



St. Paul's Hospital Millennium Medical College

**Assessment of quality of facility based medical certifications of death and
its associated factors in Saint Paul's Hospital Millennium Medical College
and Ras Desta Damtew Memorial Hospital**

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St. Paul's Hospital Millennium Medical College Graduate Study Program

“Assessment of quality of facility based medical certifications of death and its associated factors in Saint Paul's Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital, Addis Ababa, Ethiopia: Cross-sectional study”

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Abstract

Background: In many countries medical certificates of cause of death (referred to as ‘death certificate’) are often of poor quality, even when the cause of death has been certified by a doctor. There is limited information concerning the validity of death certificate given in most of the developing countries. In Ethiopia, however, the internationally recommended death certificate guidelines have not been utilized until now. So this research try to analyze the gap in filling the death certificate and put the possible solutions in improving the quality and accuracy of medical certifications of death and also can be a source of information which can be very valuable for others in conducting similar studies in the subject matter.

Objectives: Assessment of quality of facility based medical certifications of death and its associated factors in Saint Paul’s Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital.

Methods: A cross-sectional retrospective record review was conducted at Saint Paul’s Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital. Randomly selected records of patients died after admission to the hospital during the study period was included. The total calculated sample size was 620. The data was entered into a mobile using ODK version 1.26.2 and was exported to statistical package for social science (SPSS) version 25 for analysis. Binary logistic regression analysis was performed to estimate the association between outcome and explanatory variables.

Result: A cross-sectional study was done to assess the quality of medical certification of cause of death and associated factors by assessment tool of University of Melbourne and WHO recommended International form of medical certificate of cause of death.

During the period under study, a total number of 595 death certificates of Saint Paul’s Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital were reviewed. Of the 595 death certificates, 71.6% were from SPHMMC and 58.2% of them were male. Most deaths were in the age group between 25-65 years and most stayed for 1-7 days.

Most of the deaths occurred at the emergency. More than half (57.1%) of the deaths occurred at night. Majority of the death certificates (66.7%) were certified by a Resident. Almost for all the issued death certificate, the manner of death was Natural.

All death certificates were not filled correctly. The most common error was missing time interval between onset and death followed by ill-defined underlying cause of death. The death certifiers usually make three errors in filling medical certificates of cause of death. At least one major and one minor error seen in 50.9% and 34.1% of the death certificates respectively. A significant association was seen between type of health facility and quality of death certificate documentation.

Conclusion: In this study, substantial shortcomings in the death certification practices are seen; all death certificates were not filled correctly. The most common error was missing time interval between onset and death followed by ill-defined underlying cause of death. The death certifiers usually make three errors in filling medical certificates of cause of death. A significant association was seen between type of health facility and quality of death certificate documentation.

Key Words: Cause of Death, Accuracy, MCC

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Acronyms and Abbreviations

AIDS - Acquired Immunodeficiency syndrome

AOR - Adjusted odd's ratio

BLSH – Black Lion Specialized Hospital

COD- Cause of death

D4H - Data for Health

DCs- Death certificates

HMIS- Health Management Information System

HIV- Human Immunodeficiency Virus

ICD- International Statistical Classification of Diseases and Related Health Problems

ICU - Intensive Care Unit

LMICs- Low and middle income countries

MCCOD- Medical certificate of cause of death

RDDH- Ras Desta Damtew Memorial Hospital

SPSS- Statistical Package for the Social Sciences

UCOD- underlying cause of death

WHO - World Health Organization

YGH- Yangon General Hospital

1. Introduction

1.1 Background

Birth and Death are the two most important events in the life of any individual as the person's existence starts at the moment of birth and ceases at the moment of death. Statistical analysis of causes of death forms important morbidity and mortality statistics, which is the backbone of National Health Policy and Planning. For registering a death, identity of the deceased, date and time of death and cause of death are to be provided to the registering authorities. If any of these details are not available death cannot be registered.(1)

Medical officer is the sole authority in deciding the cause of death, proper documentation of cause of death by him is of utmost importance. Wrong diagnosis or incorrect filling up of the certificate will result in gross error in mortality statistics, thus directly affecting formulation of National Health Policy.(1)

The international Form of Medical Certificate of Death (known as death certificate) is recommended by the World Health Organization for certification of death in all countries. The death certification is divided into three sections. Part-1-report sequence/chain of events leading to death. Part-2-other significant condition contributing to death and a column to record the approximate interval between onset and death.(2)

In 1967, the twentieth World Health Assembly defined the causes of death to be entered on the medical certificate of cause of death as 'all those diseases, morbid conditions or injuries which either related in or contributed to death and the circumstances of the accident or violence which produced any such injuries.'(3)

Most routine statistics are based on one cause only per death and there is then the problem of which of multiple causes to select. Before 1948, the practice in most countries was to give one condition automatic precedence over another regardless of the sequence in which they were recorded. The sixth Decennial Revision Conference for the International Classification of Diseases, in 1948, agreed that the single cause of death to be used as the basis for routine mortality statistics should be the underlying cause. (4)

The accuracy of medical certification of COD depends on many factors, including the certifiers' knowledge and skills in correctly identifying the sequence of events leading to death and their understanding of the concept of the underlying COD.(5)

The public health importance of accurate COD information, the concept of the underlying COD, the sequence of events leading to death, and how to correctly complete the MCCOD are rarely introduced to medical students.(6)

Previous research, as well as experiences under the Bloomberg Data for Health (D4H) initiatives, indicates the training on certification of COD provided to medical school students is inadequate globally. As many as half of all registered deaths globally do not have an accurate COD assigned Whilst the majority of LMICs do not have complete and reliable COD data.(7) There have been media reports and studies which have revealed that approximately 50-60% of medical certificates of cause of death submitted to death registering authorities are incorrectly filled up.(8)

A 2017 study at a selection of hospitals with high inpatient death rates in the USA found that 46% of reviewed MCCODs were completed incorrectly.(9) Similarly, in 2010, about 24% of deaths in South Africa were reported as being due to ill-defined or unknown causes, resulting in suboptimal and biased COD information for planning purposes.(10)

Although DCs are an important tool for reporting and gathering vital statistics within a population, there is little evidence concerning their validity and the factors that influence their accuracy.(7,8,9)

The Medical Certificate of Cause of Death (MCCOD) assessment tool was developed by the University of Melbourne and used to assess individually each medical certificate of cause of death. It checks whether appropriate fields are filled in correctly including sections on the certificate details, details about the deceased, and checks for nine common errors and omissions of information related to the cause of death. It checks if the correct underlying cause of death is identified given the available information on the form, but does not check the validity of the ICD coding.(11)

This tool can be used to assess the quality of medical certification of death as part of routine assessment, or to assess the training needs of physicians and clinicians in designing cause of

death certification training. It can also be used to evaluate the effectiveness of death certification training.(11)

On national level, Ethiopia adopted a widespread rule monitoring the official and functioning outline of vital events registration, which was correspondingly made obligatory by the FDRE Proclamation No.760/2012.(12) Vital events registration was inaugurated across the country as of 06 August 2016, and was reinforced by the FDRE Proclamation No. 1049/2017.(13) However, the internationally recommended death certificate or ICD guidelines have not been utilized until now.

1.2 Statement of the problem

The medical part of the MCCD certificate is the responsibility of the attending physician and based on his individual assessment. In case of medico-legal cases, cause of death should be written by medical officer who performs post-mortem and on the basis of evidence noticed by him. (14)

Completeness and accuracy with which the certificate of cause of deaths filled by the attending physicians are of prime importance in building the base of cause of death statistics. Physicians should acquire the required knowledge and skill so as to fill the form as per the standard. All morbid conditions have to be written in sequence, starting from immediate cause to underlying cause. Additionally there should be regular monitoring and periodical evaluation to assess the quality of MCCD.(15)

The quality of death certificates is influenced by many factors, including medical education, physician knowledge, and hospital resources.(16)

An attending doctor may be required to report *unnatural and sudden deaths* to the legal authority for inquest /postmortem to determine the cause and circumstance of death which is usually not practiced in Ethiopia. Since postmortem examination left undone it's difficult to know the UCOD in most sudden deaths.

In most African Countries, mortality statistics systems are deficient, often characterized by fragmented and uncoordinated collections from multiple sources. The situation is more problematic when it comes to the quality of cause of death statistics in Africa. According to WHO, only five countries in Africa produce cause of death data on national basis (Cabo Verde, Egypt, Mauritius, Seychelles, and South Africa).(17) In addition, some hospitals lack the basic diagnostic facilities that are needed to determine accurately the cause of death.(18,19) Lack of awareness among junior physicians of the requirements and significance of MCCD form, nonavailability of standard Death certificate form and loose death statistics monitoring are the major problems seen in many developing countries including Ethiopia. As a result, African countries lack continuous, permanent and universal sources of mortality data, and therefore face considerable challenges in developing health interventions and building health systems, measuring and monitoring mortality and in

reporting on national and global development mortality goals and targets, such as set under the Sustainable Development Goals.(17) Therefore Evaluation of the accuracy and quality of Death certification has a prime importance to identify the gaps so as to administer a proper Death certificate.

1.3 Significance of the study

Government officials may need the death certification to review the cause of death during investigations to determine if foul play occurred.(20)

Public health policies depend heavily on the mortality data from death certificates because they are only source of information about the causes of death and illnesses preceding death. Death certificates (DC) can provide valuable health status data regarding disease incidence, prevalence and mortality in a community. It can guide local health policy and help in setting priorities.(21) Public health officials use death certificates to compare data on various statistics, including leading causes of death.(22)

DCs provide valuable data for health researchers and epidemiological studies, and also benefit families by providing data about risk factors for inherited diseases.(23)

Death and cause of death records are primary inputs for health policy and planning, monitoring and evaluation of health programs, and identifying and prioritizing health research and the generation of evidence. Accurate and timely data on mortality by age, sex and cause of death justify public health spending on interventions aimed by tackling major causes of premature mortality. Such as immunization to prevent measles, access to skilled care to prevent maternal mortality, tobacco control measures to prevent deaths from cancer and cardiovascular diseases, and behavior - change interventions to prevent HIV/AIDS.

Horton notes that neglect of civil registration systems (including death registration) has been called ‘the single most critical failure of development over the past 30 years. (17)

2. Literature Review

Mortality studies are an established resource for research into trends in the health of a population (WHO, 2014). They allow comparison between and within populations and are a method for analyzing the success of health policies and interventions. As stated by Jha (2012), “counting the dead is one of the world’s best investments to reduce premature mortality worldwide as it is one of the most robust ways to measure accurately the effectiveness of investments aimed at reducing mortality”. Accurate and consistent reporting of causes of death is critical for creating reliable data to be used by mortality studies. Highlighting the importance of mortality studies, Swain, Ward, and Hartlaub (2005) note, “the primary tool for measuring mortality rates is the death certificate”(p. 652). (24)

In 1927, the world health organization (WHO) recommended the Medical Certificate of Cause of Death (MCCD) to be the format to record the cause of a person’s death. The MCCD is divided into two sections, parts 1 and 2. The WHO defines the underlying cause of death as “a) the disease or injury which initiated the train of morbid events leading directly to death, or b) the circumstances of the accident or violence which produced the fatal injury” (WHO, 2010, p. 31). Part 2 of the MCCD is used to list other significant conditions, diseases or injuries that contributed to the death, but were not part of the direct sequence leading to death. The MCCD is completed by a medical practitioner or in some cases a coroner. The information from the MCCD is then coded using the latest International Classification of Disease (ICD) codes, to form national statistics on the causes of death of a population. The quality and reliability of MCCD for use in mortality studies is a source of scrutiny and debate: studies in Australia, Chile, Estonia, Sri Lanka, Greece, the United Kingdom and the United States have noted common problems as being ill-defined causes of death or modes of death, improper causal sequences and the mechanism rather than the cause of death being reported. (25)

2.1 Historical Background

In 1538, King Henry viii of England, in an attempt to free the plague commanded communities to register christenings, marriages, and burials. In the mid-1800s William Farr developed the International Classification of Disease through which trends in specific cause of death could be compared within and between populations. In 1850 the 7th census of the United States was largely devoted to reporting the cause of death by age, gender, ethnicity, season, occupation, duration of illness and slave status. And in 1900, the National Death Registry was started in US, with the various states joining when they could assure the accuracy of their data. (26)

In 1967, the Twentieth World Health Assembly defined the causes of death to be entered on the medical certificate of cause of death as “all those diseases, morbid conditions or death and the circumstances of the accident or violence which produced any such injuries. The first attempt to prepare a scientific classification of disease would appear to have been made towards the end of the seventeenth century since other systems have been published from time to time. At the 1893 meeting of the international statistical Institute, Bertillon presented, on behalf of a special committee, a draft “International list of cause of death” which was found, generally acceptable and was subsequently adopted by the various member countries. It came into use in England and Wales since 1911 (Myers, 1998). (27)

It is not easy to determine a really good method of selection of a single cause of death for tabulation in cases of multiple illness. The system adopted in 1893, was, however, internationally recommended in 1948 whereby the main line of causation is separated from merely contributory features and the time sequence is given of the series of causes that directly led to immediate cause. (28)

2.2 Magnitude of the problem

A 2017 study at a selection of hospitals with high in-patient death rates in the USA found that 46% of reviewed MCCODs were completed incorrectly.(9) Similarly, in 2010, about 24% of deaths in South Africa were reported as being due to ill-defined or unknown causes, resulting in sub-optimal and biased COD information for planning purposes.(10)

Study done in India in 2019 All 410(100%) MCCD forms assessed were notably incomplete and inaccurate. Time interval between mortality causes and death was mentioned in 2(0.48%) certificates only and that was also inaccurate. Other major errors were mode of dying mentioned as an immediate or antecedent cause of death 353(86%) and 170(41%) respectively, multiple causes and use of short forms 229(56%) and 143(35%) respectively.

Globally, completeness and quality of cause of death data was assessed where European Region (EUR) had maximum number of countries with high quality mortality data. In South East Asia Region (SEAR), only four countries were reported where India reported very low quality data (10%) (29).

Another study which was conducted to find out errors in the medical certification of cause of death during July 2011 at a new teaching hospital in Vadodara. All certificates of in-hospital deaths in medical record department, from May 2010 to June 2011, were assessed for major and minor errors. The results revealed that out of 40 death certificates, not a single was free from any error. Major errors occurred in 23(57.5%) cases with improper sequencing (55%) as most frequent. Most common minor error was the absence of time interval between the onset of disease and death (92.5%) (30).

In the study of Ko Ko Tun (2009), the study of medical certificate of cause of death, Sanpya Hospital, out of 109 death recorded shows that incomplete filling of death certificate is 96.3%, mechanism of death listed without an underlying cause is 44%, improper sequencing is 12.8%, Using abbreviation is 45%, absence of time interval is 98.16%, the mechanism of death followed by a legitimate underlying cause is 11.9% (38). In the study of department of health planning, 2013, random collection of five records from twenty hospitals was done.

The findings of quality issues were underlying cause of death certified as lowest line in part 1 of death certificate in 16 85.3%, all diseases described in part 1 of death certificate appear in correct sequence in 61.7%, no mode of death found in death certificate in 76%, no abbreviation found in 65.3% respectively. A study in Yangon General Hospital was founded that underlying cause of death certified as lowest line in part 1 is 85.2%, totally in reverse of correct sequence in death ertificate is 4.2%,use of mode of death in underlying cause of death is 1% ,use of ambiguous words found in part1 is 14.2% (26).

2.3 Intervention to improve the quality of MCCD

The TOT strategy led to reductions in incorrectly completed certificates of between 28% in Sri Lanka and 40% in the Philippines. Following direct training of physicians in PNG, the reduction in incorrectly completed certificates was 30%. In Peru, the reduction in incorrect certificates was 30% after implementation and training on an online system only and 43% after training on both the online system and basic medical certification principles.(32)

This study assessed the quality of medical certification in five countries, pre- and post-implementation of specific training strategies. In all countries, training physicians in medical certification improved the diagnostic accuracy of certification; the proportion of incorrectly completed MCCODs ranged from 73 to 100% prior to training, decreasing to 44–75% post-training. Despite these improvements, it is notable that 23–45% of certificates still contained major errors post-training.(32)

Study done to see educational intervention to improve internal medicine residents accuracy on death certificate completion. A total of 229 death certificates (146 completed before and 83 completed after the intervention) were audited for minor and major errors, and the rates of errors before and after the intervention were compared. Major errors were identified on 32.9% of the death certificates completed before the intervention, a rate comparable to previously reported rates for internal medicine services in teaching hospitals. Following the intervention the major error rate decreased to 15.7% ($p = 0.01$). The reduction in the major error rate was accounted for by significant reductions in the rate of listing of mechanism of death without a legitimate underlying cause of death (15.8% v. 4.8%) ($p = 0.01$) and the rate of improper sequencing of death certificate information (15.8% v. 6.0%) ($p = 0.03$). (28)

A study of medical doctor's attitude to filling of the death certificate was carried out by administering questionnaire to medical doctors at a national conference which was attended by 300 doctors. Out of this, 114 of them responded with 111 being males and 3 females. Results show that 50% of the respondents had 18 practiced for 6-15 years and 71% of them never had training in filling of the death certificate. 55% of the doctors were exposed to death certificate at the post-graduate level. This study has strongly supported the need to include formal training on death certificate completion and indications for medico-legal autopsies as part of continue Medical Education in Nigeria. (33)

In Canada, there is a study that an educational intervention was designed and implemented to improve internal medicine residents' accuracy in death certificate completion. A total of 229 death certificates (146 completed before and 83 completed after the intervention) were audited for major and minor errors, and the rates of errors before and after the intervention were compared. Major errors were identified and on 32.9% of the death certificates completed before the intervention, a rate comparable to previously reported rates for intervention the major error rate decreased to 15.7%. The reduction in the major error rate was accounted for by significant reductions in the rate of listing of mechanism of death without a legitimate underlying cause of death (15.8% v. 4.8%) and the rate of improper sequencing of death certificate information (15.8% v.6.0%). This study shows that errors are common in the completion of death certificates in the in-patient teaching hospital setting. The accuracy of death certification can be improved with the implementation of a simple educational intervention (Myers et al, 1998). (27)

2.4 Conceptual Framework

The Conceptual Framework for studying the factors associated with the quality of medical certification of cause of death had been developed by reviewing different litterateurs.

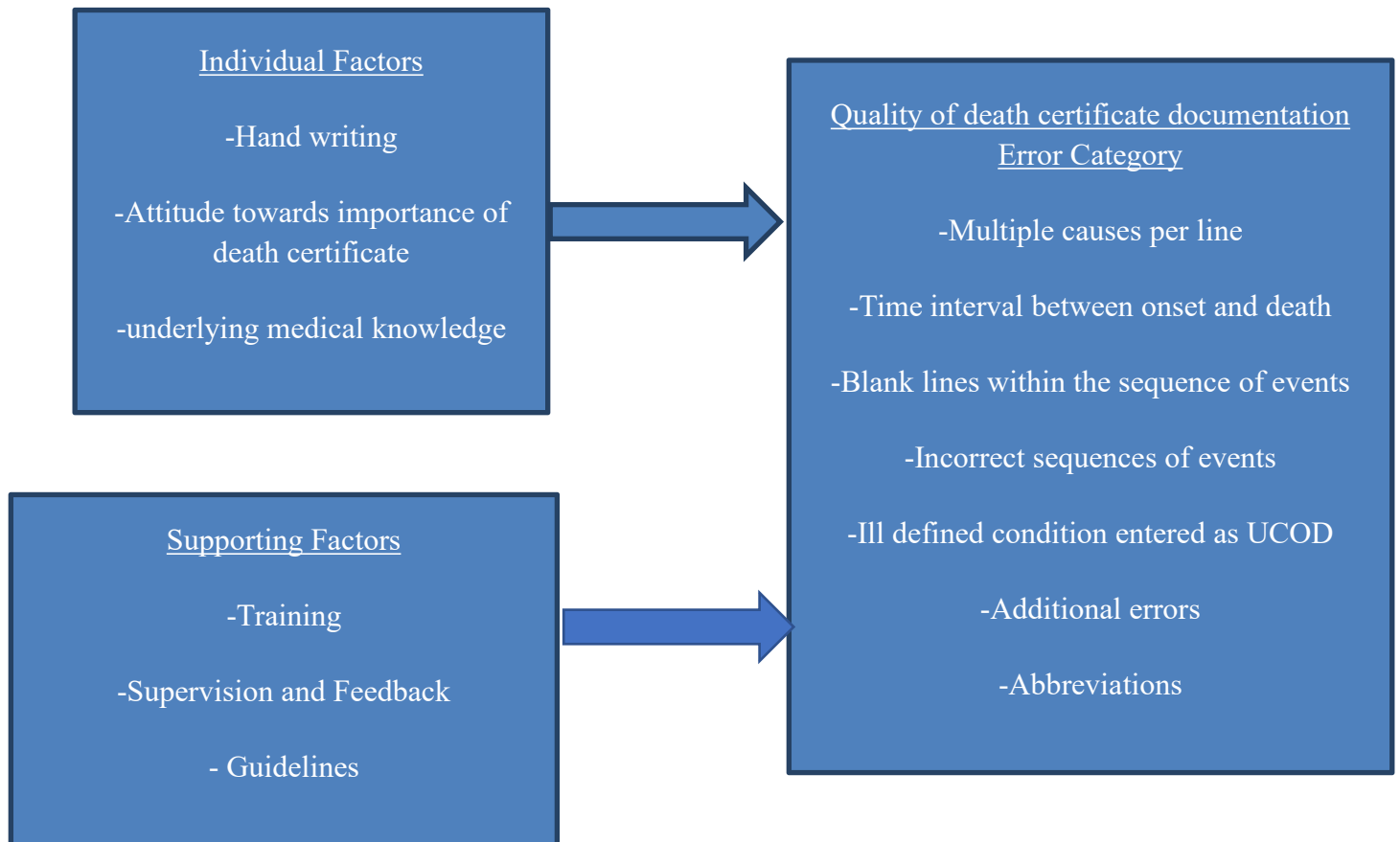


Figure 1: *Conceptual framework of factors associated with the quality of medical certification of cause of death, Addis Ababa, Ethiopia, 2022.*

3. Objectives

3.1 General Objective

- To assess the quality of facility based medical certifications of death and its associated factors in Saint Paul's Hospital Millennium Medical College and Ras-Desta Hospital between September 11, 2020 to September 10, 2021.

3.2 Specific Objective

- To assess the proportion of quality facility based medical death certificates.
- To study factors influencing the quality of death certificate documentation.

4. Methods and materials

4.1 Study area

The study was conducted at Saint Paul's Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital in Addis Ababa.

Saint Paul's Hospital Millennium Medical College is the second largest hospital in Ethiopia, was established through a decree of the Council of Ministers in 2010, although the medical school opened in 2007 and the Hospital was established in 1968 by the late Emperor Haile Selassie. The college has more than 2800 clinical, academic and administrative and support staffs that provide medical specialty services to patients who are referred from all over the country, teaching medicine and nursing students and doing basic and applied researches. While the inpatient capacity is more than 700 beds, the college sees an average of 1200 emergency and outpatient clients daily. *In 2013 EC, the total number of deaths from all service areas were 1892.* Patients are attended by physicians of different levels of training including Interns, General practitioner and residents, all of whom might complete a medical certification of cause of death.

Ras Desta Damtew Memorial Hospital initially established by Italian catholic missionaries on August 13, 1932 (1924 E.C). The Hospital has more than 930 staff including clinical, administrative and support staffs. The inpatient capacity is more than 166 beds, the hospital sees daily an average of 271 and 26 clients at outpatient and emergency department respectively. In 2013 EC, the total number of deaths from all service areas were 769 (Inpatient: 323, Emergency: 204, Adult ICU: 121, NICU: 121). Patients are attended by Interns, General practitioner and residents (at Gynecology and obstetrics department only).

4.2 Study period

The study was conducted with retrospective data collection during May 22, 2022 to June 21, 2022. The death certificate issued from September 11, 2020 to September 10, 2021 (for 01 year) was reviewed retrospectively.

4.3 Study design

Hospital based cross-sectional study was used.

4.4 Source Population and study population

4.4.1 Source population

All deaths happening in Saint Paul's Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital.

4.4.2. Study population

All deaths happening in Saint Paul's Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital and fulfilling the inclusion criteria.

4.5 Eligibility: Inclusion and Exclusion Criteria

4.5.1 Inclusion Criteria:

- All deaths in the study period that occurred in SPHMMC and Ras Desta Damtew Memorial Hospital for which death certificates and medical records are available.

4.5.2 Exclusion Criteria:

- Deaths with incomplete medical records and having medico-legal components will be excluded.

4.6 Sample size determination and sampling procedure

➔ The sample size was determined by using Single population proportion formula $\left(\frac{(z_{\alpha/2})^2 p(1-p)}{d^2} \right)$, 50% p-value was taken since there is no published similar study in our country. A 95% level of confidence, 5% margin of error will be used.

$$n = \frac{(z_{\alpha/2})^2 p(1-p)}{d^2}$$

Were

n = the desired sample size.

$Z_{\alpha/2}$ = critical value at 95% confidence level of certainty = 1.96.

P = 50% was taken since there is no published similar study in our country.

d = marginal error of between the sample and population = 5%

$$n = \frac{(1.96)^2 0.5(1-0.5)}{0.05^2} = \frac{0.9604}{0.0025} = \mathbf{384}$$

➔ The sample size for factors influencing the accuracy of death certificate documentation was calculated by using a double population proportion formula. The following parameters were entered in the software to calculate the sample size. These are two-sided confidence level at 95%, Power at 80%, Ratio of Unexposed to exposed as 1. P1 is a percent of exposed with the outcome and P2 is a percent of non-exposed with the outcome. Study done at BLSH was used to get the p-value (35).

Table 1 *Sample size calculated based on variables which are significantly associated with death certificates errors from study done at BLSH. (35)*

Variables	CL	Power	Ratio	P1	P2	Sample size
Duration of stay at the hospital before death	95%	80%	1	25.2%	74.8%	68
Qualification of death certifier	95%	80%	1	64.7	35.3	20
Place of Death	95%	80%	1	3.4	96.6	564

Variables which are significantly associated with death certificates errors were identified and were used to calculate the sample size. It is calculated by using Epi info version 7.2.5.0.

⇒ The sample size for the 2nd objective was the greatest. Therefore, 564 will be taken. By adding 10% for incomplete charts the sample size increased to **620**.

Sampling Procedure

- In Addis Ababa there are 11 governmental hospitals. All clients receive almost similar care and treatment by service providers includes intern, general practitioner, residents and senior physicians. Amongst TASH, SPHMMC and Yekatit Hospital are teaching institutions with better level of training. Considering this assumption, identification number was assigned to each hospital under the cluster. Random/lottery method was generated using excel which was then ranked SPHMMC & RDDH ranked the first and second and were selected.

Table 2: *Facility name with corresponding rank's using excel*

Cluster ID	Facility Name	Random/Lottery Number	Rank
C1	Gandi memorial hospital	0.124512321	11
C2	Tikur Anbesa	0.412512142	8
C3	St Paul hospital	0.997024587	1
C4	Amanuel hospital	0.243621458	10
C5	Zewditu hospital	0.521412141	6
C6	Yekatit hospital	0.312124512	9
C7	Minilik hospital	0.432125412	7
C7	Ras Desta Memorial hospital	0.921457258	2
C9	Alert hospital	0.714235412	4
C10	St peter specialized hospital	0.702130453	5
C11	Tirunesh Beijing hospital	0.841212145	3

Finally the sample size was distributed proportionally based on the total number of deaths registered at the facilities. The total number of deaths in SPHMMC and RDDH were 1892 and 769 respectively in the year 2013 EC.

Hence, the sample obtained from St Paul hospital will be $1892 / (1892+769) \times 620 = \mathbf{441}$ and from RDDH $769 / (1892+769) \times 620 = \mathbf{179}$

- In order to select a sample (n) of death certificates from the total 2661 death certificates a systematic random sampling was used. With systematic random sampling, there would be an equal chance (probability) that each of the 2661 death certificates could be selected for inclusion in the sample. We chose a sample size of 620 death certificates. A consecutive number from 1 to N (2661) was assigned, next to each of the death certificates. Assuming a sample size of 620 death certificates, sampling fraction was worked out, which is simply the sample size (n) selected divided by the population size (N). Thus, 1 Dc in every 4 Dc from the population of 2661 was selected. The first starting number was chosen using a lottery method.

4.7 Study Instrument

The death certificate records were reviewed for the completeness using the WHO recommended International form of Medical Certificate of Cause of Death and the Rapid Assessment Tool of University of Melbourne.

4.8. Study variable

4.8 .1. Dependent Variables

Quality of Death Certificate

4.8.2. Independent Variables

Type of health facility, age, sex, duration of stay at the hospital before death, time of death, qualification of certifying and treating Physician, place of death and manner of death.

4.9 Operational Definitions

Cause of death- 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, in accordance with the rules of the ICD.(4)

Clinically improbable sequence of cause of death-Mortality statistics are based on the underlying cause of death, which is the condition or injury that initiated the sequence of events that led directly to death. When a clinically improbable sequence of events is recorded, it is impossible to select the correct underlying cause of death. (4)

Intermediate Cause of Death- the condition which leads from the underlying cause of death to the immediate cause of death. (4)

Death certification- either a legal document issued by a medical practitioner which states when a person died, or a document issued by a government civil registration office, that declares the date, location and cause of a person's death, as entered in an official register of deaths. (4)

Ill- Defined Underlying COD- unusable and vague causes, such as septicemia/sepsis,

Heart failure, Pneumonia- unspecified, Senility, Depression, Essential primary hypertension, Cardiac arrest.(4) *The 'gold standard' for cause of death statistics is complete civil registration where each death has an underlying cause assigned by a physician and is coded according to International Classification of Diseases (ICD) rules.*(38)

Immediate cause of death- 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. (4)

Major Error- Errors were classified as major if they could have an impact on the identification of the underlying cause of death (underlying cause missing, competing potential underlying causes or improper sequencing). Multiple causes per line, Incorrect sequence of events leading to death, Ill-defined or poorly specified condition entered as the UCOD, Illegible hand writing are the major errors (4). *Clinically improbable sequence of cause of death was taken as the main dependent variable since it has an impact on the identification of the UCOD.*

Medico-legal cases – involves any injury or medical condition in which law enforcement agencies seek to investigate and fix the responsibility regarding the said injury or medical condition. (37) *In this article cases for which postmortem examination was requested including sudden death are considered as medico-legal cases.*

Minor Error- Presence of blank spaces within the sequence of events, Absence of disease time interval, Abbreviations used in certifying the death, Additional errors on the certificate (not filling name, age, sex..) are the minor errors.(4)

Underlying cause of death- the disease which has initiated the series of illnesses leading directly to death, or the circumstances connected with an accident or an act of violence which caused the injury or poisoning leading to death. (4)

4.10 Data collection and Methods

- The data was collected from the HMIS (Health Management Information System) and Mortuary registering Log books. Quality of death certificate was assessed by a structured questionnaire designed by compiling three forms including the important attributes of the

deceased, the WHO recommended International Form of Medical Certificate of Cause of Death and the Rapid Assessment Tool.

- The questionnaire has 10 main parts including socio demographic data of the deceased (including age and sex), Duration of stay, time and place of death, qualification of certifier and treating physicians, Manner of COD, International form of MCCOD and Rapid Assessment Checklist.
- The first part of the questionnaire was filled directly from the charts. The death certificate of the hospital was copied onto the prepared standard death certificate made as per the WHO recommended form.
- Mortality statistics are based on the underlying cause of death, which is the condition or injury that initiated the sequence of events that led directly to death. **When a clinically improbable sequence of events is recorded, it is impossible to select the correct underlying cause of death. Thus, clinically improbable sequence of cause of death was taken as the main dependent variable and certificates with clinically improbable sequence of cause of death were evaluated for their relationship with it. A question of “Is there clinically improbable sequence of cause of death” was dichotomized into “Yes” and “No” on the contingency table.**

WHO recommended International Form of Medical Certificate of Cause of Death for the certification of death.

CAUSE OF DEATH		Interval between on set & death approx.
I		
Immediate cause	(a)	
State the disease, injury or complication which caused death, not the mode of dying such as heart failure, asthenia, etc.	Due to (or as a consequences of)	
Antecedent cause	(b)	
Morbid conditions, if any, giving rise to the above Cause, stating underlying conditions last	Due to (or as a consequences of)	
	(c)	
II		
Other significant conditions contributing to the death but not related to the disease or conditions causing it		

WHO recommended International Form of Medical Certificate of Cause of Death for the certification of death. Example...

CAUSE OF DEATH		Interval between onset & death approx.
I		
Immediate cause	(a) <i>Pneumonia</i>	2 Days
State the disease, injury or complication which caused death, not the mode of dying such as heart failure, asthenia, etc.	Due to (or as a consequences of)	
Antecedent cause	(b) <i>Metastatic cancer of bladder and abdomen</i>	2 Years
Morbid conditions, if any, giving rise to the above Cause, stating underlying condition last	Due to (or as a consequences of)	
	(c) <i>Adenocarcinoma of rectum</i>	
II		
Other significant conditions contributing to the death but not related to the disease or conditions causing it	<i>Diabetes Mellitus</i>	10 Years

For ease of access, it was modified into a form containing its details as stated below.

Part 1

A. Immediate Cause of death _____

B. Antecedent/Intermediate Cause of death _____

C. Basic/underlying cause of death _____

Part 2

D. Contributory Cause of death _____

Part 2

E. Time interval from onset to death _____

The Rapid Assessment Tool which was adopted from the University of Melbourne was then used as a checklist to measure errors.

Error category	Number of certificates with error*	Percentage (%)
1. Multiple causes of death recorded in any of the lines of Part 1		
2. Missing time interval from onset to death in any of the lines		
3. Abbreviations used in the entries in any of the lines		
4. Illegible handwriting in any of the lines		
5. Incorrect or clinically improbable sequence of events leading to death in Part 1		
6. Impossible underlying cause entered in the lowest used line of Part 1		
7.a. Was the death due to an accident, violence, poisoning or other external cause?		
7.b. For deaths due to external causes, i.e. accident/violence/poisoning, were the circumstances missing? (details of the accident or violence including intent and activity [e.g. pedestrian knocked down by a car, assaulted with a knife] and place of occurrence)**		
8.a. Was the death due to a neoplasm?		
8.b. For deaths due to neoplasms, additional details were missing (site, morphology, behaviour)***		
Total number of certificates with at least one error*		

Based on their effect on coding, errors were categorized into ‘Major’ and ‘Minor’, as follows

Category	Type of error	Yes	NO
Major	More than 1 COD in any part of Part I		
	Clinically improbable sequence of COD		
	Ill defined or impossible UCOD		
	Illegible handwriting		
	Insufficient information on the external COD		
	Insufficient information on neoplasms		
Minor	Blank spaces		
	Abbreviations used in certifying the death		
	Time interval not determined		
	Additional errors on death certificate		

- After the the checklist being completed by checking on the ‘error’ category, percentage of certificates charts with errors was calculated. Errors were categorized and percentage of ‘Minor’ and ‘major’ criteria was calculated.
- Association of errors and variables were also evaluated.

4.11 Data quality assurance

Training was given to data collectors to ensure the validity and reliability of the data collection tool, pre-test was done on 5% of the total sample size 1 week before the actual data collection and the abstraction tool was checked for its clarity, understandability and simplicity. For missing data elements on the death certificate medical charts were reviewed. The researcher was responsible for monitoring the data collection process. Complete abstraction tools was received, checked for completeness and entered using EPI data. The investigator was responsible for supportive supervision on the spot and on reviewing all filled questionnaires on daily basis.

4.12 Data processing and analysis

The data was entered into a mobile using ODK version 1.26.2 and exported to statistical package for social science (SPSS) version 25 for analysis. During and after the data collection, data editing was done for the errors and inconsistencies. The missing data and the inconsistencies were checked by running frequencies. Data was presented by using graphs, charts, tables and proportion. The outcome variables were dichotomized to “Yes” and “No” and coded 1 and 0 respectively. Chi-square test was conducted to determine adequate cell counts for each categorical variable. Multicollinearity effect among independent variables was checked using Tolerance and Variance Inflation Factor (VIF). Bivariate analysis was performed and explanatory variables with P-value <0.25 was entered into the final regression model. Multivariate logistic regression analysis were performed to estimate the association between outcome and explanatory variables. A p-value <0.05 was considered statistically significant in this study. The degree of association between dependent and independent variables were reported using adjusted odds ratio with 95% CI. The fitness of the model was tested by Omnibus test of model coefficients and Hosmer and Lemeshow test.

4.13 Ethical Consideration

The study was started after approval of the ethical committee of Saint Paul's Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital. Information used in this study was anonymized. Serial numbers were assigned to individual cases, and the information is stored on password protected personal computer. Waiver of informed consent was asked from IRB because of the anonymization of the data, the difficulty of reaching next-of-kin and the potential value that the findings may add to clinical practice, national policy formation and the low risk involved in the use of the data.

4.14 Dissemination of the result

The result of the study will be presented and submitted to Saint Paul's hospital and Millennium Medical College and Ras Desta Damtew Memorial Hospital community and academicians. Additionally, the study result will be disseminated to Federal ministry of health, civil registration and vital statistics bureau and academic partners working on this area, further attempt will be made to publish it on national and international scientific journals.

Results

In this study, a total of 620 Death Certificates and corresponding medical records were reviewed during the study period from two Hospitals (1 General and 1 Referral). Of those, 25 Death certificates were incomplete and excluded because of illegible handwriting. In the end, 595 DCs were enrolled and included in the final analysis. Errors of 'More than 1 COD in any part of Part I' among the major errors and 'Blank space' among the minor errors couldn't be assessed because the standardized WHO recommended death certificate was not utilized in the two health facilities.

Socio-demographic Characteristics of Deceased

Of the 595 DCs analyzed, 71.6% (n=426) were from SPHMMC and 28.4% (n=169) were from RDDH. Out of which 58.2% (n=346) of them were male. Most deaths were in the age group between 25-65 years and followed by age greater than 65 years with 65.7 % (n=391) and 21.7% (n=129) respectively.

Table 3: *Socio demographic characteristics of deceased for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

Variable		Frequency	Percentage (%)
Hospital Name	SPHMMC	426	71.6
	RDDH	169	28.4
Sex	Male	346	58.2
	Female	249	41.8
Age	0-14	22	3.7
	15-24	53	8.9
	25-65	391	65.7
	>65	129	21.7
	Total	595	100

➤ **Duration of stay at the Hospital before Death**

The majority of the deceased stayed for a duration of 1-7 days 334 (56.1%), followed by deceased who stayed from 8 days to 1 month that has a frequency of 140 (23.5%) and the smallest percentage stayed for more than one month that is 11 (1.8%).

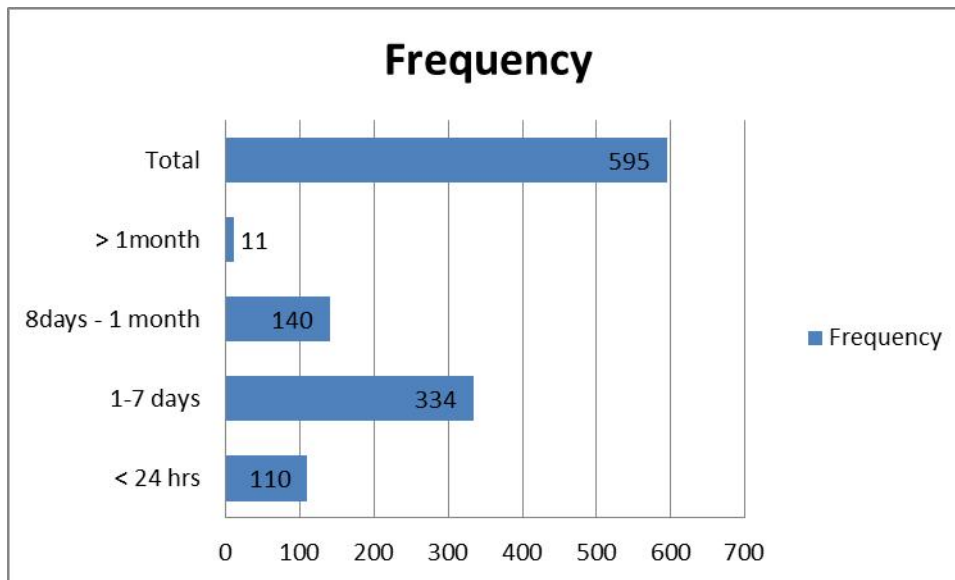


Figure 2- *Duration of Stay at the Hospital before Death*

➤ Concerning time of the day when the death occurred, 340 (57.1%) deaths occurred during Night time and 255(42.9%) at day time.

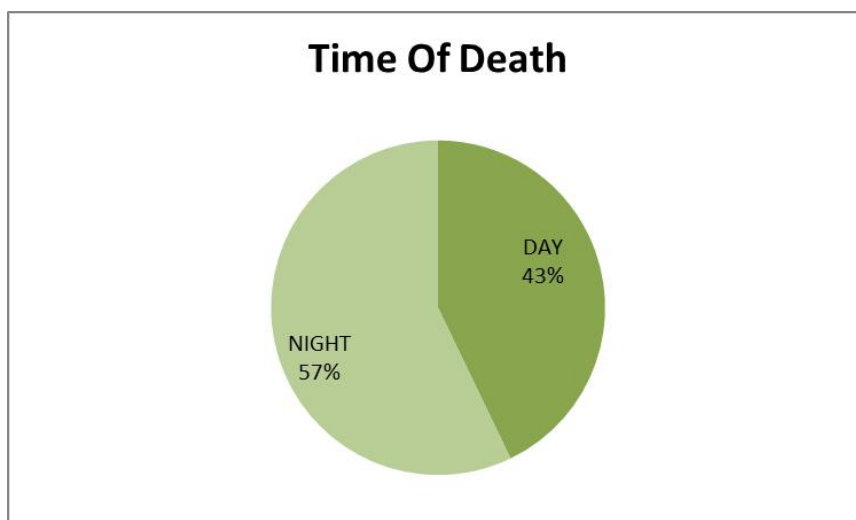


Figure 3 – *Time of the day when death occurred*

➤ **Qualification of Death Certifier**

Majority of the certificates 66.7% (n=397) were certified by Resident and the remaining 33.3% (n=198) of the certificates were certified by general practitioner.

	Frequency	Percentage
General Practitioner	198	33.3%
Resident	397	66.7%
Total	595	100%

Table 4: *Qualification of Death certifier of Deceased for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

➤ **Qualification of Treating Physician**

Majority of Deceased were treated by Senior, Resident and Intern with frequency of 397 (66.7) and the remaining 198 (33.3%) were treated by Senior, General Practitioner and Intern.

	Frequency	Percentage
Senior, Resident and Intern	397	66.7%
Senior, General Practitioner and Intern	198	33.3%
Total	595	100%

Table 5: *Qualification of Treating physicians of Deceased for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

➤ **Manner of Death**

Almost for all the issued death certificate, the manner of death was Natural. Only 5(1.5%) Deceased with unknown manner of death.

	Frequency	Percentage
Natural	585	98.5
Unknown	9	1.5%
Total	595	100%

Table 6: *Manner of Death of Deceased for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

➤ **Place of Death**

There were 259 (43.5%) deaths that took place at the Emergency whereas 191 (32.1%) and 145 (24.4%) occurred at Intensive Care Unit and Ward respectively.

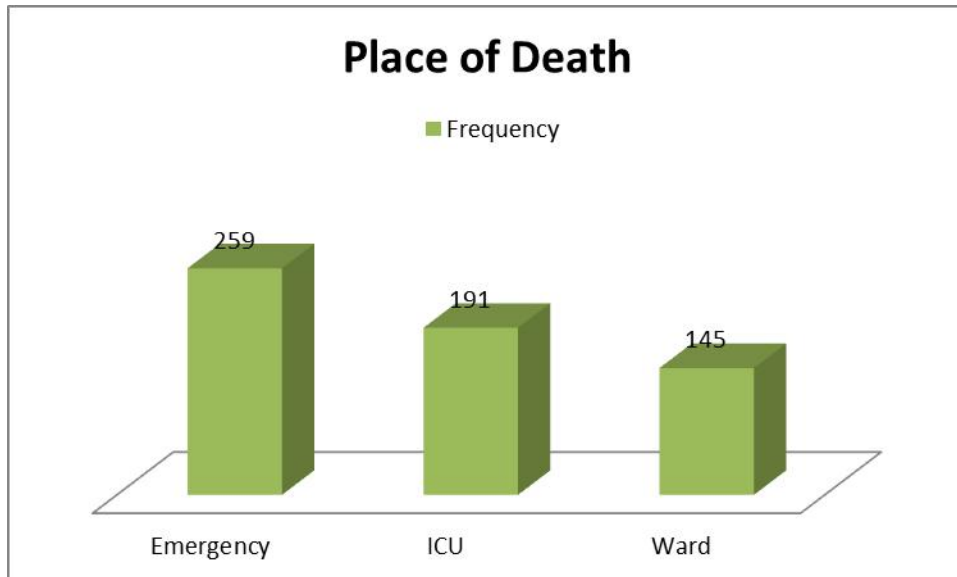


Figure 4: *Place of Death at the Hospitals*

➤ **Errors (Major and Minor) on Issued Death Certificates**

All the issued Death Certificates had errors and the most common error was a missing duration of time interval between sequences leading to death followed by death certificates with ill defined underlying cause of death.

Errors on Death Certificates		Frequency		Percentage
Major	Clinically Improbable sequence of Cause of Death	Yes	279	46.8%
		No	316	53.2%
	Ill Defined UCOD	Yes	433	72.8%
		No	162	27.2%
	Unspecified Neoplasm	Yes	38	6.4%
		No		
Minor	Abbreviations used	Yes	350	58.8%
		No	245	41.2%
	Time interval not determined	Yes	595	100%
		No	0	0%
	Additional Errors	Yes	92	15.5%
		No	503	84.5%

Table 7: *Frequency of Major and Minor Errors for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

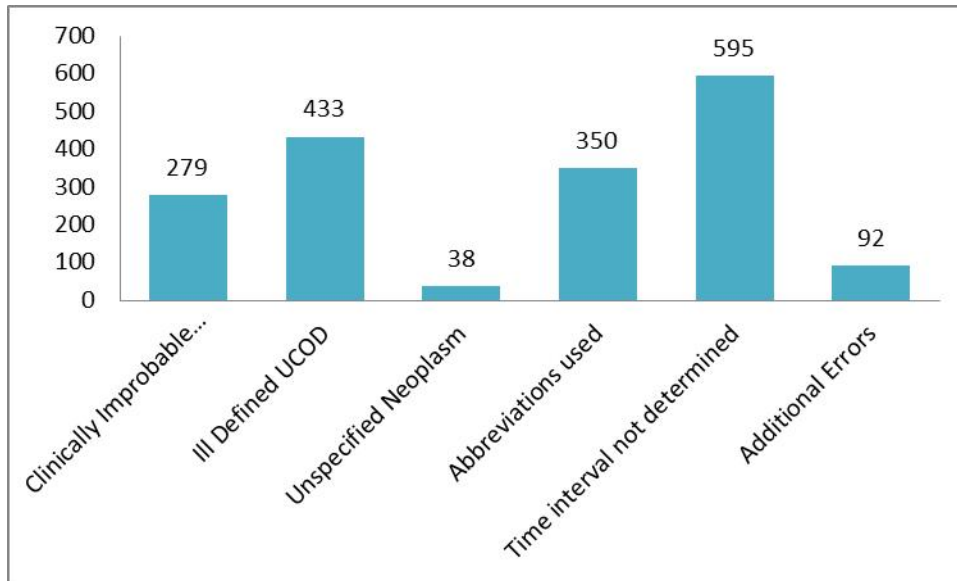


Figure 5: Documentation Errors on Issued Death Certificates

- Illegible handwriting is one among the major errors. There were 25 death certificates with illegible handwriting among the 620 reviewed medical death certificates.
- The time interval between onset and death of mentioned cause was needed to be filled in death certificate. The above table showed all death certificates were not recorded time interval between onset and death.
- The sequence of events leading to death was needed to be written correctly. Presence of clinically improbable sequence of events leading to cause of death (incorrect practice) was found in 46.8% and correct sequence of events (correct practice) was occurred in 53.2%.
- Abbreviations were found in 58.8% of death certificates and abbreviations were not found in 41.2%.
- Additional details such as site, behavior and morphology are missing for all 38 deaths due to a Neoplasm.
- Ill-defined condition entered as UCOD was 72.8% (incorrect practice) and ill-defined condition is not entered as UCOD was 27.2% (correct practice). Among the ill-defined condition, Mode of dying was the commonest with 60.9% (n=264) and followed by Mechanism of death with 33.9% (n=147).

	Frequency	Percentage
Ill-defined condition entered as UCOD	433	72.8%
Mode of Dying	264	60.9%
Mechanism of Death	147	33.9%
Laboratory Value	20	4.7%
Sign and Symptom	2	0.5%
Total	433	100

Table 8 : *Distribution of ill-defined conditions entered as the UCOD for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

➤ **Assessment of Additional errors on the death certificates**

Additional Errors	Frequency		Percentage
Not filling Name	Yes	0	0%
	No	595	100%
Not filling Age	Yes	21	22.8%
	No	574	77.2%
Not recording Sex	Yes	22	23.9%
	No	573	76.1%
Not filling DOA or DOD	Yes	33	35.8%
	No	562	64.2%
Not filling Time of Death	Yes	28	30.4%

	No	567	69.6%
Not filling Place of Death	Yes	42	45.6%
	No	553	54.4%

Table 9: *Distribution of additional errors on the death certificate for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

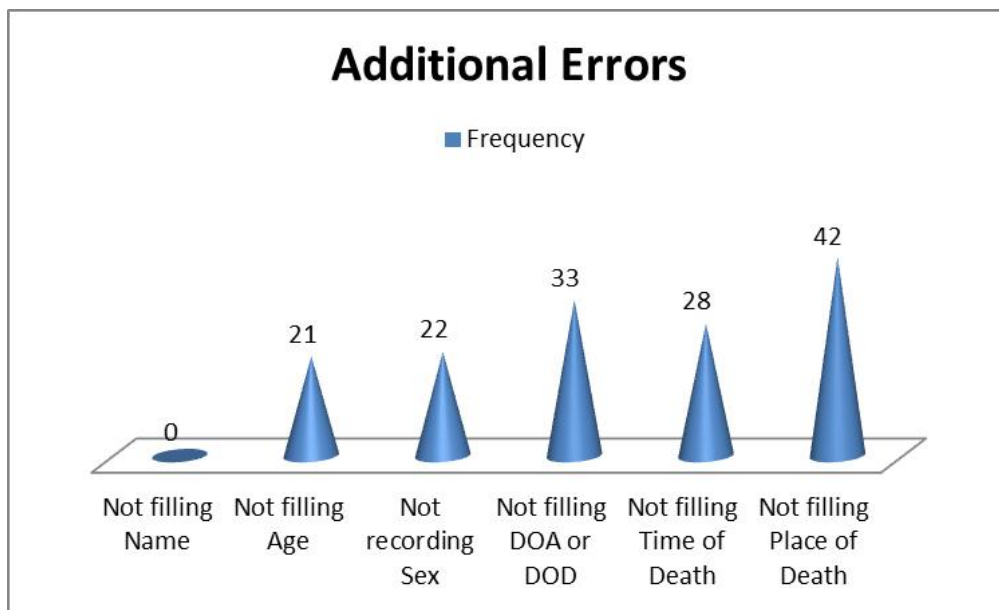


Figure 6: *Distribution of additional errors on the death certificate*

Regarding the assessment of additional errors on the death certificates, not filling the name was not found in the whole death certificates.

Not recording for age was occurred in 22.8% and recording for age was found in 77.2%.

Not record for sex in death certificate was found in 23.9% and record for sex was 76.1%.

Not filling date of admission or death in death certificate was occurred in 35.8% whereas date of admission or death was filled in 64.2%.

Not filling time of death in death certificate was seen in 30.4% and record of time of death was seen 69.6%.

Not filling place of death in the death certificate was occurred in 45.6% and place of death was recorded in 54.4%.

- The death certificate showed without error together with proper filling was recorded as overall correctly filled in. All death certificates were not filled correctly.

Overall of death certificate correctly filled in	Frequency	Percentage
No	595	100%
Yes	0	0%
Total	595	100%

Table 10 : *Distribution of overall of death certificate correctly filled in for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

- The death certifiers usually make three errors in filling medical certificates of cause of death. The least occurring error was one error. Percentage distribution of no error was 0%, one error in 3.7%, two errors in 25.9%, three errors in 40% and four or more errors in 30.4% of death certificates.

Number of Errors	Frequency	Percentage
No error	0	0%
One error	22	3.7%
Two error	154	25.9%
Three error	238	40%
Four or more error	181	30.4%
Total	595	100%

Table 11: *Distribution of errors categories for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

- The death certifiers usually make one major error in filling medical certificates of cause of death. The least occurring major error was three error. Major error was not detected in 71 (11.9%) issued medical death certificate.

Number of Major Errors	Frequency	Percentage
0	71	11.9%
1	303	50.9%
2	216	36.3%
3	5	0.8%
Total	595	100%

Table 12 : *Medical death certificates with major errors for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

- The death certifiers usually make two minor errors in filling medical certificates of cause of death. The least occurring minor error was three errors. The death certifiers made at least one minor error in 34.1% of issued medical death certificate.

Number of Minor Errors	Frequency	Percentage
1	203	34.1%
2	342	57.5%
3	50	8.4%
Total	595	100%

Table 13: *Medical death certificates with minor errors for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH*

Factors associated with quality of death certificate documentation

Type of health facility, Age, sex, duration of stay at the Hospital, time of death, Qualification of treating physician, place of death and manner of death were tested for their association with quality of death certificate by binary logistic regression analysis. Qualification of treating physician was excluded from analysis after checking multicollinearity effect.

First the association of each variable with Clinically Improbable sequence of cause of death was assessed by the binary logistic regression and then variables which were significant at the level of 0.25 were entered into the final model (multivariate analysis) to control confounding factors. On bi-variate analysis, Type of health facility, Age, Qualification of treating physician and place of death had an association with the quality of death certificate documentation.

The result of the multivariate analysis showed a significant association between type of health facility and quality of death certificate documentation. Those death certificates certified at Saint Paul's Hospital Millennium Medical College were 85.2% ($1-0.148=0.852$) less likely to show clinically improbable sequence of cause of death [AOR=0.148, 95% CI (0.061,0.357)].

Table 14: Bivariate and Multivariate Analysis to Identify Factors Associated with quality of death certificate documentation for whom medical death certificates were issued from September 11, 2020 to September 10, 2021, SPHMMC & RDDH

Variables		Clinically improbable sequence of COD		P-Value	COR (95% CI)	P-Value	AOR (95% CI)
		Yes (%)	No (%)				
Type of Health facility	SPHMMC	149 (35.0%)	277 (65.0%)	0.000	0.161(0.107,0.243)	0.000	0.148(0.061, 0.357)**
	RDDH	130 (76.9)	39 (23.1%)		1.00		1.00
Sex	Male	168(48.6%)	178(51.4%)	0.338	1.173(0.846,1.627)		
	Female	111(44.6%)	138(55.4%)		1.00		
Age	0-14	12 (54.5%)	10 (45.5%)	0.169	1.896(0.763,4.714)	0.348	1.607(0.597, 4.324)
	15-24	28(52.8%)	25(47.2%)	0.083	1.770(0.928,3.374)	0.106	1.782(0.885, 3.587)
	25-65	189(48.3%)	202(51.7%)	0.059	1.478(0.985,2.219)	0.166	1.364(0.879, 2.117)
	>65	50(38.8%)	79(61.2%)		1.00		1.00
Duration of stay at Hospital	<24 hrs	45(40.9%)	65(59.1%)	0.020	0.154(0.032,0.746)		
	1-7 days	160(47.9%)	174(52.1%)	0.044	0.204(0.043,0.960)		
	8-30 days	65(46.4%)	75(53.6%)	0.039	0.193(0.040,0.924)		

	>1 month	9(81.8%)	2(18.2%)		1.00		
Time of death	Day	110(43.1%)	145(56.9%)	0.112	0.768(0.554,1.064)		
	Night	169(49.7%)	171(50.3%)		1.00		
Qualification of treating physician	Senior, Resident and Intern	138(34.8%)	259(65.2%)	0.000	0.215(0.149,0.312)	0.764	1.134(0.500, 2.572)
	Senior, GP and Intern	141(71.2%)	57(28.8%)		1.00		1.00
Manner of COD certification	Natural	274(46.8%)	312(53.2%)	0.601	0.703(0.187,2.643))		
	Unknown	5(55.6%)	4(44.4%)		1.00		
Place of Death	Emergency	99(38.2%)	160(61.8%)	0.000	1.472(1.200,1.806)	0.226	0.752(0.474, 1.193)
	ICU	98(51.%)	93(48.7%)	0.340	0.810(0.525,1.250)	0.347	1.268(0.773, 2.081)
	Ward	82(56.6%)	63(43.4%)		1.00		1.00

Key: **Statistically significant variable at 95% CI with P value <0.05, COR: Crude odds ratio, AOR: Adjusted odds ratio, CI: Confidence Interval

Discussion

A cross-sectional study was done to assess the quality of medical certification of cause of death and associated factors by assessment tool of University of Melbourne and WHO recommended International form of medical certificate of cause of death.

During the period under study, a total number of 595 death certificates of Saint Paul's Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital were reviewed. Of the 595 death certificates, 71.6% were from SPHMMC and 58.2% of them were male. Most deaths were in the age group between 25-65 years and most stayed for 1-7 days. Most of the deaths occurred at the emergency. More than half (57.1%) of the deaths occurred at night. Majority of the death certificates (66.7%) were certified by a Resident. Almost for all the issued death certificate, the manner of death was Natural.

All death certificates were not filled correctly. The most common error was missing time interval between onset and death followed by ill-defined underlying cause of death. The death certifiers usually make three errors in filling medical certificates of cause of death. At least one major and one minor error seen in 50.9% and 34.1% of the death certificates respectively. A significant association was seen between type of health facility and quality of death certificate documentation but it was not seen in the other studies since many studies regarding the assessment of quality of medical death certificates conducted in a single facility.

Those death certificates certified at Saint Paul's Hospital Millennium Medical College were 85.2% ($1-0.148=0.852$) less odds of having clinically improbable sequence of cause of death [AOR=0.148, 95% CI (0.061,0.357)]. Being a referral and teaching center with a good diagnostic facility might be the reason for the lesser extent of errors about incorrect sequence of events seen at Saint Paul's Hospital Millennium Medical College.

Regarding on error of time interval between onset and death, it was found that time interval was not filled in 100% in this study. A cross sectional record based study was undertaken in BLSH (35). A total of 423 issued medical death certificates were reviewed and 100% of them had errors. Similar to our study, missing time interval was the most commonly seen error and it was found that error of time interval between onset and death was 100%. In the study of

medical certificate of cause of death in Sanpya Hospital, error of time interval between onset and death was 98.16%(38).

In this study, error of overall incorrectly filled death certificates was 100% because error of time interval between onset and death was 100%. similar with study done at BLSH and Yangon General Hospital, Myanmar (A total of 564 death certificates were reviewed)(26).

The incorrect sequence of events was found in 46.8% of death certificates in this study. It was 27.4% in study at BLSH, 12.8% in Sanpya Hospital, 32.4% in Yangon General Hospital. The study of death certificate completion skills of hospital physicians in a developing country in Pakistan, error of incorrect sequence of events was 87% (39).

Additional errors were seen in 15.5% of medical death certificates. In YGH additional errors which was incomplete demographic characteristic was 17%. In Pakistan it was 92%. By comparing with the two studies, additional errors seen on death certificate was satisfactory in this study.

Ill-defined conditions entered as underlying cause of death was found in 72.8% and concerning error of mode of death entered as UCOD, the error was 60.9% in our study. Error of mode of death entered as UCOD was 44% in Sanpya Hospital and 0% in YGH. In this study the incorrect practice regarding ill-defined UCOD is higher comparing with the two studies.

In this study, error of abbreviations used in death certificate was 58.8%. The study of medical certificate of cause of death in BLSH, error of use of abbreviations was 85.3%. In the study of accuracy in completion of death certificate in Vadodara municipal corporation of Gujarat, India, 2017, it was found that error of abbreviations used in death certificate was 37.2% (40). In Canada, the study of improving the accuracy of death certificate revealed that error of abbreviations used in death certificate was 19.2. Error of abbreviations used in this study is satisfactory comparing with study done at BLSH but the error is higher comparing with the other studies(27).

Concerning the error of illegible handwriting, it was 4.0% in this study. In study of medical certificate of cause of death in BLSH it was 13.7%. The study conducted in YGH for medical certificate of cause of death, error of illegible handwriting was 14.2%. In the study of accuracy in completion of death certificate in Vadodara municipal corporation of Gujarat,

India, 2017, it was found that error of illegible hand writing was 44.3%. By comparing with the three studies, error of illegible hand writing seen on death certificate was satisfactory in this study.

Regarding the error categories, there was no correct death certificate in this study which is similar to many other comparable studies including study done at BLSH and YGH. The death certifiers usually make one major error in filling medical certificates of cause of death in this study which is parallel to the study at BLSH.

Conclusion and Recommendation

Conclusion

Death certification represents an excellent source for mortality statistics and appropriate public health surveillance. Errors in reporting the cause of death impede the development of national health policies and, accordingly, allocation of resources.

In this study, substantial shortcomings in the death certification practices are seen; all death certificates were not filled correctly. The most common error was missing time interval between onset and death followed by ill-defined underlying cause of death. The death certifiers usually make three errors in filling medical certificates of cause of death. At least one major and one minor error seen in 50.9% and 34.1% of the death certificates respectively. A significant association was seen between type of health facility and quality of death certificate documentation.

Recommendations

To improve the quality of medical certificate of cause of death, the following recommendations are suggested:

➤ For Health Care providers

The doctors must be sensitized, motivated and trained to complete the death certificate properly. The Seniors who are supervising the junior doctors must regularly cross check the completion of death certificate.

➤ For Saint Paul's Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital

Information about importance and uses of medical certification of cause of death should be explicated to all the health professionals. A structured and standardized WHO recommended death certificate should be introduced to replace the existing death certificate form. The death certificate should be amended to incorporate the information on ICD-10. The Hospital shall adjust training for the health care provider regarding death certificate documentation. Regular

supervision and monitoring in record unit for hospital statistics should be maintained. A clear and concise guideline or standard operating procedure regarding death registration is needed.

➤ For policy makers

Medical Certificate of Cause of Death training should be delivered to all in-service doctors, and newly appointed doctors. It should be included in curriculum of under and post graduate courses. Feedback mechanism on completeness of the medical certificate of cause of death should be promoted.

➤ For Researchers

Qualitative study shall be conducted to identify the perception of death certifiers on the death certificate documentation. Further multi-center studies required for optimization of the results.

Strength and Limitations of the study

Strength of the study

- The study included two health facilities and tried to identify determinant factors affecting the quality of death certificate.
- No published study was found regarding the quality of death certificates in Ethiopia. Thus, it could be a baseline study for similar study in the future.

Limitations of the study

- The study used secondary data so that complete information was lacking.
- Assessing sequence of cause of death without the direct involvement of the attending physician or team might result in some degree of misinterpretation.

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APPENDIX

APPENDIX 1: QUESTIONNAIRE TOOL

Study Questionnaire

Date _____

Title of Research- “Assessment of quality of facility based medical certifications of death and its associated factors in Saint Paul’s Hospital Millennium Medical College and Ras Desta Damtew Memorial Hospital, Addis Ababa, Ethiopia”, Retrospective record review.

Part I - Identification Serial Number _____ Medical Record Number _____	Part II- Socio-demographic Data Age(years) 1. Birth - 14 _____ 2. 15 - 25 _____ 3. 25-64 _____ 4. >65 _____ Sex 1. Male 2. Female
Part III - Duration of stay at the hospital before death 1. <24 hour s _____ 2. 1-7 days _____ 3. 8days - 1 month _____ 4. > 1 month _____	Part IV - Time of Death 1. Working day _____ 2. Nights _____
Part V- Qualification of death certifier 1. Intern 2. GP 3. Resident	Part VI- Qualification of treating physician 1. Senior, Resident and Intern 2. Senior, GP and Intern
Part VII - Manner of COD certification 1. Natural _____ 2. Accident _____ 3. Homicide _____ 4. Suicide _____ 5. Unknown _____	Part VIII - Place of death 1. Emergency _____ 2. ICU _____ 3. Wards _____
Part IX – WHO recommended International Form of Medical Certificate of Cause of Death for the certification of death	
Part 1 A. Immediate cause of death _____ B. Antecedent/Intermediate cause of death _____ C. Basic/underlying cause of death _____	
Part 2 D. Contributory Cause of death _____	
Part 3 E. Time interval from onset to death _____	

Part X – Assessment Tool for MCCOD

Category	Type of Error	Yes	No	Not assessed due to illegible handwriting
Major	1. Illegible hand writing?			
	2. Incorrect or clinically improbable chain of events leading to death?			
	3. An ill-defined condition entered as the underlying COD?			
	3.1 If yes, was the ill-defined condition:			
	- Impossible underlying cause (i.e. signs and symptoms)			
	- Mechanism of death			
	- Mode of dying (i.e. respiratory arrest)			
	- Laboratory result			
	4. Was the death due to accident, violence, poisoning or other external cause?			
	4.1 For deaths due to external causes (accident, violence, poisoning) were the circumstances (how occurred, intent, activity, place of occurrence) missing?			
	5. Was the death due to a neoplasm?			
	5.1 For deaths due to neoplasms, additional details were missing (site, behavior, morphology)?			
Minor	6. Abbreviation were used in certifying the cause of death?			
	7. Missing time interval from onset to death?			
	8. Additional errors			
	- Not filling Name			
	- Not filling Age			
	- Not recording sex			
	- Not filling address			
	- Not filling Date of Admission or Discharge			
	- Not filling Time of Death			
	- Not filling Place of Death			

ANNEX 1 : International Form of Medical Certificate of Cause of Death (2016)

Administrative Data (can be further specified by country)											
Sex		☐ Female			☐ Male			☐ Unknown			
Date of birth					Date 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								
			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											
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					
Please describe how external cause occurred (If poisoning please specify poisoning agent)											
Place of occurrence of the external cause:											
☐ At home		☐ Residential institution		☐ School, other institution, public administrative area				☐ Sports and athletics area			
☐ Street and highway		☐ Trade and service area		☐ Industrial and construction area				☐ Farm			
☐ Other place (please specify):								☐ Unknown			
Fetal or infant Death											
Multiple pregnancy						☐ Yes		☐ No		☐ Unknown	
Stillborn?						☐ Yes		☐ No		☐ Unknown	
If death within 24h specify number of hours survived								Birth weight (in grams)			
Number of completed weeks of pregnancy								Age of mother (years)			
If death was perinatal, please state conditions of mother that affected the fetus and newborn											
For women, was the deceased pregnant?						☐ Yes		☐ No		☐ Unknown	
☐ At time of death						☐ Within 42 days before the death					
☐ Between 43 days up to 1 year before death						☐ Unknown					
Did the pregnancy contribute to the death?						☐ Yes		☐ No		☐ Unknown	

Annex 2: Classification of major and minor errors on medical certificates of cause of death

The errors were defined into major and minor errors as described by Myers and Farquhar(28)

Error type	Description and implications
Major errors	
Multiple causes per line	The WHO ICD guidelines state that only one cause should be recorded per line in a medical certificate of cause of death (MCCOD). When more than one cause is reported on a single line, there will be more than one potential sequence, making it difficult for coders to identify the correct sequence of events leading to death, thus making it more difficult to select the correct underlying cause of death (UCOD).
Incorrect sequence of events leading to death	Mortality statistics are based on the UCOD, which is the condition or injury that initiated the sequence of events that led directly to death. When a clinically improbable sequence of events is recorded, it is impossible to select the correct UCOD.
Illegible handwriting	Illegible handwriting makes it difficult to determine if the sequence of events leading to death is probable or if an ill-defined condition is entered as an underlying cause. Illegible handwriting can also prevent coders from selecting the UCOD, rendering the MCCOD unusable for statistical purposes.
Ill-defined or poorly specified condition entered as the underlying COD	Ill-defined or poorly specified conditions are of no value for public health priority setting and do not provide any information for decision-makers about the comparative need for specific diseases and injury prevention programmes. These include, for example, organ failure (e.g. hepatic or cardiac failure), symptoms or signs (e.g. haematemesis, dyspnoea, fever), mode of dying (e.g. cardiac arrest, respiratory arrest), pathophysiological findings (shock), and others (trivial diseases such as colds, rhinitis).
Insufficient information on the external COD	Sufficient detail should be provided to identify the UCOD (e.g. circumstances, intent or nature of the accident or violence).
Insufficient information on neoplasms	Sufficient detail should be provided regarding the neoplasm (e.g. site, whether benign or malignant).
Minor errors	
Presence of blank spaces within the sequence of events	In completing the MCCOD, the certifier should use consecutive lines in part 1 of the certificate starting at line 1a. The UCOD should be recorded in the lowest used line of part 1. There should not be any blank lines within the sequence/chain of events leading to death.
Abbreviations used in certifying the death	Doctors are encouraged not to use abbreviations when certifying deaths as abbreviations can mean different things to different people. There is a chance that coders may misinterpret the abbreviation and code the death to a non-relevant cause.
Absence of disease time interval	The time interval should be entered for all conditions reported on the MCCOD, especially for the conditions reported in part 1. Time intervals are very important for correctly coding certain diseases and provide a check on the accuracy of the reported sequence of conditions.
Additional errors on the certificate	There may be other additional errors on MCCODs failing to identify pregnancy and maternal deaths.

Assurance of the Principal Investigator

I, the undersigned, agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide timely progress report to my advisors and seek the necessary advice and approval from my primary advisors in the course of the research. I will communicate timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name: Natnael Getu

Signature _____

Date _____

Approval of the primary Advisor

Name: **Belayneh Lulseged (MPH)**

Signature: _____

Date: _____

Approval of the Co-Advisor

Name: **Yoseph Worku, MD, MPH**

Signature: _____

Date: _____