to as "garbage codes." These are conditions that either fail to provide meaningful information about the underlying cause or reflect poor diagnostic practices and limitations in the certification process. The proportional distribution of ill-defined causes of death is shown in Figure 8.

Figure 8. Proportion of ill-defined causes of death by Symptoms, signs, and abnormal clinical and laboratory findings



Source: DHIMS 2023

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

The figure 8 highlights the predominance of ill-defined causes. Notably, "Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified" accounted for 32.7% of all recorded deaths.

Diseases of the Circulatory system represented 29.9% of deaths, reflecting a significant burden of cardiovascular conditions. Diseases of the respiratory system accounted for 13.8%, while diseases of the genitourinary system contributed 8.6%. Infectious and parasitic diseases comprised 6.9% of deaths, and external causes of morbidity and mortality (such as injuries and accidents) made up 6.3%. Other causes were reported at much lower levels: diseases of the digestive system (0.8%), endocrine, nutritional, and metabolic diseases (0.6%), diseases of the blood (0.3%), perinatal conditions (0.05%), and neoplasms (0.04%).

4.1.2 Ill-Defined and invalid ICD-11 codes and their Implications.

A key challenge identified in the assessment of the 2023 DHIMS II dataset is the high frequency of ill-defined and invalid ICD-11 codes, which undermines the overall quality and reliability of cause-of-death (COD) reporting. Ill-defined causes are conditions that lack sufficient specificity or fail to accurately identify the underlying cause of death, often arising from errors in medical certification, incomplete diagnostic investigations, or weak documentation practices within health facilities. To address these issues, invalid or problematic codes were systematically identified and flagged using the ANACOD3 tool, a standardised algorithm designed to detect inconsistencies and coding errors in mortality data.

Several frequently used invalid codes that do not conform to standard ICD-11 guidelines were observed in the data used in this study. For instance:

Code	Description	Notes
X0	Unspecified external causes of morbidity and mortality	Most recorded invalid entry reflects major documentation and classification gaps.
X45.49	Other specified accidental poisoning due to exposure to drugs and biological substances	Frequently appeared but lacked sufficient detail to inform intervention strategies.
X39.34	Exposure to unspecified environmental factors	Recorded but lacks specificity.
X59.54	Unspecified accidental exposure	Recorded but lacks specificity.

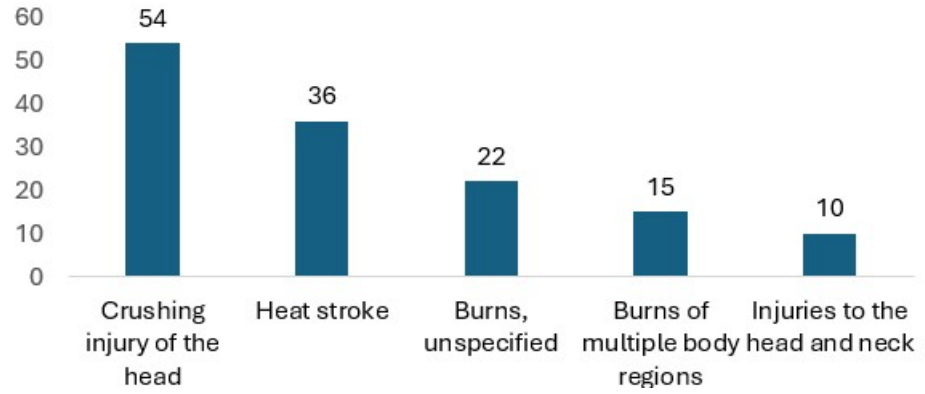
These codes often reflect either insufficient clinical investigation or non-compliance with coding protocols and collectively highlight structural limitations in the mortality recording process.

4.1.3 Inappropriate Use of ICD-11 codes as underlying causes of death.

In addition to invalid codes, the dataset revealed a significant misapplication of ICD-11 codes, particularly those that should not be used as underlying causes of death (see figure 9). Such codes represent modes of dying or terminal events, like heart failure or respiratory failure, and are not suitable for public health planning purposes. These misclassifications distort the mortality profile and hinder the accurate assessment of disease burden in the population [12]. The most misclassified condition was crushing injury of the head, accounting for 54 cases. This was followed by heat stroke (36 cases) and burns, unspecified (22 cases). Other notable misclassified entries included burns of multiple body regions (15 cases) and injuries to the head and neck (10 cases). These external causes often require detailed contextualization and should be properly linked to antecedent events or conditions in line with ICD-11 coding standards.

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

Figure 9. Other Problematic Entries Recorded



Source: DHIMS 2023

Furthermore, challenges related to the classification of perinatal and neonatal deaths were also evident. Conditions such as single stillbirth (20 deaths) and intrapartum fetal death (12 deaths) were frequently coded as underlying causes of death, despite WHO guidelines recommending that maternal or obstetric complications leading to these outcomes should be identified instead. Similarly, acute myocardial infarction, which was recorded in 296 deaths, though clinically significant, should not be recorded as the underlying cause if it conceals the primary cardiac condition. The presence of unknown and unspecified causes of morbidity (67 cases) further reflects diagnostic uncertainty or incomplete documentation, weakening the overall interpretability and usability of the mortality data.

5 Discussion

The assessment of cause-of-death (COD) data from Ghana's 2023 DHIMS II underscores persistent challenges in the completeness, accuracy, and utility of mortality data for public health action. A substantial proportion of deaths were attributed to ill-defined or nonspecific causes such as "symptoms, signs, and abnormal findings", indicating systemic deficiencies in clinical documentation, diagnostic precision, and adherence to ICD-11 standards. Similarly, evidence from a study conducted by Mikkelsen and colleagues in 2020 shows that garbage codes frequently represent more than 30 percent of recorded deaths in many low- and middle-income countries, reducing the reliability of mortality statistics for surveillance, policy formulation, and research [13]. The high prevalence of ill-defined causes of death indicates inadequate diagnostic accuracy and medical certification practices at the facility level, often due to limited diagnostic capacity, insufficient training, and inconsistencies in cause-of-death documentation. This challenge is further compounded by the inappropriate assignment of intermediate or terminal causes (e.g., pulmonary embolism) as underlying causes of death, and the incomplete linkage of external causes (e.g., burns, crushing injuries, and heat stroke) to antecedent events or conditions. Such practices distort the true epidemiological profile and can lead to the misallocation of policy attention and health resources. Addressing these systemic weaknesses will require targeted interventions that directly enhance the validity and reliability of cause-of-death data. Strengthening the medical certification process through standardised training will ensure that healthcare providers accurately identify and record the underlying causes of death, reducing errors arising from incomplete or inconsistent documentation. Equally important is improving the capacity of Health Information Officers and Disease Control Officers who code data in Ghana's health facilities. Enhancing ICD-11 coding proficiency among coders through comprehensive training and continuous professional development improves the accuracy and consistency of coding, minimising misclassification and ill-defined codes. Additionally, instituting routine supervision, audits, and quality control checks at health facilities enables early detection and correction of errors, fostering accountability and reinforcing adherence to coding standards. Collectively, these measures are critical for generating high-quality mortality data that can reliably inform public health planning, resource allocation, and policy formulation [14].

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

Non-communicable diseases (NCDs) emerged as the leading causes of institutional deaths (57.4%), compared with communicable, maternal, neonatal, and nutritional conditions (36.6%). This finding reflects the broader shift from infectious to chronic conditions observed in sub-Saharan Africa, driven by demographic change, urbanization, and lifestyle modification. Ghana is increasingly grappling with a "double burden" of disease, where infectious diseases remain prevalent but NCDs have risen sharply in importance [15]. The prominence of ischaemic heart disease and cirrhosis of the liver in the top ten causes highlights the growing impact of modifiable risk factors such as tobacco and alcohol use, sedentary behaviour, and poor diets. These findings are consistent with global evidence showing that behavioural risk factors such as poor diet, physical inactivity, tobacco use, and harmful alcohol consumption, combined with structural weaknesses in health systems, including limited preventive care, inadequate screening, and poor disease management, contribute significantly to premature mortality from chronic diseases. Importantly, this pattern suggests that without urgent preventive interventions, including population-level lifestyle modification programs, improved screening, and stronger chronic disease management, the burden of NCDs is likely to accelerate.

Sex- and age-disaggregated data further highlight the gendered and life-course dimensions of mortality. Males in the working-age population appear disproportionately affected by conditions linked to occupational exposures, hypertension, and cardiovascular disease, a pattern that may also reflect cultural norms around lower healthcare-seeking behaviour among men. This echoes prior evidence from West Africa showing that men tend to delay accessing healthcare, often presenting with advanced disease stages. By contrast, women's higher mortality at older ages reflects both their longer life expectancy and the cumulative health challenges of ageing, including frailty and chronic illness. The persistence of perinatal causes among the top ten for both sexes' points to systemic weaknesses in maternal and neonatal care, particularly surrounding delivery practices. Although neonatal mortality has declined in Ghana, the continued prominence of conditions such as birth asphyxia and low birth weight suggests either heightened biological vulnerability among male neonates or gaps in obstetric and postnatal service delivery. Strengthening maternal and newborn health services, therefore, remains a priority, alongside NCD prevention and geriatric care. Communicable diseases, though less dominant, continue to impose a substantial burden. HIV/AIDS ranked among the top ten causes of death for females (3.6%) but not males, pointing to persistent gender disparities in exposure, diagnosis, and treatment adherence.

This aligns with broader evidence showing that women's vulnerability to HIV is influenced not only by biological factors but also by structural inequalities, such as limited bargaining power in relationships and unequal access to healthcare services [16]. The continued burden of lower respiratory infections, especially among females, may reflect environmental exposures such as biomass fuel use, as well as occupational and social determinants disproportionately affecting women. These findings underscore the need for gender-sensitive strategies to address both infectious and non-communicable diseases.

The gender-specific mortality patterns provide important insights into health system priorities. Among males, lower respiratory infections, cerebrovascular diseases, and hypertensive disorders accounted for 23.0%, 19.5%, and 15.2% of the top ten causes, respectively. Among females, cerebrovascular disease was the leading cause (21.6%), followed by lower respiratory infections (18.9%) and hypertensive disorders (16.6%). These patterns suggest that while men are more susceptible to NCD-related premature deaths during working ages, women continue to bear a dual burden, facing both communicable disease risks and age-related chronic conditions. Public health responses must therefore be calibrated to address these intersecting vulnerabilities.

In summary, the findings highlight a dual imperative. First, they underscore the urgent need to improve the quality and completeness of COD data to enable robust health system planning. Without reliable mortality data, policies risk being misaligned with actual population health needs. Second, they reflect Ghana's shifting disease landscape, where NCDs now dominate but communicable and perinatal conditions remain significant. Addressing this complex burden requires concurrent, gender-responsive, and life-course-oriented health strategies. Strengthening neonatal care, reducing preventable male adult mortality through occupational safety and chronic disease prevention, and enhancing geriatric and women-focused

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

services will be critical. Simultaneously, investments in mortality data systems, including certification, coding, and facility-level audits, are essential to ensure that health policy is evidence-based and responsive to Ghana's changing epidemiological profile.

6 Conclusion

This study underscores both the major health challenges facing Ghana and the limitations of the available data in fully capturing and understanding these issues. The analysis of institutional mortality data from the 2023 DHIMS II dataset reflects Ghana's ongoing epidemiological transition marked by the coexistence of non-communicable and communicable diseases, while also revealing underlying data quality issues that affect the completeness and accuracy of cause-of-death reporting. The leading causes of death point to a growing burden of chronic conditions such as cardiovascular and metabolic diseases, alongside persistent infectious and maternal health concerns.

Gender differences in cause-of-death patterns also highlight important disparities in health risks and outcomes, with some conditions disproportionately affecting women. These findings underscore the need for a health system that is responsive to both long-term lifestyle-related illnesses and persistent infectious diseases, particularly through prevention, early detection, and tailored care strategies.

At the same time, the analysis exposes serious gaps in the quality of mortality data. Widespread use of ill-defined or improperly coded causes of death, underreporting, particularly of deaths occurring outside health facilities and inconsistent application of ICD-11 standards undermine the reliability of the data for public health planning. These issues stem from weaknesses in clinical documentation, certification practices, and coder training.

While institutional mortality data holds significant potential to guide health policy and resource allocation in Ghana, its current utility is constrained by persistent data quality challenges. Addressing these limitations will require targeted capacity-building for both medical doctors, who certify causes of death, and Health Information Officers and Disease Control Officers, who code the deaths using ICD-11. Strengthening doctors' competencies in accurate medical certification and enhancing coders' proficiency in ICD-11 application through continuous training, supervision, and mentorship will be essential. Additionally, instituting routine data quality audits and deploying automated validation tools will further enhance the completeness and accuracy of cause-of-death reporting. Improving the quality of mortality data is therefore not merely a technical exercise but a public health imperative for evidence-based decision-making and an effective health system response.

Support

This study received training support from the United Nations Economic Commission for Africa (UNECA).

Availability of Data and Materials

The study used administrative data obtained from the Ghana Health Service (GHS).

Ethics Approval and Consent to Use Data

Formal approval to access and use the data for this study was obtained from the Ghana Health Service.

Consent for Publication

Not applicable.

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613

Competing Interests

The authors declare that they have no competing interests.

References

[1] Babarinde AO, Ayo-Farai O, Maduka CP, Okongwu CC, Sodamade O. Data analytics in public health, a USA perspective: a review. *World J Adv Res Rev*. 2023;20(3):211–24.
[2] Owusu AY, Kushitor SB, Ofosu AA, Kushitor MK, Ayi A, Awoonor-Williams JK. Institutional mortality rate and cause of death at health facilities in Ghana between 2014 and 2018. *PLoS One*. 2021;16(9): e0256515.
[3] Flagg LA, Anderson RN. Unsuitable underlying causes of death for assessing the quality of cause-of-death reporting. 2021.
[4] Harrison JE, Weber S, Jakob R, Chute CG. ICD-11: an international classification of diseases for the twenty-first century. *BMC Med Inform Decis Mak*. 2021;21(Suppl 6):206.
[5] Comber AJ, Brunsdon C, Radburn R. A spatial analysis of variations in health access: linking geography, socio-economic status and access perceptions. *Int J Health Geogr*. 2011;10(1):44.
[6] Ghana Statistical Service. *2021 Population and Housing Census: General report (Vol. 3A, Population of Regions and Districts)*. Accra, Ghana: GSS; 2021. Available from: https://census2021.statsghana.gov.gh/
[7] Mensah Abrampah NA, Okwaraji YB, Oteng KF, Asiedu EK, Larsen-Reindorf R, Blencowe H, Jackson D. District health management and stillbirth recording and reporting: a qualitative study in the Ashanti Region of Ghana. *BMC Pregnancy Childbirth*. 2024;24(1):91.
[8] Odei-Lartey EO, Prah RKD, Anane EA, Danwonno H, Gyaase S, Oppong FB, et al. Utilization of the national cluster of district health information system for health service decision-making at the district, sub-district and community levels in selected districts of the Brong Ahafo region in Ghana. *BMC Health Serv Res*. 2020;20(1):514.
[9] Okine PENA. An evaluation of community health care service in Ghana: A case of the Community-Based Health and Planning Service (CHPS) compound in Ghana [doctoral dissertation]. London: Brunel University; 2024.
[10] Toelsie J, Mendes R, Dhanpat R, Ori R, Adams R, van Gool C, et al. Digital transformation of mortality reporting using an ICD-11 integrated death certificate system in Suriname. *Rev Panam Salud Publica*. 2025;49: e85.
[11] Murray CJ. The global burden of disease study at 30 years. *Nat Med*. 2022;28(10):2019–26.
[12] Voß S, Hoyer A, Landwehr S, Pavkov ME, Gregg E, Brinks R. Estimation of mortality rate ratios for chronic conditions with misclassification of disease status at death. *BMC Med Res Methodol*. 2024;24(1):2.
[13] Mikkelsen ME, Still M, Anderson BJ, Bienvenu OJ, Brodsky MB, Brummel N, et al. Society of Critical Care Medicine's international consensus conference on prediction and identification of long-term impairments after critical illness. *Crit Care Med*. 2020;48(11):1670–9.
[14] Wright L, Tobias SM, Hickman A. *Coding and documentation compliance for the ICD and DSM: a comprehensive guide for clinicians.* Routledge; 2017.
[15] Agyei-Mensah S, de-Graft Aikins A. Epidemiological transition and the double burden of disease in Accra, Ghana. *J Urban Health*. 2010;87(5):879–97.
[16] Nguyen H, Pullum T, Le T. *Assessment of the quality of cause-of-death statistics in Viet Nam: Results from a verbal autopsy validation study.* Hanoi: World Health Organization; 2013.

 J Health Inform Afr. 2025;12(2):69-82. DOI: 10.12856/JHIA-2025-v12-i2-613