EVALUATION OF AN EDUCATIONAL INTERVENTION

TO IMPROVE THE ACCURACY OF DEATH

CERTIFICATION AMONGST MEDICAL INTERNS

DESIREE OLGA PASS

Student No: 8511023

UNIVERSITY *of the*

WESTERN CAPE

A mini-thesis submitted in partial fulfillment of the requirements for the degree

Masters in Public Health in the School of Public Health,

University of the Western Cape.

Supervisor: Prof Jon Rohde

Co-supervisor: Dr Gavin Reagon

May 2008

EVALUATION OF AN EDUCATIONAL INTERVENTION TO IMPROVE THE ACCURACY OF DEATH CERTIFICATION AMONGST MEDICAL INTERNS

DESIREE OLGA PASS

KEYWORDS

Death certification

Accuracy

Cause of death

Mortality

Medical Interns

Educational intervention

Training

Quality

Underlying cause of death

Causal sequence

UNIVERSITY *of the*
WESTERN CAPE

ABSTRACT

EVALUTION OF AN EDUCTATIONAL INTERVENTION TO IMPROVE THE ACCURACY OF DEATH CERTIFICATION AMONGST MEDICAL INTERNS

DESIREE OLGA PASS

MPH mini thesis, School of Public Health, University of the Western Cape

Background

The death certificate is a legal document with diverse and far-reaching implications. Mortality statistics are derived from the information recorded on the death certificate. The inaccuracy of death certification can lead to the misallocation of resources in health care programs and research. Given the importance of this document, it is crucial that its completion be thorough and accurate. Unfortunately, errors in death certification are common and range from incomplete certificates and illegible handwriting to inaccurate reporting of causes and manners of death. Although most doctors are confronted with completing death certificates, many do not receive adequate training in this skill.

Objectives

To assess the knowledge and attitudes of doctors in relation to death certification and also assess whether an educational intervention can improve the accuracy of death certificate completion and thereby improve mortality information.

Methods

A randomized control trial was used to do a pre- and post-evaluation among medical interns at an academic hospital in Cape Town. The interns were randomly assigned to

either attend a short didactic session on medical certification and receive a flyer or only receive the flyer. The evaluation based on a questionnaire which included three vignettes describing the medical circumstances of death and dummy death certificates completed during the pre and post-test. Each certificate being evaluated was scored based on the presence of five distinct errors. An acceptable cut-point was set prior to undertaking the study.

Results

Comparisons were done on the overall score as well as the major and minor error scores of the pre-test and post-test. The overall difference between the pre and post-test score was 11.4 (SD =1.1; $p<0.0001$) between the pre- and post-test major errors was 5.9 (SD=0.9; $p<0.0001$) and between the pre- and post-test minor errors was 5.4 (SD=0.5; $p<0.0001$). There was an overall significant improvement of 75% ($p<0.0001$) between the pre-test and post-test which scored 12/18 or above the acceptable cut-off point. The improvement between control group (82%; $p=0.0027$) and the intervention group (69%; $p=0.0027$), showed that the didactic session had little impact.

Conclusion

The low scores obtained during the pre-test appeared to reflect a lack of training in death certification. It can be concluded that this intervention is brief, highly effective and can be widely implemented to improve death reporting in South Africa. All hospitals should required new medical interns to read and refer to the educational guidelines on death reporting produced by this study.

May 2008

DECLARATION

I declare that *Evaluation of an educational intervention to improve the accuracy of death certification amongst medical interns* is my own work, that it has not been submitted for any degree or examination at any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Desiree Olga Pass   May 2008

Signed:_____

ACKNOWLEDGEMENTS

A sincere thank you to:

Dr D Carter, Chief Superintendent of Tygerberg Hospital for granting permission for the study, Dr Philly Mabusela for co-coordinating, and the medical interns for consenting to the study.

Prof. Jon Rohde, my supervisor and Dr Gavin Reagon my co-supervisor for their invaluable feedback and guidance.

Dr Pam Groenewald, Dr Lenè Burger and Prof Debbie Bradshaw for their assistance in developing the educational intervention and participation in the study.

Mr. Antonio Erasmus, MRC Studio, Corporate and Public Affairs Directorate, Medical Research Council for designing the educational material.

Janè Joubert, Michelle Schneider Ria Laubscher, Elize de Kock and Lenadine Koza for all their support.

A final special thank you to my Creator, and to my husband, children, family and friends for their support and understanding.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Sound statistics on cause of death are vital for decision-making in the health sector as they provide important information on the recent health situation and allow for the monitoring over time of the burden of disease (BOD). Cause-specific mortality rates together with life expectancy, infant mortality rates, and crude death rates are essential for measuring the health status of a population (Bradshaw & Schneider, 1995). The reliability and accuracy of death statistics are governed by the ability of the death certifier to make a proper diagnosis and by the care with which the information is recorded on the death certificate. The World Health Organization (WHO) has taken a leading role in organizing and managing the civil registration process; that includes the standardization of reporting and coding practices of cause of death information, but despite this effort, death registration remains inadequate in most countries (Sibai, 2004). In South Africa the systematic collection of mortality data was a recent occurrence. The Department of Home Affairs runs a vital registration system and Statistics South Africa, the national statistics office, is responsible for coding the cause of death information and compiling death statistics. In South Africa, as in other developing countries, the death statistics are not complete and/or correct reflecting under-registration and misclassification of causes (Bah, 2003). To improve the registration a new death certificate was introduced after 1998 using the ICD-10 classification to obtain underlying causes of death.

Doctors completed the forms certifying death. There had been difficulty in deciding how to report the sequence of events which led to death and representing it accurately. Often the exact cause of death may be unclear because the deceased patient was suffering from several chronic illnesses concurrently. Many studies (Jordan & Bass

1

1993; Weeramanthri, Beresford & Sathianathan, 1993; Messite & Stellman 1996; Magrane, Gilliland & King 1997; Pritt *et al.,* 2005) found that the task of death certification had usually been the responsibility of the intern, who was the least experienced member of the physician team and may not have fully understood the importance of the death certificate. Underreporting and misclassification of cause of death were common as a consequence of lack of training in death certification. A study done by Meel (2003) found that at Umtata General Hospital almost 80% of 304 deaths reviewed were certified as cardio respiratory failure, which was not a cause but rather a mechanism of death and concluded that the doctors were not experienced in death certification and that there was a need for continuing education on death certification for doctors.

Factors influencing death certification

A study to determine the level of knowledge of death certification of final year medical students in Nigeria, found that about 63% of students had no formal training in the completion of a death certificate and more than 55% had never seen a completed death certificate (Izegbu *et al.,* 2004). Of the 45% who had seen a death certificate completed, only 25% did this at various levels of their postings during their training. Another study found that 50% of general practitioners felt that they were not sufficiently instructed about death certification (Magrane, Gilliland & King, 1997). There was no formal training in determining the cause and manner of death for physicians and this responsibility was simply given to them during residency training. Bobbi *et al.,* (2005) surveyed death certificates of fifty randomly selected patients who died but did not undergo autopsies. They found that 34% of death certificates had the wrong cause or manner of death and 82% of death certificates had multiple errors. They attributed these errors to house staff inexperience, fatigue, time constraints, and unfamiliarity with the deceased and perceived lack of importance of

2

the death certificate. A survey done in the Republic of Ireland, reported a high level of dissatisfaction among nearly half of the doctors about the restrictions placed on them by the current death certificate, especially in cases where the deceased person was elderly and there was no cause for a postmortem examination to be ordered (Payne, 2000). Ninety four percent of GPs said that they had no written protocol or policy for dealing with the death of a patient and had received no training on how to complete a death certificate, either during undergraduate or postgraduate training. Inaccurate death certification by doctors can be attributed to: 1) the difficulty with properly recording the clinical sequence due to inadequate available information, 2) a problem with understanding the concept of underlying cause of death and the sequencing of causes of death, 3) a relatively low priority attached to this function, 4) lack of training on death certification process, 5) family pressures on the certifier not to divulge the true cause of death, 6) lack of time to properly complete death certificates, 7) lack of clear definitions on death certificates, 8) poorly structured and formatted death certificates, 9) deceased not treated by the doctor prior to death, 10) inexperience with death certification, and 11) junior doctors poorly supervised by more experienced doctors when completing their first death certificates.

Since only a few studies have been found in the literature about the problems doctors encounter when completing death certificates and no studies on training of doctors in South Africa, this study aims to evaluate an educational intervention for use in training doctors in death certification.

PROBLEM

Inaccuracies in death certificates arose mainly from the inadequate formulation of cause of death and failure to report relevant information. There were several documented causes of inaccuracies in death certificate completion at various stages of

3

the process, impacting on mortality statistics. Knowledge of the accuracy and completeness of the death certificate was required so that this information could be assessed. It was not enough to know the extent of the problem without the reasons for the deficiency in certification. Death certificates were usually issued by doctors and often completed in badly with sometimes only a mode of death as opposed to the disease producing the death. At Tygerberg Hospital, the site of this study, as in most academic hospitals, interns were given this responsibility without formal instruction regarding the rules to be used for correct completion of death certificates available to them. An educational intervention may have contributed to improved accuracy of death certification completion. The literature showed that there is not much difference in major and minor death certification errors between junior and more experienced doctors. It was reasonable to assume that if interns were taught how to complete a death certificate properly at the beginning of their career this result can improve the data needed for statistical purposes.
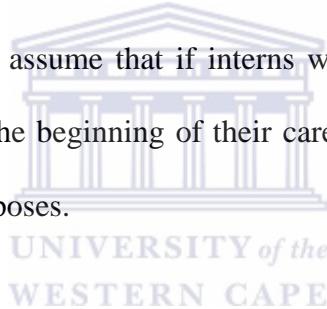
PURPOSE

The purpose of the study is to assess the level of accuracy of and assist in improving the level of death reporting in South Africa amongst medical interns.

AIM

The aim of the study is to assess the knowledge, training and attitudes of doctors in relation to death certification and also assess if the intervention will improve the accuracy of death certificate completion and thereby improve mortality information.

OBJECTIVES

1. To asses participants' level of prior undergraduate training, knowledge of and previous experience in death certification.

4

2. To assess comfort level, awareness of guidelines, desire for further training and desire for supervision in death certificate completion.

3. To measure the level of accuracy of death certification at baseline.

4. To measure the level of accuracy of death certification after the intervention and compare the pre and post intervention within and between groups.

UNIVERSITY *of the*

WESTERN CAPE

CHAPTER 2

LITERATURE REVIEW

Background

Death certification was introduced in the United Kingdom in 1837 with the objectives of providing proof of death and producing accurate mortality statistics. Reliable, comparable information about the main causes of diseases and injury in populations and the changing patterns, is a critical input for discussion about priorities in the health sector (Roa *et al.*, 2005). National registration and certification of all deaths in poorer countries is less common. This is mostly due to the cost of establishing and maintaining a system and often mortality collected from these systems are often incomplete and of poor quality. Population mortality statistics are derived from the stated Underlying Cause of Death (UCD), which makes the accurate completion of the medical certificate of cause of death of vital importance (Pain *et al.*, 1996). The (WHO, 1992) has recommended a standard cause of death diagnosis form to be used on death certificates to ensure valid comparisons within and among countries. Death certification inadequacies have been reported in the literature over many years (Swartout & Webster, 1954, Heasman & Lipworth, 1967, Alderson & Meade, 1967). The lack of demand for information is cited as a barrier to the provision of information in practice, especially in developing countries.

Importance of Mortality Information

In the face of intense pressure to change the financing and delivery of health care, the content of health care and priority actions to improve health is very important (Brundland, 1998). Consequently, many health systems are undergoing major restructuring. Burden of disease (BOD) information is important because it provides comprehensive assessment of health challenges to help inform public debate on the

priorities for health action. Decision-makers need information on the size of the current health problem in a particular population and they also need to know what interventions will work to improve health. The BOD approach also allows decision-makers to focus on the inequalities among vulnerable groups. Information about the BOD in South Africa, as in other developing countries is incomplete and has not been reviewed for coherence and consistency (Bradshaw *et al.,* 2003.)

Importance of death registration

In the United States, a death certificate is seen as the permanent record of the fact of death and depending on the State, in which the death occurs, may be needed to obtain a burial permit (CDC, 2003). South Africa also has the same requirement. There is legislation by State law regulating the time required for completing and filing the death certificate. The death certificate provides important personal information about the decedent, the circumstances and cause of death. The attending physician who last attended to the deceased is responsible for completion of the medical part of the death certificate by filling in the cause of death (Zumwalt & Ritter, 1987). When the physician fulfills the role of the certifier, he performs the final act of care to a patient by providing closure with a well-thought-out and complete certificate.

Death registration process

The medical practitioner is the person responsible for signing the death certificate indicating which morbid conditions led directly to death and stating any antecedent conditions giving rise to this cause (Tsung-Hseuh *et al.,* 2001).In most cases, the attending physician will both pronounce death as well as certify the cause of death. In instances where the attending physician is unavailable to certify the cause of death at the time of death, a different physician will pronounce death.

7

<u>Death registration process in South Africa</u>

The death registration process in South Africa can be classified as complex. When someone dies from a natural cause (not an external cause or injury) a medical certificate is issued by a medical practitioner. On receipt of the medical certificate, a death register is issued by an appointed registrar of death (i.e. policeman, undertaker, or official from the Department of Home Affairs). The Burial Order is issued, followed by an Abridged Death Certificate or a Death Certificate. If the identity number of the deceased is known, it can be linked to the Population Register. Details are then forwarded to the Department of Home Affairs in Pretoria, where the Population Register is amended. Copies of the Medical Certificates and the Death Certificates are sent from the regional office of Home Affairs to Statistics South Africa, where "cause of death" is coded using ICD codes for statistical purposes which get reported annually (Bradshaw & Schneider, 1995).
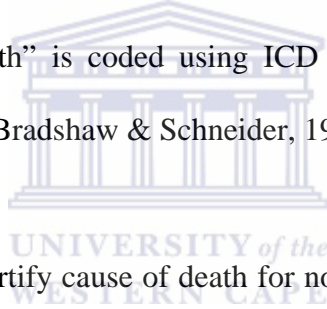
Doctors are not allowed to certify cause of death for non-natural deaths and the court has the final decision as to whether a death was unnatural and the cause. When someone dies from an unnatural cause such as homicide or injury, a medical practitioner or district surgeon must complete Block C of a medical certificate to certify a death as unnatural. Details concerning the cause of an unnatural death may not be submitted according to the Birth and Death Registration Act (May 1992). The Inquest Act requires an inquest but the details of the postmortem as to the "cause of death" are not fed back into the death registration system. Local governments collect information on non-natural deaths from the mortuary registers through an informal arrangement. Local authorities, such as the Cape Metropole, established an arrangement with Regional Home Affairs to improve the quality of their death data by obtaining photocopies of BI-12 and BI-7 forms, on supply of paper (Bradshaw & Schneider, 1995).

Figure 1: Current Official Mortality System

Current Official Mortality System
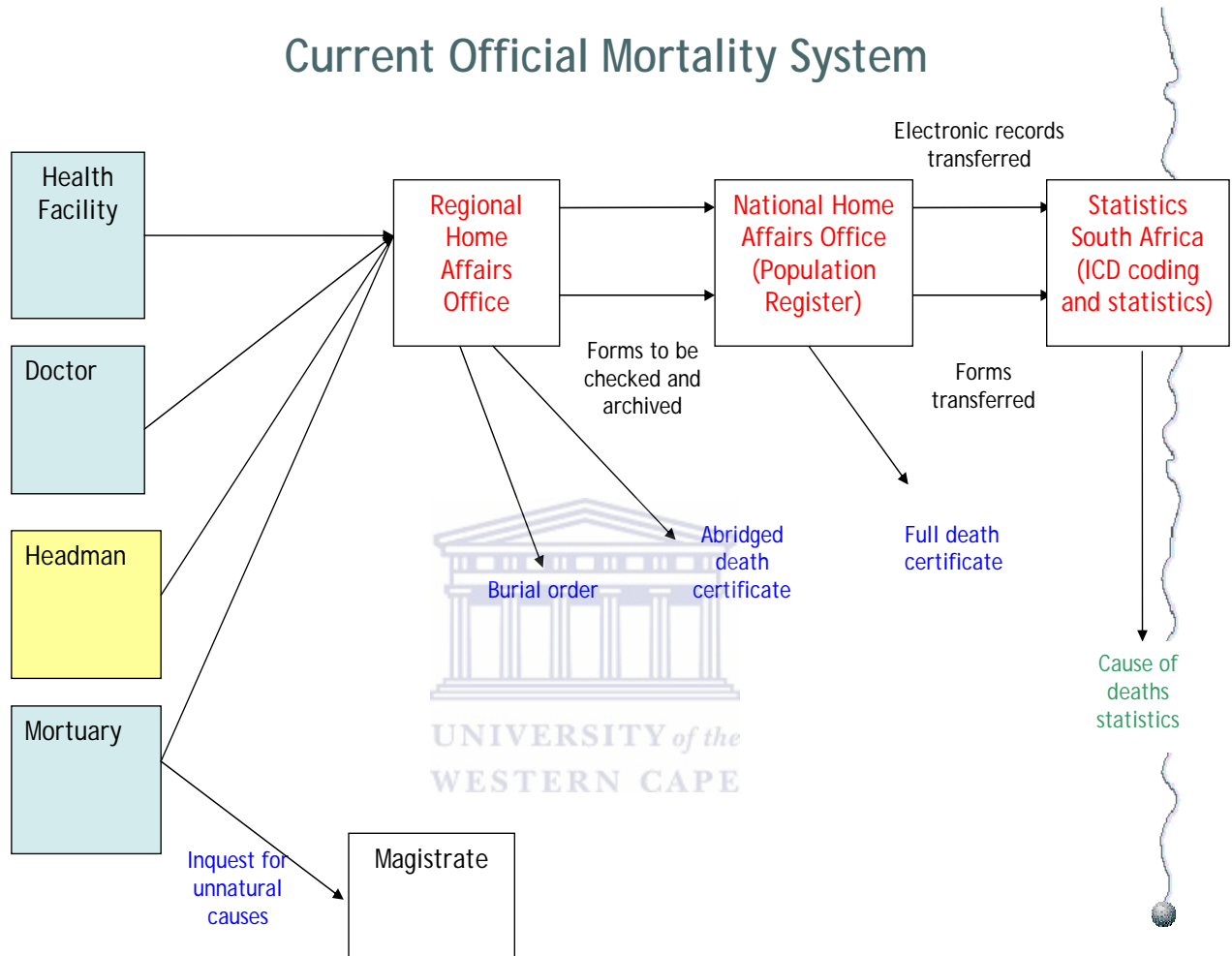
Death Certificate

A death certificate is the primary recording instrument for the death registration system. It provides important personal information about the decedent and about the circumstances and cause of death. It is both a legal and statistical document. It is required to obtain a burial permit, for proof of death for insurance and other purposes and to establish the cause of death, especially in medico-legal cases (Israel *et al.*, 1986). Among the many statistical purposes served by the medical information on the death certificate are its use in vital statistics surveys, in supplying end-points to

longitudinal studies and monitoring health programs. Mortality statistics are also used in demographic analysis and population projections.

The term 'death certificate' is not statutorily defined and can mean the certificate from the doctor or forensic pathologist, and the copy of the death register entry for the next of kin. For statistical and research purposes it is important that the cause of death be reported specifically and as precisely as possible (NCHS 2004). The causes reported will be coded and tabulated according to the latest revisions of the International Classification of Disease (ICD) at the statistical offices. The death certificate originally invited a single cause of death entry and although multiple entries were routine, only one would be coded. An international standard Cause of Death statement was introduced in 1948 allowing multiple entries, but the certifier had to identify the underlying cause of death in the sequence based on agreed strict rules for 'single cause-coding' (Maudsley & Williams, 1996). The general rule firstly selects the condition entered alone on the lowest line in Part I as the underlying cause of death, and secondly applies supplementary rules that attempt to retrieve the probable underlying cause of death from incorrectly constructed cause of death statements.

Both demographic and medical information are collected on the death certificate. Demographic information includes age, sex, and race, place of residence, marital status, occupation, and industry of the decedent. Medical information which focuses on the sequence of medical conditions that resulted in death is provided by a form comprising a two-part format recommended by the World Health Organization (WHO) (Messite & Stellman, 1996).

Completion of Cause of Death Section of the Death Certificate

When completing Part I of the cause of death section, only one cause should be entered on each line. There are 4 lines on Part I. It is not necessary to use all lines; additional lines may be added when necessary. The immediate cause of death, reported on line (a) must always have an entry (NCHS 2004). It can be the only entry in the cause of death section and can act as both the immediate as well as underlying cause, if that condition is the only condition causing the death. The disease/injury/condition, if any, which gave rise to the immediate cause of death, is reported on line (b). If this resulted from a further condition, that condition is reported on line (c). For as many conditions that are involved, the full sequence is written, one condition per line with the most recent conditions at the top, and the underlying cause of death on the lowest line in Part I.
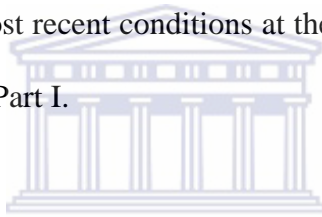
In accordance with WHO specifications, the conditions listed in Part I should form a causal sequence initiated by the underlying cause. The theory of the underlying cause of death concept is that if the starting point of a sequence of events is known, death can be postponed by preventing the initiating cause from happening (Messite & Stellman, 1996).

Space is provided at the end of lines (a) to (d) for recording the interval between the onset of the condition and the date of death. This should be entered for all conditions in Parts I and II and the physician establishes these intervals based on available information. The time sequence can be important for chronic conditions and also provides a useful check on the accuracy of the reported sequence of conditions (NCHS 2004). All other important diseases or conditions that were present at the time

of death and may have contributed to the death but did not lead to the underlying cause of death listed in Part I should be recorded in Part II.

Misunderstanding of the terms "cause", "manner", and "mechanism" of death is the most common error in death certification (Kircher & Anderson, 1987). Cause is defined as that which produces an effect, and is not merely a list of the deceased's problems. It is a distinct entity that is etiologically specific, and is the disease/injury/condition that led to the death. In contrast, manner of death refers to the circumstances that led to death and is designated as either natural or unnatural. Furthermore, mechanism of death is a physiologic abnormality or biochemical disturbance brought about by the cause of death. Mechanisms of death include a defined list of terminal events (such as asystole) and a larger group of nonspecific physiologic derangements (such as portal hypertension) and are differentiated from nonspecific anatomic processes (such as cirrhosis). Mechanisms of death lack etiologic specificity because they have more than one cause and are unacceptable substitutes for cause of death (Zumwalt & Ritter, 1987) and should never stand alone on a death certificate. When the cause of death is uncertain, it may be necessary to use qualifying terms such as "presumed" or "probable" (Magrane *et al.,* 1997, NCHS 2004). If the initiating condition reported on the death certificate could have arisen from a pre-existing condition but the certifier cannot determine the etiology, he/she should state that the etiology is "unknown", "undetermined" or "unspecified" so that it is clear that the certifier did not have enough information to provide even a qualified etiology (NCHS 2004).

Figure 2: The South African Death Notification Form

The South African Death Notification Form

REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF HOME AFFAIRS
NOTIFICATION / REGISTER OF DEATH / STILL BIRTH

in terms of the Births and Deaths Registration Act,
1992 (Act No. 51 of 1992)

BI - 1663

Space for Bar Code

* Must be completed in black ink (please tick ✓ where applicable)
* Please refer to instructions
FILE No: DATE:

SERIAL No:
A 0 1857265

A PARTICULARS OF DECEASED INDIVIDUAL ☐ / STILLBORN CHILD ☐

Identity number of deceased
Surname
Maiden Name (If female)
Forenames

Date of death Y Y Y Y M M D D
Date of birth Y Y Y Y M M D D
Age at last birthday   years
Sex
If death occurred within 24 hours after birth
No. of hours alive

MARITAL STATUS OF DECEASED Single ☐ Civil Marriage ☐ Living as married ☐ Widowed ☐
Religious Law Marriage ☐ Divorced ☐ Customary Marriage ☐

Left thumb print of deceased

PLACE OF BIRTH (municipal district or country if abroad)
PLACE OF DEATH (City / Town / Village)
PLACE OF REGISTRATION OF DEATH
CITIZENSHIP OF DECEASED

B PARTICULARS OF INFORMANT

Identity number
Initials and Surname
Relationship to deceased Parent ☐ Spouse ☐ Child ☐ Other ☐ Other (specify) ☐
Postal address

Left thumb print of informant

Postal Code   Dialling Code
Was the next of kin of the deceased a smoker* during the past five years? Yes ☐ No ☐ Refuse to answer ☐ Telephone No.
Date   Signature

C PARTICULARS OF FUNERAL UNDERTAKER

Office Stamp of Funeral Undertaker

Initials and Surname
Designation No.   Place of burial / cremation
Date   Signature

D CERTIFICATE BY ATTENDING MEDICAL PRACTITIONER / PROFESSIONAL NURSE

Postal Address

I, the undersigned, hereby certify that the deceased named in Section A, to the best of my knowledge and belief, died solely and exclusively due to NATURAL CAUSES specified in Section G ☐
I, the undersigned, am not in the position to certify that the deceased died exclusively due to natural causes ☐

Postal Code
SAMDC / SANC Reg. No.

INITIALS AND SURNAME   SIGNATURE
Date signed Y Y Y Y M M D D

CERTIFICATE BY DISTRICT SURGEON / FORENSIC PATHOLOGIST
I, the undersigned, hereby certify that a medicolegal post-mortem examination has been conducted on the body of the person whose particulars are given in Section A and that the body is no longer required for the purpose of the Inquest Act, 1959 (Act No. 58 of 1959) and that the cause of death is: Unnatural ☐ Under investigation ☐
Natural (Cause of Death as indicated in Section G) ☐

Postal Address

Postal Code

Initials and Surname
Place of post-mortem   Date Y Y Y Y M M D D
Signature   Date signed Y Y Y Y M M D D

Mortuary Reference
SAMDC Reg. No.

E FOR OFFICIAL USE ONLY

Initials and Surname of Registrar
Office Stamp ▷

Registration of death approved and burial order issued
Address
Force No. / Designation No.
Persal No.

Date   Signature

* Someone who smokes tobacco on most days

PARAGON 225639 99

13

NOTIFICATION / REGISTER OF DEATH / STILL BIRTH

INFORMATION FOR MEDICAL AND HEALTH USE ONLY
(After completion *seal* to ensure <u>confidentiality</u>)

BI - 1663
Page 2

Space for Bar Code

SERIAL No:
A 01857265

FILE No: DATE:

F DEMOGRAPHIC DETAILS

Initials and Surname of deceased

Identity Number

Place of death   1. Hospital: (Inpatient ☐   ER/ Outpatient ☐   DOA ☐)   2. Nursing Home ☐   3. Home ☐   4. Other (Specify) ☐

FACILITY NAME (If not institution, give street and number) ....

Usual residential
address of deceased # ....   Suburb

                                                Town / Village

Name of Plot, Farm, etc. ....   Census Enumerator Area

Street name and number ....   Magist. Dist.

Deceased's Education (Specify ✓ only highest class completed/achieved)   Postal Code

None	Gr1	Gr2	Gr3	Gr4	Gr5	Gr6	Gr7	Gr8 Form 1	Gr9 Form 2	Gr10 Form 3 NTC1	Gr11 Form 4 NTC2	Gr12 Form 5 NTC3	Univ Tech	CODE

Province ....

Country ....

USUAL OCCUPATION OF DECEASED (give type of work done during most of working life. Do not use retired)   TYPE OF BUSINESS INDUSTRY (e.g. Mining, Farming) refer to instructions

Was the deceased a smoker* five years ago? (✓) :   Yes ☐   Do not know ☐   Not applicable (minor) ☐

G MEDICAL CERTIFICATE OF CAUSE OF DEATH

PART 1. Enter the disease, injuries or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.

Approximate interval between onset and Death (Days/Months/Years)

FOR OFFICE USE ONLY
ICD-10

IMMEDIATE CAUSE (Final disease or condition resulting in death)
a. ....
Due to (or as a consequence of)

Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE last (Disease or injury that initiated events resulting in death)
b. ....
Due to (or as a consequence of)
c. ....
Due to (or as a consequence of)
d. ....
Due to (or as a consequence of)

PART 2. Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1. ....

If a female, was she pregnant 42 days prior to death? (✓) :   Yes ☐   No ☐

If stillborn, please write mass in grams

Do you consider the deceased to be: African ☐   White ☐   Indian ☐   Coloured ☐   Other ☐ (Specify) ....

Method of ascertainment of cause of death:

1. Autopsy ☐   2. Opinion of attending medical practitioner ☐   3. Opinion of attending medical practitioner on duty ☐

4. Opinion of registered professional nurse ☐   5. Interview of family member ☐

6. Other ☐ (Specify) ....

Where someone lived on most days   * Someone who smokes tobacco on most days

14

ICD Classification

The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) is the international standard for the coding of diseases and other health issues for morbidity and mortality reporting (WHO, 1992). ICD-10 is published by the WHO Family of International Classifications Network (WHO-FIC). Clinical coding can be described as the translation of diseases, health related problems and procedural concepts from texts to alphanumeric codes for storage, retrieval and analysis. ICD-10 is used for the coding of hospital discharge (morbidity) or death certificate (mortality) data. It uses rules established by WHO to ensure that data are comparable between individual hospitals or provinces or states or internationally as well as at different points in time. Coded data can be used for public health research and epidemiological studies at population level and also for hospital management and funding purposes, to allocate resources to areas of greatest need, to assess specific information and literature to inform clinical practice and support clinical and managerial decision-making.
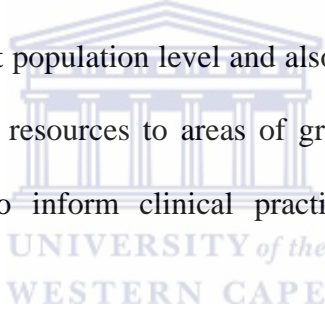
Selecting the underlying cause of death

Mortality statistics, including the selection of the "underlying cause of death: are usually based on a single cause of death. Part I of the death certificate which has three lines, the certifier needs to state the conditions leading directly to death, starting with the immediate cause on line I(a) and going back through the sequence on subsequent lines. Part II is for other conditions which contributed to the death but were not part of the direct causal sequence. If the death certificate has been properly completed, with only one condition on each line, and the conditions in Part I forming an acceptable sequence, the general rule can normally be used to select the condition entered in the lowest line of part I as the underlying cause (UCD). If the death certificate has not

15

been completed correctly, it becomes necessary to apply one or more of the three selection rules in the ICD-10. Several studies conducted in the United States and elsewhere have determined that underlying cause of death data often do not concur with data derived from expert panel reviews and autopsy reports (Kitcher, 1990).

<u>Errors in death certification</u>

Errors in the process of obtaining statistical information about the cause of death from death certificates can occur at three stages of the process. First, the diagnosis of disease and thus the cause of death is an inexact science. It follows that in the absence of further information (such as that provided by autopsy) any statement about the cause of death, such as the death certificate, will contain errors inherent in the process of disease diagnosis. Secondly, the certificate might contain errors caused in the writing of the certificate itself; these are the foci of interest for this discussion. Thirdly, the information on the death certificate might be coded incorrectly.
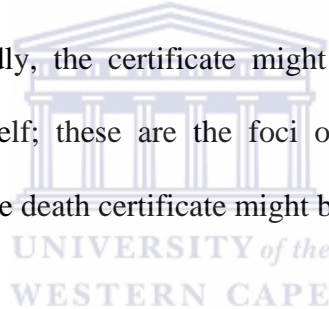
Weeramanthri and Beresford (1992) developed a method to classify death certification errors which arrived from misunderstanding the certification process into major and minor errors. Major errors were those mistakes that affected the underlying cause of death and minor errors are those with little epidemiological impact but their frequency could help in the overall understanding of the process and rules of death certification. The results of the above study show that 16% of 430 death certificates were classified as major errors and 35% had minor errors. There were no significant variations in the major error rate between city and country areas or between teaching hospitals and other settings.

Messite and Stellman (1996) used six written cases of hospital deaths adapted from materials from the National Center for Health Statistics (NCHS) and asked

participants to complete the cause of death section of the death certificate. The study found that only 15% of certificates for case 1 had a correct underlying cause and none included all the significant or contributing conditions. Using the ICD-9 coding rules, the most commonly reported underlying cause of death (63%) was "other disorders of the urethra and urinary tract". The level of agreement with the correct underlying cause of death was similar for internists, physicians, and students and ranged from 55% to 57%.

James and Bull (1996) in London assessed the frequency with which the cause of death on death certificates included the relevant information requested of certifying doctors, in death due to malignant disease. A review of clinical notes and of laboratory data was used to determine the number of cases for which detailed histological diagnoses were not available. In almost 80% of cases of deaths due to malignancy, the histological data was available but only recorded in 24% of death certificates. Detailed sites of primary tumors were only recorded in 23 of 89 cases of tumors of the large bowel (22/36), lung (1/35) and stomach (0/18).

A study between hospital doctors and general practitioners in Northern Ireland found that the most common inaccuracies in death certification occur in the areas of poor terminology, sequence errors, and unqualified mode (Armour & Bharucha, 1997). Almost 34% of cases had one or more inaccuracies and 4% of these inaccuracies were serious enough to warrant referral by the registrar to the coroner. General practitioners were responsible for 38% and hospital doctors for 62% of inaccuracies.

A study to determine the accuracy with which medical certificates for cremation were completed found that only 41% were completed sufficiently accurately for the cremation to proceed without further enquiry (Horner & Horner, 1998). The authors

found that junior doctors contributed the most errors (64%) but general practitioners and consultants also contributed large numbers of errors.

Hut and Barr (2000) examined the precision of the perinatal death certificate (PDC) by obtaining the 'main' and 'other' causes of death the PDC from the Registry of Births, Deaths and Marriages in New South Wales, Australia. They compared it with those from clinicopathological summaries (CPS) that were available for the 7-year period under review. Of the 179 neonatal deaths, the PDC and CPS main causes of death were concordant in 58% and discordant in the remaining 42%. The PDC main cause of death was incorrectly classified in 80% with discordant finding and was incompletely classified in the remaining 20%. The discordances with an incorrect classification included transposition of the main and other causes in 23%, recording a non-pathological condition as the main cause in 66% and recording an incorrect pathological condition as the main cause of death in 11%.
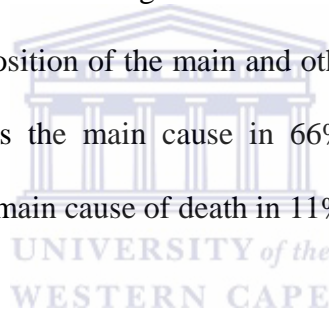
Johannsson and Westerling (2000) linked death certificates for 1995 to the national hospital register in Sweden. This resulted in a database of 75% of all deaths, 43% of whom died in hospital. The last main diagnosis and the underlying cause of death agreed in only 46% of cases, agreement decreased rapidly after discharge. The main diagnosis was reported on 83% of death certificate for hospital deaths but only on 46% of non-hospital deaths. Malignant neoplasm's showed the best agreement and was often reported as underlying causes.

Morton and colleagues (2000) investigated the extent of erroneous and or omitted information on death certificates of patients implanted with Bjork-Shiley Convexo-Concae (BSCC) heart valves. They carried out a review of death certificates and clinical notes for 478 patients implanted with BSCC valves which involved 38

hospitals. Twenty one percent (101/478) of the total number of death certificates recorded the presence of valve prosthesis, 6% of death certificates reported inaccurate information related to the valve surgery. Twenty five percent recorded a single cause of death, 23% of all death certificates reviewed recorded only the mode of dying, and 8% of death certificates of patients who had a postmortem did not record it.

Lakkireddy *et al.,* (2004) found that only a small percentage (23%) of house staff at the St Luke's Hospital, Kansas City, Missouri complete the death certificate accurately when they asked residents to fill in a model death certificate and 45 % incorrectly identified a cardiovascular event as the primary cause.

Pritt *et al.,* (2005) surveyed death certificates of 50 randomly selected patients who died and did not undergo an autopsy. A medical chart review was undertaken for each case, and a brief summary was produced. Grade I, II and II errors were noted in 72%, 32%, and 30% respectively. They found that 34% of death certificates had the wrong cause or manner of death and 82% of death certificates had multiple errors. They attributed these errors to house staff inexperience, fatigue, time constraints, and unfamiliarity with the deceased and perceived lack of importance of the death certificate.

Swain *et al.,* (2005) listed incorrect attribution of the immediate cause of death, listing causes in an incorrect or illogical order, multiple competing immediate causes of death, poor match between cause and manner of death, and failure to identify the true underlying causes, or causes as common errors.

 Selinger *et al.,* (2007) did a retrospective audit of all death certificates issued over a 4-month period with the elderly care department of a district general hospital in

Keighley, UK and found that almost 14% of 140 death certificates issued did not meet the legal criteria, as no evidence was found that these patients were attended to by the issuing medical officer. In 59% of the death certificates minor errors and omissions were found.

During the years 1997-2001, Statistics South Africa (Stats SA) found that medical certification in South Africa was relatively poor, as many causes on the death certificates were classified as ill-defined' causes and general symptoms and signs' which can be described as vague categories (Bah S, 2003). Meel (2003) found that at Umtata General Hospital almost 80% of 304 death certificates reviewed, deaths were certified as cardio-respiratory failure, which is neither a cause nor a mechanism of death and concluded that the doctors are not experienced in death certification. Despite the fact that there is improved death registration in South Africa, due to the introduction of a new death notification form in 1998, the quality of information collected and the coverage remains imperfect (Stats SA, 2005). A review of data from local authorities in Cape Town on the quality of death certification and coding found that 75% of the death certificates had adequate information, 13% had incomplete information and 11% had poor information (Bradshaw *et al.,* 2006).

Studies on Accuracy and Completeness

Glasser (1981) noted in an editorial comment that the requirement for accuracy will vary between researchers. An epidemiologist following a rare disease will have exacting requirements which would not be necessary for a community health planner interested in broad disease categories. To address this, researchers have adopted different solutions to the problem by using review panels of physicians, others have

used coders, and others have relied on the pragmatic interpretation by the researchers of the rules available to doctors.

A hospital-based study in the United Kingdom by the Royal College of Physicians in 1978 studied 191 Death Certificates produced in a hospital setting and compared them with hospital case notes, consultant opinion and necropsy findings. They found that 20% of certificates contained major discrepancies and 28% had minor discrepancies of epidemiological importance.

Leadbeatter (1986) concluded in a study of death certificates in a hospital setting in Cardiff, UK that approximately 25% of death certificates were inaccurate or incomplete. The criteria used for incompleteness or inaccuracy were either no cause given for death, an inadequate sequence of events described, absence of relevant detail or error in layout. The study did not include any category for incorrect selection of the underlying cause of death. Since this category of inaccuracy was not measured in this study, the 25% inaccuracy rate is extremely high, and the fact that this study relied on the counterfoils of the certificate for information rather than the certificate itself, is a major difficulty. Doctors may complete the certificate much more carefully than the counterfoil, which they might see as a less important part of the certificate as it is not submitted, thus the true level of inaccuracy may be lower.

Another UK study in a hospital setting by Slater in 1993 examined 500 counterfoils produced by doctors and suggested a 29% inaccuracy rate. Wording and formulation inaccuracies were defined as those contrary to the advice given in books of Death Certificates in the UK. Inclusion of modes of death rather than cause, reporting of symptoms, use of poor or non-existent terminology, errors in sequence of events and lack of appropriate reporting to the coroner were among the inaccuracies recorded.

Criticism of Slater's work by Leadbeatter and Knight (1993) suggested that the criteria concerning the inclusion of modes of death were unfairly stringent and that if this were taken into account the rate of unsatisfactory completion would reduce to 14%.
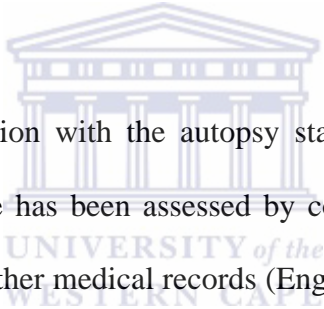
McKelvie and Rode (1992) examined the death certificates produced in an Australian Metropolitan hospital and was critical of the reporting in these certificates. The two main problems in certificate completion were that a full clinical diagnosis was not included in all certificates and that many death certificates recorded mechanisms rather than causes of death. An audit demonstrated that 4% of certificates were inaccurate despite having made a correct clinical diagnosis. McKelvie (1993) reported from the same Australian Metropolitan hospital that the death certificates completed for the 132 autopsies performed in 1992 were reviewed. In addition to the expected differences between ante and postmortem diagnosis, inaccurate certification was noted, these included reporting modes rather than causes in 11% of certificates, inconsistent or incomplete cascade of diagnoses in Part I in several certificates, and incorrect or incomplete reporting of the place of death.

Validity studies on the relation between medical death certification and underlying cause coding

The validity of medical information on a death certificate depends firstly on the correctness of Cause of Death (COD) diagnoses determined after clinical information or post-mortem examinations or both, and secondly on the presentation of causes of death on the death certificate. The process results in various deficiencies and errors. Typical inaccuracies in death certification according to Jordan and Bass (1993), among others are failure to specify accurately the disease/condition/injury causing the

22

death, to describe adequately the circumstances of death and to state correctly the causality between causes of death in Part I of the death certificate.

Autopsy results have been used as the "gold standard" of medical death certification in various studies and the number of discrepancies between death certificates and autopsy diagnoses used as an indicator of the correctness of medical death certificate. Disagreement rates in these studies for main category level of ICD were in the range of 15 to 40% (Kircher *et al.*, 1985, McKelvie 1993, Jordan and Bass 1993, Myers and Farquhar 1998, Smith-Sehdev and Hutchins 2001). Due to declining autopsy rates and the resulting selection bias, use of the autopsy standard for epidemiological purposes has caused controversy.

In addition to or in conjunction with the autopsy standard, the completion of the medical part of the certificate has been assessed by comparison of death certificate information with hospital or other medical records (Engel *et al.*, 1980, Goldacre 1993, Naruse *et al*., 1997 D'Amico *et al*., 1999), with information obtained from other informants such as next-of-kin, attending physicians or medical examiners (Goraya *et al.,* 2000, Coady *et al*., 2001) and this is usually reviewed by medical and nosological experts. Re-examining of original death certificates (Lu *et al.,* 2001(a)) or case vignettes (Lu *et al.,* 2001(b)) also happen as well as the assessment of the correctness of death certification for specific disease entities which exist for heart and vascular diseases (Engel *et al.,* 1980).

The validation of COD information for statistics by querying certifiers has been emphasized and examined. In the US, national criteria for COD query are published by the National Center for Health Statistics (NCHS). Hopkins and colleagues (1989) found in a survey of 50 states, that 29 areas fulfilled the minimum criteria, among

them Oregon where the efficacy of applied query policy was further assessed during a one year period. Ten percent of death certificates queried for additional information resulted either in a new or a more specific underlying cause of death (UCD) data in 56% of the queries. The authors also emphasized the importance of educational benefits of the query process, which they considered an effective means of informing physicians what information is being sought for reliable mortality statistics and how to complete a death certificate. Hanzlick (1996) also discussed the relevance of queries and coding procedures when presenting COD queries and ICD-9 coding rules in relation to the medical certification of causes of death. The process for elaborating mortality statistics was based on three main stages after the establishment of death: determination, certification and coding of the causes of death. For acceptable quality of COD statistics, proper functioning of every step in this COD collecting process is essential. Medical certification of death is more prone to conceptual differences and human errors than COD coding. The COD is a centralised coding system because of the concise ICD definitions, the rules on the causes of death, and the coding and selection of the underlying cause of death for mortality statistics.

Intervention studies

Only a few studies on educational interventions designed and implemented to improve physicians' accuracy in death certification could be found in the literature. Authors Bell and Cremona (1989) assessed the effect of a minimal educational intervention on housemen's practice of recording details of alcohol consumption in case notes and alcohol abuse on death certificates at the Middlesex and University College Hospitals, UK.

They examined death certificates signed by the first group of housemen over a 3 month period and those death certificates in which a diagnosis of alcohol abuse may have been aetiologically relevant, were selected both for case note and death certificate review. The authors developed an education intervention consisting of a letter informing housemen of changes to the coroners' rules and emphasizing the importance of recording adequate details of alcohol consumption in the case notes and alcohol abuse on the death certificate was then sent to the second group of housemen. The results showed that only 57% of case notes of the first group of housemen gave a quantitative assessment of alcohol assumption compared with 82% of the second group of housemen (p=0.05). Although 90% in both groups felt that recording alcohol abuse on death certificates was important, a small group of housemen (45% vs. 22%) expressed reluctance to record alcohol abuse in almost half the patients where they thought alcohol may have contributed to the death. In both groups similar numbers felt that the stigma of alcoholism or the risk of distressing relatives would influence their recording (7% vs. 9%). Knowledge of the current coroners' rules increased from 18% in the first group to 56% in the second group ($p<0.01$). The results suggest that a minimal education intervention can influence the attitudes and practice of the housemen.

An Australian study by Weeramanthri *et al.,* (1993) evaluated the effect of an educational intervention on the knowledge and behaviour of hospital staff pertaining to death certification. A questionnaire was administered and the death certification errors were assessed before and after the education intervention. Although the response rate to the questionnaire was very low (19%), the results revealed a poor baseline understanding of the subject that improved after reading the educational material. The certification error fell from 22% before the intervention to 15.1% after the intervention, two months later although this drop was not statistically significant.

It was concluded that questionnaires in conjunction with educational material can focus attention on potential knowledge gaps relating to death certification.

Ramos and Mayo (1996) evaluated the efficacy of mortality seminars on the International Criteria of Medical Certification of Cause of death in a primary heath care district in Spain. They used a pre-post-test evaluation with no reference group as a design. Forty four doctors participated in the evaluation six months before and six months after the seminar. After the intervention there was an improvement of 17% in the confusion between mechanism and the cause of death and the legibility of handwriting improved by almost 12%.

Pain *et al.,* (1996) produced a video on death certification suitable for use by medical students and postgraduates. The evaluation was by means of a randomized control trial among 185 first year medical students. Both groups received the usual lecture on death certification and the video was show only to the intervention group. A test of knowledge, skill, and motivation was recorded in both the control and intervention groups. The intervention group scored slightly better overall on knowledge and skill (median=3; *p*=0.046). They also gave a significantly higher priority to avoiding distress caused to relatives as a reason for certifying accurately (60% vs. 35%; *p*=0.0002). The authors conclude that adding the video to the usual lecture had a limited effect on overall knowledge and skills of undergraduate students but was highly effective in conveying the message that inaccurate death certification can cause distress to relatives.

A study done by Suarez *et al.,* (1998) evaluated workshops in Health Care and Medical-legal institutions in Spain between 1992 and 1996 with the goal of teaching the usefulness of Mortality Statistics and the International WHO norms of

certification. A quasi-experimental pre-post-test epidemiological design was used. The workshops were both theoretical and practical in nature and lasted two hours, targeting medical students and interns in Family and Community Medicine. More than 78% individual indicators were correct in the pre-test and 52.3% of the participants completed everything correctly. Twenty five percent of students and 14.4% of physicians showed an improvement in assigning the correct cause of death. Eighty one percent of physicians and 80.2% of students reported that the workshop was useful for correctly certifying a death, independent of the previous background.

Myers and Farquhar (1998) observed frequent errors in the completion of the cause of death section and this prompted efforts to develop an educational intervention aimed at improving the accuracy of death certification by residents. Death certificates were collected over a 12 month period for the pre-intervention. Over a 6 month period, residents working in the internal section of a hospital were invited to attend a 75 minute seminar on death certification every two months.

The intervention started with a didactic session outlining the process of death certification and the terminology used in writing cause of death statements, followed by an interactive session where residents completed the cause of death statement based on 10 case scenarios. Death certificates were collected over a 6 month period for the post intervention. Major errors were identified on 33% of death certificates completed before the intervention which decreased to 15% after the intervention. This also led to a significant reduction in the major error rates of listing mechanisms of death without a legitimate underlying cause of death (15.8% vs. 4.8%, p=0.01) and improper sequencing of death certificate information (15.8% vs. 6%, p=0.03). The authors conclude that the accuracy of death certification can be improved with the implementation of a simple intervention.

Lakkireddy and colleagues (2007) in the US found that resident physicians' accuracy in death certification completion was poor, and decided to assess the impact of two educational interventions on the quality of death certificate completion. Two hundred and nineteen internal medicine residents were asked to complete a sample case of an in-hospital death before the intervention. The participants were randomized into one of the two educational interventions either in the interactive workshop (group I) or provided with printed instruction material (group II). At baseline, competency in death certificate completion was poor and only 19% of all residents achieved an optimal test score. Sixty percent wrongly identified a cardiac cause of death. In both groups the death certificate score improved significantly from baseline to post intervention. Group I improved from 14.6 to 24.5, $p<0.001$ and group II from 14.5 to 19.5, p<0.001 where group I had a higher degree of improvement than group II. Noteworthy is that the workshop group showed a dramatic reduction of incorrect identification of cardiac causes from 56% to 6% ($p<0.001$). The stepwise logistic regression analysis showed that desire for further training before the intervention ($p<0.001$), intervention through didactic workshop ($p<0.001$), pre-intervention awareness of guidelines ($p=0.003$) and level of training were independent predictors of change of death certificate scores from an unacceptable to an acceptable range. In this study, the interactive workshop was a more effective intervention than the printed educational material.

During a re-audit of death certificates by Selinger *et al.,* 2007 at a general hospital in the UK, to determine whether information was correct and legal requirements were met, shortcomings were discovered and educational measures were undertaken and their effect measured. Following education about these problems, there was a significant improvement (2.4% vs. 14%) of certificates that did not meet the legal criteria and minor errors and omissions fell from 59% to 20%.

CHAPTER 3

METHODOLOGY

3.1   Study design

A randomized control trial was used to do an evaluation among medical interns at Tygerberg Hospital during their orientation period. The randomized controlled trial was found to be a practical and simple means of evaluating teaching methods for medical students by Pain *et al.,* (1996). Experimental studies provide the best evidence about the influence of an intervention.

3.1.1   Study Setting

Tygerberg Hospital is a tertiary hospital located in Parow, Cape Town. The hospital was officially opened in 1976 and is the largest hospital in the Western Cape and the second largest hospital in South Africa. It acts as a teaching hospital in conjunction with the University of Stellenbosch's Health Science Faculty. Tygerberg Hospital was selected because of accessibility and, of the three tertiary hospitals in the Western Cape; the hospital accommodates the most medical interns at any given time.

3.1.2   Study population

Medical interns with at least six months internship experience. At the hospital there were 49 medical interns who had completed at least six months of internship.

3.2   Intervention

Educational material was developed from available sources and modified to highlight common misconceptions. The intervention was designed based on a didactic teaching

session, and written educational material on death certification. The intervention group received both the didactic teaching session and the written educational materials. The control group received only the written educational materials. The didactic session (Appendix F) outlines the process of death certification, the importance of mortality data to public health, the use of mortality data and the terminology used in writing "Cause of Death statements". A key concept of "underlying cause of death" and its correct placement in part I of the death certificate, the distinction between cause and mechanism, and the freedom to change a death certificate after post mortem will be taught practically by using case scenarios and examples. Each participant was then given the written educational material (Appendix G) for further self-study purposes. The written educational material recalled the main topics and guidelines in death certification and included an explanation of the importance of the death certificate, the concept of causes of death sequencing, the selection of the underlying cause, detailed information on specific causes, terminology to avoid, indication as to when a case should be referred to forensic pathology, and provide a sample of a properly completed death certificate.

3.3   Sampling

As the study population was small the sample included everyone in the study population. A large proportion of the study population volunteered to be included in the study.

3.3.1   Sampling procedure

A list of all interns in the hospital was retrieved by the Intern Co-coordinator at Tygerberg Hospital. All interns were invited to participate in the study. Each intern was randomly assigned to either the control or the intervention group. The participants were assigned to the intervention and control groups depending on the colour of a

marble randomly selected by the participant. For the study population, double the required number of marbles comprising two different colours i.e. green and blue, were put in a bag to give each participant an equal chance to be assigned either to the intervention or the non-intervention group. Those assigned to the intervention group received the lecture on death certification and written educational material to take home for self-study. The non-intervention group received only the educational material for self-study.

3.4   Data collection

Upon completion of a study consent form (Appendix D) by the participants, a self-administered questionnaire (Appendix C) was presented to each consenting doctor (control and intervention group) for completion. The structured questionnaire addressed questions on the respondents' age, sex, number of death certificates completed, confidentiality, prior formal training, comfort with filling in the death certificate, which category of staff normally completes the death certificate, perceived need for supervision, desire for further training regarding death certificate completion. The questionnaire also included three case scenarios which the doctors filled in using model death certificates (Appendix B). The case scenarios were adapted from the literature in conjunction with experts in the field of epidemiology, death certification and forensic pathology. Case scenarios were selected based on evidence from previous studies that showed the problems with South African mortality data (i.e. TB and HIV, alcoholism and infant deaths). The case scenarios primarily examined skill in completing death certificates, knowledge about when to refer a case to forensic pathology and the distinction between natural and unnatural death. The participants were required to place the completed questionnaire in an envelope and seal it, and the researcher collected the completed questionnaires.

During the post intervention phase of the study, data were collected by completing another set of three case scenarios two weeks later by both groups (Appendix E). The same types of decisions regarding cause of death were used in the pre-and-post-test questionnaires but using different case scenarios.

Assessing completion of Model Death Certificates

Two previous methods of auditing death certificates (Jordan and Bass, 1993 and Weeramanthri and Beresford, 1992) for errors were adapted for use in this study. For each model death certificate the following questions based on WHO guidelines was asked:

1. Was a mechanism listed as a cause of death listed in Part I?
2. Were there any sequencing errors?
3. Were 2 competing causes of death listed in Part I?
4. Was a time interval recorded between onset of the conditions and death?
5. Was any other inappropriate or irrelevant information recorded?

Not all errors have the same impact on the critical information, which is the underlying cause of death. For my study I use a classification system which classified 'major errors' only as those mistakes which affects the ascertainment of the underlying cause of death. Other errors with little direct impact on determining the underlying cause of death were classified as 'minor errors'. The first three items of the WHO guidelines are considered major errors while items 4 and 5 are deemed minor ones. Each item was scored on a scale of 0 to 2, where 0 did not conform to the guidelines (inaccurate and inappropriate); 1 was acceptable, but there was incomplete adherence to the guidelines; and 2 referred to exact adherence to the guidelines. In my grading system "1" was representative of responses that was not 100% correct but indicated some knowledge and understanding.

Types of Errors	Definition
Major	
Mechanism of death listed without an underlying cause	Mechanism or nonspecific condition listed as the underlying cause of death
Improper sequencing	Sequence of events does not make sense; underlying cause of death not listed on the lowest completed line of Part I
Competing causes	Two or more casually unrelated, etiologically specific diseases listed in Part I
Minor	
Abbreviations	Abbreviations used to identify diseases
Absence of time intervals	No time intervals listed in Part I
From Weeramanthri and Beresford (1992), Jordan and Bass (1993) and Myers and Farquhar (199).	

3.5   Piloting

The case scenarios were piloted among doctors who were not part of the study population to ensure that they understood what was expected, i.e. the required information to be collected. Time to complete the questionnaire was also assessed. Experts in the field of death certification were approached to assess the relevance of the educational material.

3.6   Validity

The questionnaire will have face validity as the death certification process was used as the main testing method and was therefore a valid test of improved death certification. The case histories were adapted from the Physicians Handbook on Medical Certification of Death by the CDC and an underlying cause of death was independently assigned by a pathologist on the basis of her interpretation of the clinical and pathological material available. The student was trained to audit the certificates for accuracy and where there was uncertainty as to the classification of errors, the pathologist reviewed the certificate with the student.

3.7   Contamination

Contamination was thought to be particularly problematic in trials of educational interventions because these interventions can often be easily transferred to members of the control group and in this case the handout could easily be passed on. To address contamination in my study both groups received the educational material for self-study. I would have preferred to use the didactic session and the educational material in the intervention group versus no intervention in the control group.

3.8   Co-intervention

Tygerberg Hospital agreed to have no other intervention to improve death certification during the study. It is unlikely that there would be any other continuing education in death certification during the time of the study as it is a neglected area of ongoing medical education.
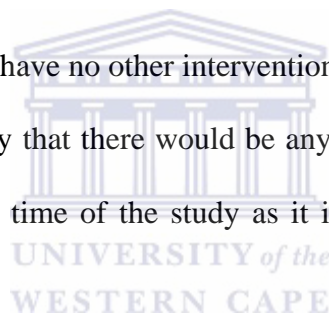
3.9   Blinding

There was an attempt at blinding but the this was done incorrectly because the groups could unfortunately be identified by the person entering and analyzing the data..

3.10   Confounders

Preventing the confounding effect is to obtain groups that are similar (medical interns) at the beginning of the exposure, in terms of the distribution of the possible confounding variables. Possible confounders were which department they worked in, which university trained at, the time period as intern, previous experience, formal training and knowledge of guidelines. It would be difficult to stratify by these

confounders because of the small sample used but data have been collected on these and will be presented.

3.11 Data analysis

Data was analysed using SAS 9.1 statistical package. The baseline questionnaire was analysed using basic descriptive statistics inferential and the results will be presented in tables and graphs. The completion of the "practice" death certificates was analysed based on a 2 point scoring system per case scenario question, utilising the guidelines established by the National Medical Examiner Association. All responses were graded individually based on the agreement with the standard (0=poor agreement, 1= borderline, 2=good). All scoring variables were given equal importance. There were five questions per case scenario and therefore a maximum of 10 points per case with a total maximum possible score of 30. Comparison of overall scores and various sub-scores (major errors, minor errors, knowledge and skill) was made between the intervention and control group. Comparison was done between the scores of the pre- and post-test of the intervention and control group.

For categorical data, the pre-test, and post-test were scored as the proportion above and below acceptable scoring levels and comparisons were made between both the control and intervention groups as well as for each group's pre and post intervention. The proportion in both the intervention and control groups that shifted between scoring categories after the intervention was assessed as well.

Acceptable cut-off point

The score for the first three questions will be assessed out of 18 and an acceptable score cut-off point has been set at 12 out of 18 provided that they don't score 0 on any

of the three questions. A score of 0 would mean that the participant gave an inappropriate and inaccurate answer and this will impact on the underlying cause of death.

Although questions 4 and 5 were classified as 'minor errors' with little direct epidemiological impact, the frequency of minor errors would give an indication of the participants' understanding of the process and rules of death certification

3.12   Ethical consideration

Throughout the study various ethical issues were considered. Firstly, permission from the Chief Medical Superintendent at Tygerberg Hospital was sought and granted. Secondly, informed consent (Appendix D) was obtained from all participating interns. Participants were assured about confidentiality of the information and the fact that it was solely an educational exercise with an evaluative component. Confidentiality was maintained at all times, by placing all questionnaires in sealed envelopes once completed. There were no adverse consequences if anyone refused to participate. Interns were free to leave any questions unanswered and could withdraw from the study at any stage without being required to explain their withdrawal. Ethical approval for the study was obtained from the University of the Western Cape.

CHAPTER 4

RESULTS

This chapter describes the effect of an educational intervention on the knowledge and behaviour of medical interns pertaining to death certification. A questionnaire was administered and a certification error assessed through written case scenarios both before and after a didactic workshop and written educational material was provided.

Out of the 49 medical interns at Tygerberg Hospital only 32 consented and participated in the baseline portion of the study, which resulted in a 65% response rate. Table 1 shows demographic and training information of the respondents' baseline assessment.

Table 1: Characteristics of Medical Interns who participated in the study

Characteristic	Percentage	Total	Intervention	Control
Age				
Max	28.7			
Median	25.3			
Min	22.9			
Mean age	25	31		
Gender				
Male	38		9	3
Female	62	32	9	11
Medical School				
University of Stellenbosch(US)	19		2	4
University of Cape Town(UCT)	22		4	3
University of the Free State(UFS)	9		1	2
University of the Witwatersrand(WITS)	13		3	1
University of KwaZulu Natal(UKZN)	25		4	4
University of Pretoria(UP)	9		3	0
University of Transkei(UNITRA)	3	32	1	0
Date internship started				
01/01/2006	16		4	1
01/01/2007	81		13	13
01/05/2007	3	32	1	0

It can be seen that there were more females (62%) than males (28%) in the sample population. There were more males in the intervention group compared to the control group. Their ages ranged from 23 to 29 years, with a median age of 25 years. There is a close relationship between the age and date when internship started because most students enter university in their teens and graduate at similar ages. About two-thirds of the respondents were trained at UKZN, UCT and US, with small numbers at UFS, UP and UT. There were even distribution between the two groups, besides the three interns from UP and the one from UNITRA who were in the intervention group. Eighty percent of the medical interns had at least 6 months of internship experience.

Table 2: Departments the medial interns worked in during the study

Department	Percentage	Total	Intervention	Control
Anaesthesiology	20	6	2	4
Orthopaedics	7	2	0	2
Paediatrics	10	3	0	3
Surgery	10	3	3	0
Internal Medicine	10	3	2	1
Gynaecology and Obstetrics	20	6	4	2
Family Medicine	17	5	3	2
Psychiatry	3	1	1	0
Cardiovascular	3	1	1	0
Total	100	30	16	14

Table 2 shows that the largest proportions of respondents worked in anesthesiology (20%), gynaecology and obstetrics (20%) and family medicine (17%) at the time of the study. The intervention group had no medical interns in the Orthopaedics and Paediatrics departments while the control groups had no-one in Surgery, Psychiatry and Cardiovascular departments.

Table 3: Percentage of medical interns with previous experience in Death Certification

Ever completed a DC before	Percentage	Number	Intervention	Control
Yes	88		15	13
No	12	32	3	1
Number of death certificates ever completed				
Less than 10	44		7	6
11-25	28		4	4
More than 25	28	28	5	3
Find completing the death certificate straightforward				
Yes	54		9	6
No	46	28	6	7
Ability to provide all non-medical details				
Yes	4		0	1
No	96	28	15	12

Table 3 shows the responses of medical interns when asked about their previous experience in death certificate completion. The intervention and the control group had similar experiences in death certification. Eighty eight percent of medical interns had experience in completing death certificates. Of those who completed a death certificate before, more than half (56%) completed more than 10 death certificates. Less than half (46%) of those who had completed a death certificate before did not find it straightforward to complete. The interns strongly agreed (96%) that they were not able to provide all the non-medical details i.e. education, address, and occupation etc. on the death certificates with only one in the control group who felt that he/she was able to comply.

Figure 3 show the results of the questionnaire for what was difficult in completing a death certificate. Those who replied said that they did not find completing the death certificate straightforward.

Figure 3: Problems encountered during death certification

N=13
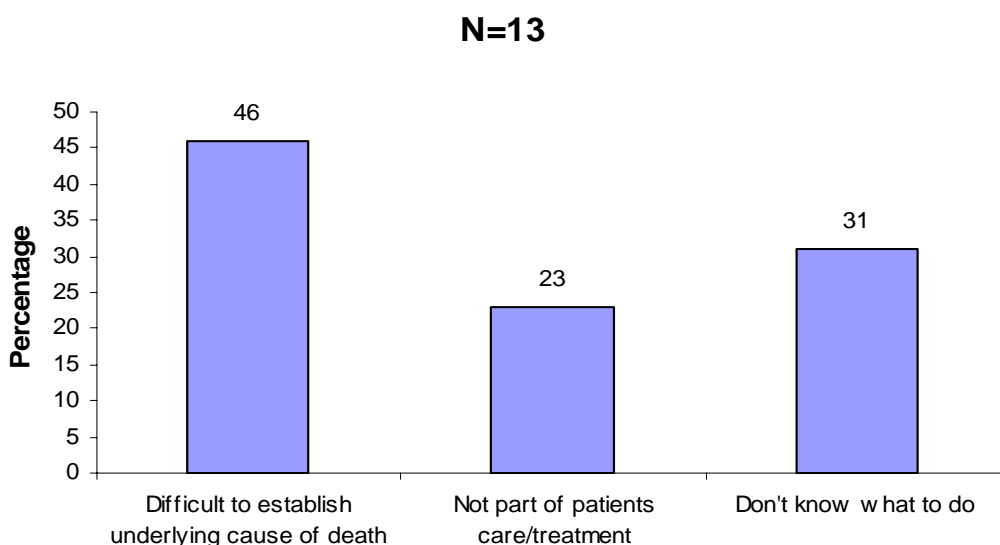
Thirteen of the medical interns experienced difficulties with completing death certificates. Forty six percent reported difficulty with establishing the underlying cause of death, followed by 31% who did not know how to complete the death certificate and 23% who were not part of the patient's medical care.
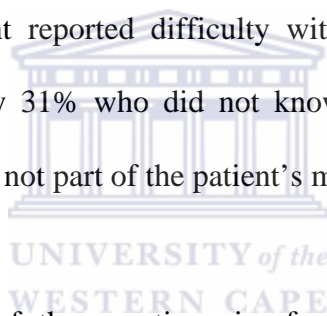
Table 4 shows the results of the questionnaire for those questions which were concerned with modification of the death certificate.

Table 4: Reasons for Modifying Death Certificates	Percentage			
	Yes	No	Unsure	Number
Not to distress relatives	3	90	7	30
Not to require a postmortem	3	93	4	30
Concern about stigma	10	83	7	30

A percentage of interns – between 3 and 10 percent – were willing to consider modifying death certificates to avoid involving the forensic pathologist, to avoid perceived distress to relatives and to avoid inserting a diagnosis that may be associated with stigmatization.

Table 5(a) below outlines the participants' responses to whether they've received formal training in writing cause of death statements.

Table 5 (a): Formal training received by the medical interns					
Formal training	Number	Percent	Total	Intervention	Control
Yes	14	48		7	7
No	15	52	29	9	6
Place where medical interns trained					
Medical School	12	86		7	5
Intern year of residency	2	14	14	1	1

More than half of the participants did not receive any formal training in writing cause of death statements [Table 5(a)]. Of the 48% who received training, 86% received their training at medical schools. There were a similar number of the medical interns in the intervention and control groups who received training.

Table 5(b): Where medical interns received their training in death certification and adequacy of the training			
	Number	Percent	Total
University of Stellenbosch(US)	2	17	
University of the Witwatersrand(Wits)	1	8	
University of KwaZulu Natal(UKZN)	7	58	
University of Pretoria(UP)	2	17	12
Adequacy of training			
Yes	2	17	
No	7	58	
Unsure	3	25	12

Table 5(b) shows that of those who received certification training, over half received such training at UKZN, followed by about one-fifth each at US and UP, and only a small proportion at W. The two that thought that their training was adequate were both from the UKZN.

Figure 4 shows the participants' responses to whether they believe that there is room for improvement in the manner in which they completed a death certificate. The majority (83%) felt that there was room for improvement.

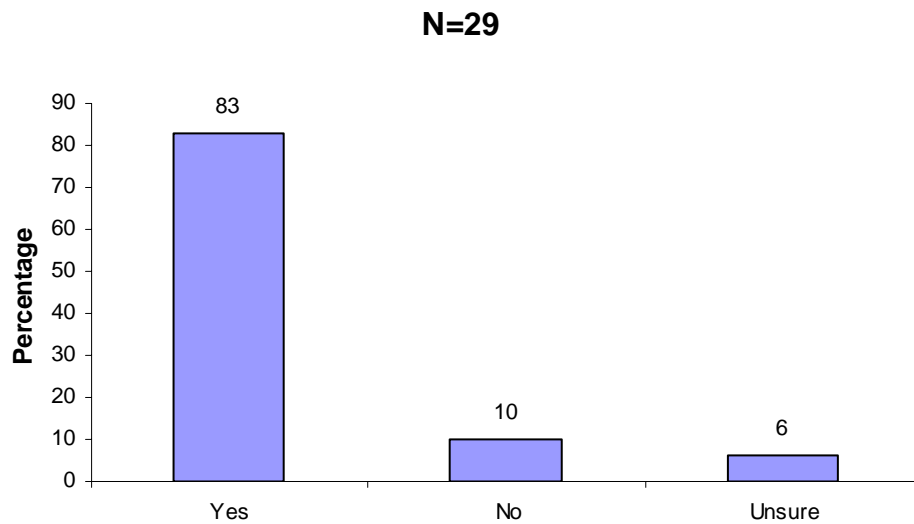**Figure 4: Improvement in death certification**

N=29

Table 6 reports the responses of the 22 medical interns who indicated that there is room for improvement in the way they completed death certificates. They were asked to indicate what they thought could assist them in completing it correctly.
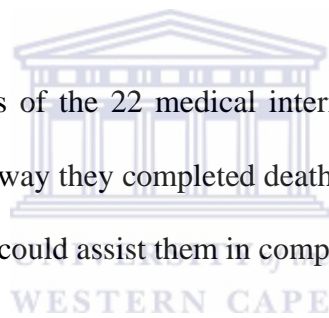
Table 6: Exploring the scope for improvement in Death Certification amongst Medical Interns		
Which of the following could improve your performance?	Percentage	Number
'having more time devoted to it		
Yes	45	
No	55	
		22
'having less pressure form relatives, funeral directors etc.'		
Yes	64	
No	32	
Unsure	4	22
'having more readily available information'		
Yes	95	
No	5	22
'making the format more amenable to logical completion'		
Yes	82	
No	9	
Unsure	9	22

Forty five percent thought that having more time to complete the death certificate, while 64% felt that having less pressure from relatives, funeral director (i.e. to complete the death certificate as soon as possible within the shortest possible time) would assist them. A large majority of participants (95%) felt that having more readily available information would enhance certification and 82% thought that a more logical format would aid the completion.

Table 7: Presents the proportion of medical interns who were aware of written instruction about the method of death certification		
Death Certification Guidelines	**Percentage**	**Number**
South African Guidelines		
Yes	17	
No	83	30
WHO & CDC Guidelines		
Yes	7	
No	93	30

Less than one-fifth of medical interns knew about the South African Guidelines and 7% knew of other guidelines such as the WHO guidelines, Physicians' Handbook on Medical Certification of Death by the CDC and the e-Learning website for Death certification etc., that are available (Table 7).

Figure 5 shows the results of the questionnaire for the question which concerned formal training where 93% indicated that they would benefit from formal training in death certificate completion.

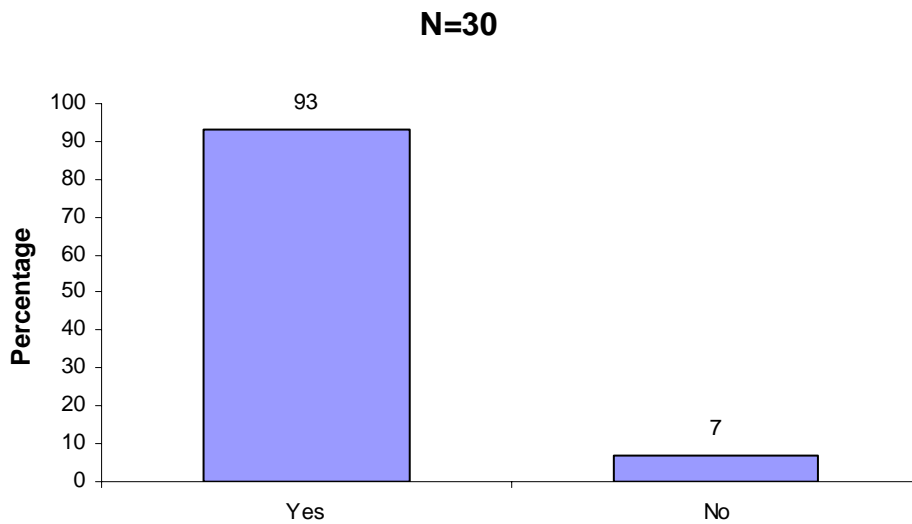**Figure 5: Benefit from formal training**

N=30

Figure 6 shows the responses to the questionnaire on whether the medical interns should have supervision when completing their first few death certificates. The majority (73%) of participants felt that they needed supervision when they complete their first few death certificates until they were familiar with the protocol.

Figure 6: Supervision of death certificates

N=30
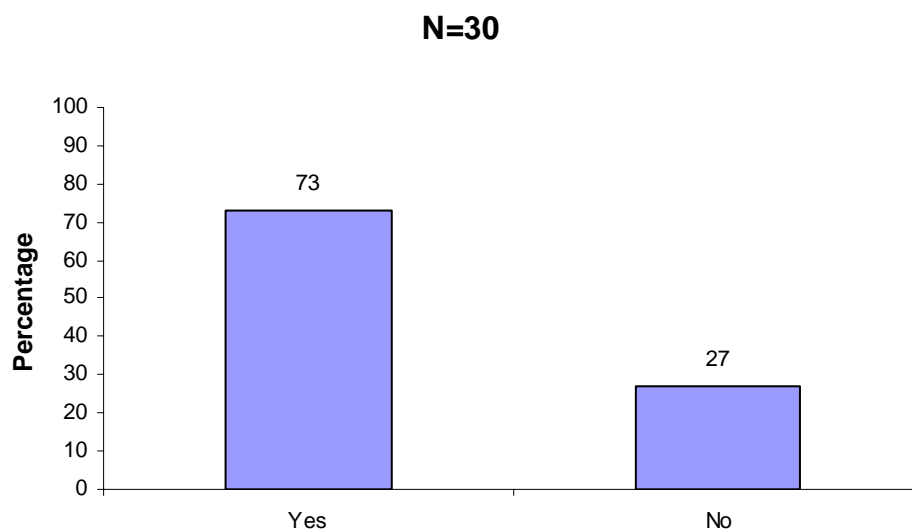
Pre and Post-test Evaluation

The medical interns were asked to participate in the post intervention and completed a questionnaire which included three case scenarios on death certification two weeks after the intervention. Only 24 of the 32 medical interns participated in this part of the study, resulting in a 75% response rate.

Death Certificate Score

Table 8: Shapiro-Wilk W test for normal data					
Variable	Obs	W	V	z	Prob>z
Prescore	32	0.98879	0.374	-2.042	0.97943

Parametric analysis was used after the Shapiro-Wilk test revealed a large probability of 0.97943 (P>0.05) which suggested that the Pre-test scores were compatible with a normal distribution [Table 8(a)]. Appendix H shows the graphical display of the distribution of the data. Each "dummy" death certificate was scored on a scale of 0 to 2, where 0 did not confirm to the guidelines (inaccurate and inappropriate); 1 was acceptable, but without complete adherence to the guidelines; and 2 indicated an exact adherence to the guidelines.

A chi-squared test was done that showed no significant difference between the control and the intervention groups during the pretest [Table 8(a)].

Table 8(a): Death certificates scoring 12 or above on 9 questions of the pre-test			
Control (N=11)	Intervention (N=13)	Pearson chi2	*P-value*
1	2	0.1460	0.702

A paired sample t-test was used to determine whether there was a significant difference between the pre and post-test scores. The test was based on the paired

differences between the post and pre-test scores of the overall group, intervention and controls and major and minor score. A positive difference indicated an improvement in the score.

There was an overall significant difference of 11.4 (SD=1.1 *p<0.0001*) *between* the pre-test and the post-test score [Table 8(b)]. Similar significant differences applied to the overall major error score (pre-post difference=5.9, SD=0.9 *p=<0.0001*) and minor error score (pre-post difference=5.4, SD=0.5 *p<0.0001*).

Table 8(b): All participants" Overall, Major and Minor scores of "dummy" death certificates (DC)			
Total (N=24) All participants			
Score on All sections of DC Maximum Score=30	Pre-test	Post-test	Post-Pre Diff
Mean	13.5	24.9	11.4
SD	1.2	0.7	1.1
t=-9.9 degrees of freedom=23 p<0.0001			
Score on Important (Major) sections of DC Maximum Score=18	Pre-test	Post-test	Post-Pre Diff
Mean	8.5	14.4	5.9
SD	0.8	0.5	0.9
t=-6.8 degrees of freedom=23 p=<0.0001			
Score on Less Important (Minor) sections of DC Maximum Score=12	Pre-test	Post-test	Post-Pre Diff
Mean	5.0	10.4	5.4
SD	0.5	0.4	0.5
t=-11.0 degrees of freedom=23 p<0.0001			

Table 8(c) shows the pre-post difference of the overall sections of the death certificate of the control and intervention group. The overall pre-post difference was 9.8 (SD=1.7 *p=0.0002*) for the control and 12.7 (SD=1.8 *p=<0.0001* for the intervention group.

Table 8(c): Overall scores of "dummy" death certificates for the control and intervention group			
Score on All sections of DC (Maximum Score=30)			
Control Group (N=11)	**Pre-test**	**Post-test**	**Post-Pre Diff**
Mean	15.5	25.3	9.8
SD	1.5	1.1	1.7
t=-5.7 degrees of freedom=10 p=0.0002			
Intervention Group (N=13	**Pre-test**	**Post-test**	**Post-Pre Diff**
Mean	11.8	24.5	12.7
SD	1.8	1.0	1.5
t=-8.5 degrees of freedom=12 p<0.0001			

Table 8(d) shows the post-pre difference of the major section of the death certificate for control and the intervention group. The intervention group had a slightly larger significant post-pre difference between the pre and post test than the control group. However, the differences between the pre- and post-test for both groups were significant.
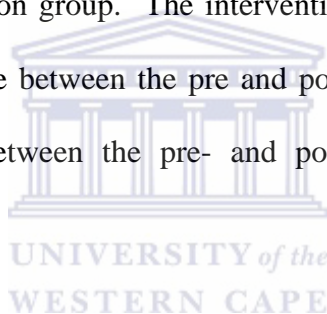
Table 8(d): Major scores of "dummy" death certificates (DC) for the control and intervention group			
Score on Important (Major) sections of DC (Maximum Score=18)			
Control Group (N=11)	**Pre-test**	**Post-test**	**Post-Pre Diff**
Mean	10.1	14.5	4.4
SD	0.9	0.8	1.3
t=-3.4 degrees of freedom=10 p=0.0071			
Intervention Group (N=13)			
Mean	7.2	14.4	7.2
SD	1.2	0.6	1.1
t=-6.7 degrees of freedom=12 p<0.0001			

Table 8(e) shows the pre-post difference of the minor section of the death certificate for the control and the intervention groups. Both groups had a significant post-pre difference.

Table 8(e): Minor scores of "dummy" death certificates for the control and intervention group			
Score on Less Important (Minor) sections of DC (Maximum Score=12)			
Control Group (N=11)	**Pre-test**	**Post-test**	**Post-Pre Diff**
Mean	5.4	10.8	5.4
SD	0.7	0.6	0.7
t=-7.3 degrees of freedom=10 p<0.0001			
Intervention Group (N=13)			
Mean	4.7	10.2	5.5
SD	0.7	0.5	0.7
t=-7.9 degrees of freedom=12 p<0.0001			

At the baseline assessment there was no real differences between the intervention and the control group, but both groups had a significant improvement after the intervention. Although there was a significant pre-post difference within the groups, table 8 (f) shows that the pre-post differences between the groups were not significant.

Table 8(f): Comparison of mean difference of the Pre- and Post-intervention			
Comparison of: Overall Difference	**N**	**Mean Difference**	**SD**
Intervention	13	12.7	5.4
Control	11	9.8	5.7
t=1.2671 degrees of freedom= 22 *p=0.2184*			
Difference on Important (Major) sections of DC			
Intervention	13	7.2	1.07
Control	11	4.4	1.30
t=1.7186 degrees of freedom= 22 *p=0.09997*			
Difference on Less Important (Minor) sections of DC			
Intervention	13	5.5	0.69
Control	11	5.5	0.74
t=0.0069 degrees of freedom= 22 *p=0.9946*			

Acceptable cut-off point for the Important (Major) Section of the DC

For categorical data the pre- and post-test were scored as the proportion above and below acceptable scoring levels and analysed using a McNemar test. The student and co-supervisor developed the cut-off point and it was tested with experts working in the field. The acceptable cut-off point was set at 12 on the scores and no zero score

on any of the 9 questions. A full percentage (100%) was equal to a perfectly filled death certificate.

There was an overall significant improvement of 75% (*P*<.0001) between the pre-test and post-test participants who scored 12 or above the acceptable cut-off point (Table 9). The same was noticeable when the pre and post-test of the control and intervention groups were compared. Both groups improved substantially, the improvement for the control group was 82% (*p*=0.0027) and for the intervention group 69% (*p*=0.0027). Using the cut-off analysis the control group improved more but the intervention group performed better at baseline.

Table 9: "Dummy" Death Certificates who scored 12 or above					
	N	**Pre-test**	**Post-test**	**Pre-Post Diff**	*P-value*
Overall Group	24	13%	88%	75%	<0.0001
Control Group	11	9%	91%	82%	0.0027
Intervention Group	13	15%	84%	69%	0.0027

An exact logistical regression was used because it calculated the probabilities exactly and did not require the assumptions of standard logistical regression which might not be valid when the sample size was small. It estimated the treatment effect, test for significance and reported confidence intervals based on exact methods. There were no significant difference between the intervention and the control groups (OR 1.05, 95% Confidence Interval 0.13 – 5.52).

Tables 10 (a-c) shows "dummy" death certificates that scored zero (0) for specific types of errors for the overall, control and intervention groups before and after the intervention per case scenario. A negative response showed an improvement in the death certificates that scored zero for specific types of errors. Table 10(a) shows that case scenario 3 had the most zero scores across all the sections of the death certificate

49

during the pre-test and also had the largest improvement in the post-test. In all 3 case

scenarios, time intervals were poorly completed.

Table 10(a): Error analysis - Overall Group N=24									
	Case Scenario 1			Case Scenario 2			Case Scenario 3		
Type of errors	Pre	Post	Diff	Pre	Post	Diff	Pre	Post	Diff
Major									
Mechanism only	18%	8%	-10%	50%	17%	-33%	50%	8%	-42%
Improper sequencing	23%	4%	-19%	23%	8%	-15%	32%	8%	-24%
Competing causes	36%	4%	-32%	36%	4%	-32%	59%	4%	-55%
Minor									
Absence of time	55%	8%	-47%	59%	8%	-51%	77%	13%	-64%
Use of abbreviations	27%	8%	-19%	32%	8%	-24%	41%	4%	-37%

The zero scores for mechanism only remained high during the post-test of the 3 case

scenarios for the control group [Table 10(b)]. Only in case scenario 2 did the error

improper sequencing increase from 10% to 18%. For case scenarios 1 and 3, the

percentage zero scores for use of abbreviations dropped to 0% during the post-test.

Table 10(b): Error analysis – Control Group N=11									
	Case Scenario 1			Case Scenario 2			Case Scenario 3		
Type of errors	Pre	Post	Diff	Pre	Post	Diff	Pre	Post	Diff
Major									
Mechanism only	20%	18%	-2%	30%	18%	-12%	20%	9%	-11%
Improper sequencing	20%	9%	-11%	10%	18%	8%	30%	18%	-12%
Competing causes	50%	9%	-41%	30%	0%	-30%	70%	9%	-61%
Minor									
Absence of time	60%	9%	-51%	60%	9%	-51%	70%	18%	-52%
Use of abbreviations	40%	0%	-40%	20%	9%	-11%	50%	0%	-50%

Case scenario 1 was better completed during the pre-test compared with the other two

case scenarios and also had almost no errors during the post-test for the intervention

group [Table 10(c)].   Case scenario two also had more zero scores (15%) for

mechanisms only during the post-test compared with the other two (0% and 8%).

Table 10(c): Error analysis – Intervention Group N=13								
	Case Scenario 1			Case Scenario 2			Case Scenario 3		
Type of errors	Pre	Post	Diff	Pre	Post	Diff	Pre	Post	Diff
Major									
Mechanism only	17%	0%	-17%	67%	15%	-52%	75%	8%	-67%
Improper sequencing	25%	0%	-25%	33%	0%	-30%	33%	0%	-30%
Competing causes	25%	0%	-25%	42%	8	-34%	50%	0%	-50%
Minor									
Absence of time	50%	8%	-42%	58%	8%	-50%	83%	8%	-75%
Use of abbreviations	17%	0%	-17%	42%	8	-34%	33%	8%	-25%

Types of errors

Minor and major errors were the two types of errors identified in this study. Errors were classified as major when they had the potential to change the ranking of the leading cause of death thus impacting on the underlying cause of death, whereas minor errors did not affect the ICD-Classification and had little direct impact on the underlying cause of death but their frequency could help with the overall understanding of the process and rules of death certification. The first three items of the WHO guidelines were considered major errors and items 4 and 5, minor errors. Each item was scored on a scale of 0 to 2. Scoring zero meant that it did not conform to the guidelines and that it was inaccurate and inappropriate.

Overall the post-test showed a huge decrease in death certificates that scored 0 on one or more death certificates [Table 11(a)]. A negative score showed an improvement. The death certificates went from a mostly wrong to only a few that scored zero. Most of the mistakes were caused by the absence of time intervals (58%) during the pre-test. There was also an improvement in death certificates which had competing causes (40% to 4%) followed with those death certificates which only had a mechanism of death without an underlying cause of death (36% to 11%).

Table 11(a): Types of errors (Death Certificates scoring 0)			
	Overall N=72 **(24X3 case scenarios)**		
Type of error	**Pretest**	**Posttest**	Difference
Major			
Mechanism only	36%	11%	-25%
Improper sequencing	17%	7%	-10%
Competing causes	40%	4%	-36%
Minor			
Absence of time	58%	10%	-48%
Use of abbreviations	31%	7%	-24%

When comparing the control and intervention groups, Table 11(b) shows that the control group had fewer death certificates which scored 0 on one or more death certificates during the pre-test except for the error of competing causes. The control group showed an improvement in 4 of the errors except for improper sequencing where there was no improvement. Although the intervention group had fewer death certificates which scored zero during the pre-test they had a larger improvement during the post-test. Both groups had the largest improvement in for the minor error "absence of time intervals".

Table 11(b): Types of errors (Death Certificates scoring 0) for the Control group and the Intervention group						
	Control Group **N=33** **(11X3 case scenarios)**			**Intervention Group** **N=39** **(13X3 case scenarios)**		
Type of errors	**Pre**	**Post**	Difference	**Pre**	**Post**	Difference
Major Errors						
Mechanism only	21%	15%	-6%	48%	8%	-40%
Improper sequencing	15%	15%	0%	28%	0%	-28%
Competing causes	45%	6%	-39%	36%	3%	-33%
Minor Errors						
Absence of time	58%	12%	-46%	59%	8%	-51%
Use of abbreviations	33%	3%	-30%	28%	5%	-23%

The post-test questionnaire consisted of multiple-choice questions using statements related to the underlying cause of death and identifying mechanisms of death where

the respondents were asked to give a true or false response. The questionnaire could only tell me about knowledge of the interns at that point in time as it was not included in the pre-test and thus could not be compared.

A Pearson chi-square test was done to see if there was a relationship between the intervention and control group and the correct answer. Table 12 indicates that there are no significant difference between the intervention and the control group and their knowledge about the underlying cause of death.

Table 12: Knowledge about the Underlying Cause of Death	Control (N=11)	Intervention (N=13)	Pearson chi2	*P-value*
	Correct	Correct		
Normally appear in Part II of the certificate	10	11	0.2158	0.642
Appear on the first completed line of Part I	8	11	0.5106	0.475
Appear on the lowest line of Part I	9	12	0.5994	0.5994
Should include interval between onset of this condition and death	9	11	0.0336	0.855
Should be abbreviated where possible	10	10	0.8392	0.360
All answers correct	6	7	0.0012	0.973

The phrase "mechanism of death" often arises when discussing causes of death and the death certificate, and is classified as physical or biological abnormality brought about by a cause. When asked to identify the mechanisms of dying the intervention group scored slightly better than the controls (Table 13).

Table 13: "Mechanisms of death"	Control (N=11)	Intervention (N=13)	Pearson chi2	*P-value*
	Correct	Correct		
Heart failure	8	11	0.5106	0.475
Lung cancer	11	13		
Stroke	10	10	0.8392	0.360
Asphyxia	11	11	1.8462	0.174
Kidney failure	9	11	0.0336	0.855
All answers correct	6	7	0.0012	0.973
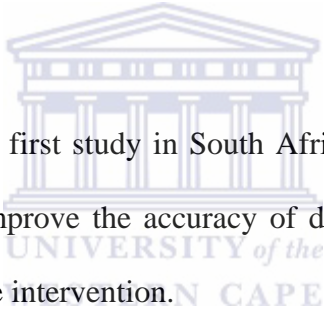
Seventy seven percent of the intervention group and 64% of the controls correctly identified heart failure as a mechanism of death. The controls had a 100% correct response that Asphyxia is a mechanism compared with 85% of the intervention group. In both groups more than 80% identified kidney failure as a mechanism of death. Nine percent of the control group disagreed that stroke was a cause of death and instead thought it to be a mechanism of death.

The findings revealed a poor baseline understanding of the death certification that improved after the didactic session and reading the educational material. There was an overall significant improvement of 75% ($P<.0001$) between the pre- and post-tests of those who scored 12 or above the acceptable cut-off point with similar improvement for the control and intervention groups. Both groups improved substantially and significantly, the improvement for the control group was 82% ($P=0.0027$) and for the intervention group was 69% ($P=0.0027$). It can be concluded that a questionnaire used in conjunction with a didactic session and educational material could focus attention on potential knowledge gaps relating to death certification, although a long term improvement in certification outcome is yet to be demonstrated.

CHAPTER 5

DISCUSSION

Completing a death certificate properly and as soon as possible after death is an important responsibility for medical doctors, who must understand how the certificate is used and be able to recognise and accurately utilise the concepts of immediate, underlying and contributing causes of death. Although many doctors are confronted with the task of completing death certificates, they may not have received adequate training for such completion. Resulting inaccuracies in information undermine the quality of the data derived from death certificates and so affect the reliability of mortality data.
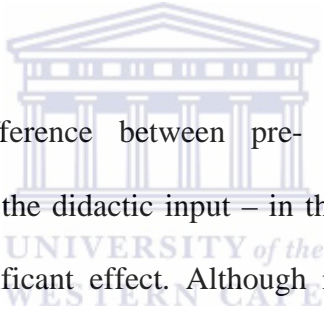
To my knowledge, this is the first study in South Africa that implemented a simple educational intervention to improve the accuracy of death certification and actually measured the changes after the intervention.

In this study both groups performed poorly during the pre-test with only 9% of the control and 15% of the intervention group that could score above the acceptable cut-off point.

The most important result of this study is the production of a set of educational tools (written educational material, didactic session, and a questionnaire plus case scenarios) that could be used to improve doctors' knowledge about death certification. Both the control and experimental groups' ability to complete a death certificate improved significantly which suggests that the educational material in itself is an important tool for improving the quality of death certification. While both groups

improved significantly in the post-test (82% for the control and 69% for the intervention), it should be noted that the controls improved more in terms of the cut-off analysis. The didactic session added relatively little beyond the written guidelines.

Educational material was developed from available sources and modified to highlight common misconceptions. The designed intervention was based on a didactic teaching session and written educational material on death certification. To address contamination in my study both groups received the educational material for self-study and the intervention group received the didactic session. This deprived the study of the opportunity to assess the impact of the written guidelines controlled against no input.

However, the dramatic difference between pre- and post intervention tests demonstrated adequately that the didactic input – in the form of the written guide – had a large and highly significant effect. Although it is difficult to separate this difference from the "placebo effect" of the case studies themselves, the huge change was only credible as a result of the study input. The didactic session which was controlled, added little, if anything.

Classifying errors into major and minor errors was important for identifying and improving the types of errors made. From the literature this study developed a classification system that assessed five types of errors and then classified them into minor and major errors.

Major errors

Not all errors had the same impact on the underlying death, therefore only mistakes which affected the underlying cause of death were classified as major errors.

Use of Mechanisms of death

Physicians sometimes confused the cause of death with the mechanism of death, partly because the medical treatment intervention often was the mechanism. It was not always possible to identify specific complications or mechanisms that resulted from an underlying cause of death because of their multiple or difficult nature, or because adequate information was lacking as might have occurred when an autopsy cannot be performed. In the present study, 36% of all death certificates recorded mechanisms as a cause of death at baseline but this was reduced to 11% after the intervention. This error was recorded in 21% of controls and 48% of the intervention group before the intervention and was reduced to 15% and 8% respectively after the intervention.

Improper sequencing

Improper sequencing occurred when there was no sequential cause-and-effect relationship between the underlying, intermediate and immediate cause of death when read from bottom to top. Doctors sometimes copied the summary diagnosis directly onto the medical certificate as cause of death and then incorrectly listed the underlying problem first, followed by other conditions, as in a problem list. The present study revealed that 17% of all death certificates had improper sequencing at baseline which was reduced to 7%. During the pre-test the control group (21%) did

better than the intervention group (28%) but the intervention group reduced this error to 0% compared with the control group who reduced it marginally to 15%.

Competing causes

The variation in the extent of agreement between the medical interns' death certificate entries and the correct cause-of-death sequences appeared to reflect lack of training in death certificate completion at all levels of the medical experience. Recording two legitimate causes of death in Part I of Section G of the death notification form may have confused the issue of determining the most probable cause of death and could have lead to a different ICD code from the actual cause of death. The appropriate place to record competing causes would be in Part II of Section G of the cause of death section of the death certificate.

In this study competing causes accounted for 40% of all death certificates in the pre-test which was significantly reduced to 4% after the intervention. This error was also significantly reduced from 45% to 6% for the control group and from 36% to 3% for the intervention group during the post-test.

Minor errors

Only errors with little direct epidemiological impact were classified as minor errors.

Absence of time intervals

Although this error is not seen as serious as listing only the mechanism of death, the nosologist would be able to recognise the reversal but without time intervals this would be more difficult. Its recognised that filling in time intervals is a difficult task;

however the certifier should use his/her best clinical judgement to estimate these intervals. A certificate could lack time intervals and contain other inappropriate information and still be considered acceptable. Generic intervals such as minutes, hours, days, months and years are acceptable.

In the present study time intervals was the least filled in part of all three case scenarios. Fifty eight percent of all death certificates had no time intervals recorded and this was significantly reduced to 10% in the post-test. This error was high for groups, 58% for the control and 59% for the intervention group at baseline which was significantly reduced after the intervention.

Use of abbreviations/inappropriate information

Since most nosologists do not have a medical background, the use of abbreviations is not allowed in death certification, as it can lead to confusion.

The present study showed a huge reduction in the use of abbreviations during death certification. Overall, this error was significantly reduced from 31% at baseline to 7% after the intervention and the same pattern of reduction was observed for the control and intervention groups.

This study, similar to previous overseas studies, has attributed the existing problems in certification to a lack of knowledge of correct procedures, and the suggested solution from this and other studies had been education and appropriate supervision.

Our error rate at baseline was comparable with other overseas studies which reported that between 29% and 35% of death certificates recorded only mechanisms (Zumwalt

& Ritter, 1987; Katsakiori *et al*., 2007), but was higher than a recent South African study which major errors included 13.5% use of mechanisms of death (Burger *et a.*, 2007). Reducing this error rate by other intervention studies was also possible as could be seen by Villar and Pèrez-Mèndez (2007), who significantly reduced this error from 43% to 2.4% and Myers and Farquhar (1998) also reduced it from 15.8% to 4.8.

Only a few studies could be found in the literature that evaluated the impact of an educational intervention on the death certification process. Pain and colleagues (1996) found the overall performance of the students reasonably acceptable, with the intervention group performing slightly better than the control group (difference in median score = 3). Twenty four percent of the intervention group scored above 47.5 whereas only 7% of the control group did so and concluded that adding the video to the usual lecture had a limited effect on the overall knowledge and skills.
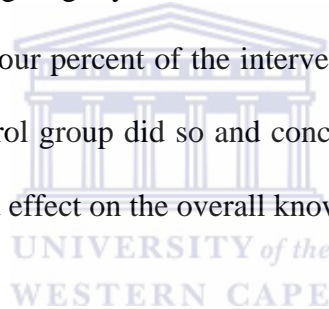
Lakkireddy and colleagues (2007) in the USA designed their interventions by using a validated scoring system instead of counting error rates. Both groups performed poorly at baseline when only 19% could achieve an optimal test score and the death certificate score improved significantly in the post-intervention with group I (14 +- 6 vs. 24+-5 *p*<0.001) and group II (14+-5 vs. 19+-5, *p*<0.001). They concluded that physician skill in death certification can be improved with an educational intervention and that an interactive workshop is more effective than a printed handout - just the opposite of the result found in this study.

Other intervention studies showed a reduction in error rate although not significant (Weeramanthri *et al.,* 1993, Suarez *et al.,* 1998, Selinger, *et al.,* 2007) while for Myers and Farguhar (1998) major errors decreased significantly from 33% to 15%,

listing mechanisms of death without a legitimate underlying cause of death (15.8%vs4.8%;) and improper sequencing (15.8%vs6.6%). Villar and Pèrez-Mèndez (2007) revealed similar results to this study by reducing improper sequencing from 18.7% to 0.6%. Competing causes were higher in a Canadian tertiary care teaching hospital where the Department of Medicine (23.9%) recorded this error most frequently (Jordan & Bass, 1993). In South Africa, Burger *et al.,* (2007) found competing causes in 15% of Death Notification Forms and Myers and Farquhar (1998) reported that 7.5% (n=146) of death certificates before and 8.4% (n=83) after the educational intervention contained this error.

In this study the absence of time intervals were significantly reduced after the intervention whereas Myers and Farquhar (1998) could not reduce this error as it remained high both before as well as after the intervention (69.2% vs. 75.9%). The present study showed a highly significant reduction in the use of abbreviations during death certification while both studies by Villar and Pèrez-Mendèz (2007) and Myers and Farquhar (1998) failed to reduce this error.

It was concluded that this intervention was brief, highly effective and can be widely implemented to improve death reporting in South Africa. All hospitals should require new medical interns to read and refer to the educational guidelines on death reporting produced by this study.

Generalisability

The findings are likely to be generalisable to all doctors in South Africa, as they all receive the same training as medical students and are therefore likely to both require and be as receptive to the education on Death Certification. The medical interns in the sample represented students from all the major universities in South Africa, and

there were no differences in improvement post intervention amongst those from different medical schools The results are therefore likely to be generalisable to all new medical interns. It's plausible that it could be generalised to all doctors irrespective of the time lapse since their undergraduate training but this assumption remains untested, as only recent medical interns were included in the study.

Limitations

The study had several limitations. The study population was small, not all medical interns participated in the study and no data was available on those who did not participate.

The limitation of using case history vignettes was that this method did not embrace the range of real-life clinical conditions. The class room style vignette method of assessment would have induced the Hawthorne bias: namely that the medical interns may have completed the death certificate more carefully than usual because they were participating in a study. This is not a major limitation as the Hawthorne bias would have been present at both the pre and post intervention assessments, and the study was less interested in the absolute results at each assessment than in the change post intervention.

The controls were similar to the intervention group in that they received the educational material as a consequence of attempting to minimize contamination. It is quite likely that the assessment itself played an important role in the improvement levels as the very act of being assessed at completing death certificates is likely to have increased their ability to competently complete death certificates in future, and it is therefore unclear that an intervention based on educational material alone, or

educational material and a didactic lecture (without the benefit of the assessment) would result in a similar level of improvement.

Ideally there should have been three groups of interns at different hospitals; one for the didactic session and the educational material, one for the educational material and one group who was the control. This was not done as this was a small research project with limited time and resources.

Not all medical interns participated in the post-test which lead to loss to follow-up and possible information bias.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1   Conclusion

Major errors in the completion of the correct cause of death on death certificates are very common among medical interns and the study has demonstrated that a didactic session with educational material can dramatically improve the accuracy of death certificate completion.

This study leads to the conclusion that there is a need to improve the quality of death certificate completion by medical interns at Tygerberg Hospital. This conclusion is based on the study's findings which include low levels of knowledge on various aspects of death certification, which have improved after an educational intervention, as well as the interns own acknowledgement that quality improvement in Death Certification was required. The findings also reflect the lack of formal training in death certification by most medical schools in South Africa at the time of study of the respondents.

Completeness of death certificates by medical interns is to a great extent influenced by different major and minor errors. Of the major errors the use of competing causes was the most frequent major error which endorse the lack of training in death certificate completion at all levels of the medical experience. The key concept of underlying cause of death and its correct placement in Part I of the death certificate, the distinction between cause and mechanism, use of abbreviations are all concepts that were insufficiently understood prior to the intervention. The fall in major certification errors immediately following the educational intervention was significant

Previous certification experience was not shown to affect certification knowledge as assessed by the questionnaire and case scenarios; while the assessment of errors on the "dummy" death certificates was in itself an assessment.

While much remains to be done, this study has clearly demonstrated the improvements that can be reliably predicted to result from relatively simple efforts to train medical interns and other front line doctors in the basic skills and logic of completing death certificates properly. If done widely, this intervention alone could greatly improve the quality of cause of death statistics for South Africa.

6.2   **Recommendations**

What can be done to improve the system?

From the study's conclusion that the training of doctors in death certification clearly needs to be improved, it is recommended that a training package be developed which should include printed material and interactive didactic sessions. The materials used for this study would be a reasonable starting point for the development of such materials. Such a training package would gain from inputs from various role-players, including medical interns, practicing doctors, pathologists, government departments capturing and coding the certificate information, researchers using and interpreting the data, and lecturers at medical schools.

Further improvement in Death Certificate completion could be encouraged by:

- The introduction of questions on death certification into undergraduate medical examinations.
- Focus on Death Certificate completion and the value of mortality information through continuous professional development.

6.3   Further Research

Further research is required to confirm and extend the knowledge gained by this study. It is necessary that further studies assess other grades of medical practitioners and in particular, the general practitioners.   Although there is some evidence to suggest that similar rates of unsatisfactory certification exist overall, this is not firmly established. The value of educational interventions requires further study in a larger sample.

REFERENCES

Alderson MR and Meade TW (1967). Accuracy of Diagnosis on Death Certificates Compared With That in Hospital Records. *Brit J Prev Soc Med,* **21:** 22-29.

Armour A, Bharucha H (1997). Nosological Inaccuracies in Death Certification in Northern Ireland. A Comparative Study between Hospital Doctors and General Practitioners. *Ulster Med,* **66**(1): 13-7.

Bah S (2003) A Note on the Quality of Medical Certification of Deaths in South Africa, 199-2001. *S Afr Med J,* **93**(4): 239.

Barber JB (1992). Improving the Accuracy of Death Certificates. *J Natl Med Assoc,* **84**:1007-1008.

Bell G, Cremona A (1989). Alcohol and Death Certification: Influencing Current Practice and Attitudes. *British Journal of Addiction,* **84**: 1523-1525.

Benavides FG, Bolumar F, Peris R (1989). Quality of Death Certificates in Valencia, Spain. *Am J Public Health,* **79**: 1352-1354.

Bobbi SP, Hardin NJ, Richmond JA and Shapiro SL (2005). Death Certification Errors at an Academic Institution. *Arch Pathol Lab Med,* **129**: 1476-1479.

Bradshaw D and Schneider M (1995). Vital Registration and Statistics in South Africa: Case Study Metropolitan Cape Town. Medical Research Council, South Africa.

Bradshaw D, Groenewald P, Boure DE, Mohamed H, Daniels J and Nixon J (2006). Making Cause of Death Statistics Useful for Public Health at Local Level in the City of Cape Town. *Bull World Health Organ,* **84**:11-217.

Burger EH, van der Merwe L and Volmink J (2007). Errors in the Completion of the Death Notification Form. *S Afr Med J,* **97**:1077-1081.

Coady SA, Sorlilie PD, Cooper LS, Folsom AR, Rosamond WD and Conwill DE (2001). Validation of Death Certificate Diagnosis for Coronary Heart Disease: the Atherosclerosis Risk in Communities (ARIC) study. *J Clin Epidemiol,* **54**:40-50.

Comstock GW, Markush RE (1996). Further Comments on Problems in Death Certification. *Am J Epidemiol,* **124**: 180-181.

D'Amico M, Agozzino E, Biagino A, Simonetti A, Marinelli P (1999). Ill-defined and Multiple Causes on Death Certificates – A Study of Misclassification in Mortality Statistics. *European J Epidemiol,* **15**: 141-148.

Doyle YG, Harrison M and O'Malley F (1990). A Study of Selected Death Certificates from Three Dublin Teaching Hospitals. *J Public Health Med,* **12**(2):118-23.

Engel LW, Strauchen JA, Chiazze L, Heid M (1980). Accuracy of Death Certification in an Autopsied Population with Specific Attention to Malignant Neoplasms and Vascular Disease. *Am J Epidemiol,* **111(1):** 99-112.

Glasser JH (1981). The Quality and Utility of Death Certificate Data. *Am J Public Heath,* **71(3)**:231-233.

Goldacre MJ (1993). Cause-specific Mortality: Understanding Uncertain Tips of the Disease Iceberg. *J Epidemiol Community Health,* **47**:491-496.

Goraya TY, Jacobsen SJ, Belau PG, Weston SA, Kottke TE, Roger VL (2000). Validation of Death Certificate Diagnosis of Out-of-Hospital Coronary Heart Disease Deaths in Olmsted County, Minnesota. *Mayo Clin Proc,* **75**:681-687.

Groenewald P, Nannan N, Bourne D, Laubscher R, and Bradshaw D (2005). Identifying Deaths from AIDS in South Africa. *AIDS,* **19**:193-201.

Hanzlick R (1997). Principles for including or excluding 'mechanisms' of death when writing cause of death statements. *Arch Pathol Lab Med,* **121**:377-380.

Heasman MA and Lipworth L (1966). Accuracy of Certification of Cause of Death. *Studies on Medial and Population Subjects,* HMSO, London:20-30.

Hopkins DD, Grant-Worley JA, Bollinger TL (1989). Survey of Cause-of-Death Query Criteria used by State Vital Statistics Programs in the US and the Efficacy of the Criteria used by the Oregon Vital Statistics Program. *Am J Public Health,* **79**(5): 570–574.

Horner JS and Horner JW(1998). Do Doctors Read Forms? A One-year Audit of Medical Certificates submitted to a crematorium. *J R Soc Med,* **91**:371-376.

Hunt R, Barr P (2000). Errors in the Certification of Neonatal Death. *J Paediatr Child Health,* **36**(5):498-501.

Iribarren C, Crow RS, Hannan PJ, Jacobs DR Jr, Luepker RV (1998). Validation of Death Certificate Diagnosis of Out-of-Hospital Sudden Cardiac Death. *Am J Cardiol,* **8**:50-53.

Israel RA, Rosenberg HM, Curtin LR (1986). Analytical Potential for Multiple Cause-of-Death Data. *Am J Epidemiol,* **124**:161-79.

Izegbu MC, Agboola AOJ, Akiode O, Abudu EK (2004). Incomplete and Inaccurate Death Certificate by Medical Students in Nigeria, the Need for Guidance. *Nigerian Medical Practitioner,* **46**(4):84-86.

James D, Bull AD (1996). Information on Death Certificates: Cause for Concern? *J Clin Pathol,* **49**:213-216.

Johannson LA, Westerling R (2000). Comparing Swedish Hospital Discharge Records with Death Certificates: Implications for Mortality Statistics. *In J Epidemiol,* **29**:495-502.

Jordan JM and Bass MJ (1993). Errors in Death Certificate Completion in a Teaching Hospital. *Clin Invest Med,* **16**(4):249-255.

Katsakiori PF, Panagiotopoulu EC, Sakellaropoulus GC, Papazafuriopoulo A, Kardara M (2007). Errors in Death Certificates In a Rural Area of Greece. *Rural and Remote Health,* 7:822.

Kircher T, Nelson J, Burdo H (1985). The Autopsy as a Measure of Accuracy of the Death Certificate. *N Engl J Med,* **313**:1263-1269.

Kitcher T (1990). The Autopsy and Vital Statistics. *Hum Pathol,* **21**:166-173.

Lakkireddy DR, Gowda MS, Murray CW, Basarakodu KR and Vacek JL (2004). Death Certificate Completion: How Well Are Physicians Trained and Are Cardiovascular Causes Overstated? *Am J Med,* **117**:492-498.

Lakkireddy DR, Basarakodu KR, Vacek JL, Kondur AK, Ramachandruni SK, Esterbrooks DJ, Markert RJ, Gowda MS (2007). Improving Death Certificate Completion: A Trial of Two Training Interventions. *Society of General Internal Medicine,* **22**:544-548.

Leadbeatter, S (1986). Semantics of death certification. *Journal of Royal College of Physicians London,* **20:**129–132.

Lindahl BIB (1985). The Causal Sequence on Death Certificates: Errors Affecting the Reliability of Mortality Statistics for Rheumatoid Arthritis. *J Chronic Dis,* **38***:* 47-57.

Lloyd-Jones DM, Martin DO, Larson MG, Levy D(1998). Accuracy of Death Certificates for Coding Coronary Heart Disease as the Cause of Death. *Ann Intern Med,* **129:**1020-1026.

Lu TH, Chang HY, Hwu CM, Chiu HC, Yin WH, Pan WH (2001)(a). Comparison of Official Coders versus Physician Panel in Assignment of Underlying Cause of Death. *J Formos Med Assoc,* **100:***365*-369.

Lu TH, Shih TP, Lee MC, Chou MC and Lin CK (2001)(b). Diversity in Death Certification. A Case Vignette Approach. *Int J Clin Epidemiol,* **54**:1086-1093.

Lu TH, Shau WY, Shih TP, Lee MC, Chou MC and Lin CK (2001)(c). Factors Associated with Errors in Death Certificate Completion. A National Study in Taiwan. *Int J Clin Epidemiol,* **54**(3):232-238.

Magrane BP, Gilliland MGF, and King DE (1997). Certification of Death by Family Physicians. *American Family Physician*, **56**(5):,1433-1438.

Maudsley G and Williams EMI (1993). Death Certification by House Officers and General Practitioners – Practice and Performance. *Journal of Public Health Medicine,* **15**(2): 192-201**.**

McAllum C, St George I, and White G (2005). Death Certification and Doctors' Dilemmas: a Qualitative Study of GPs' Perspectives. *British Journal of General Practice,* 55:677-683.

McKelvie PA, Rode J (1992). Autopsy Rate and a Clinicopathological Audit in an Australian Metropolitan Hospital – Cause for Concern? *Med J Aust,* **156**:456-462.

McKelvie PA, (1993). Medical Certification of Causes of Death in an Australian Metropolitan Hospital. *Med J Aust,* **158**:816-821.

Meel BL (2003). Certification of Deaths at Umtata General Hospital, South Africa. *Journal of Clinical Forensic Medicine,* **10**:13-15.

Messite J and Stellman SD (1996). Accuracy of Death Certificate Completion: The Need for Formalized Physician Training. *JAMA,* **13**(275):794-796.

Morton L, Omar R, Caroll S, Beirne M, Halliday D, Taylor KM (2000). Incomplete and Inaccurate Death Certification – the Impact on Research. *Journal of Public Health Medicine,* **22**(2):133-137.

Myers KA, Farquhar DRE (1998). Improving the Accuracy of Death Certification. *CMAJ,* **158**: 1317-1323.

Naruse Y, Nakagawa H, Yamagami T, Sokejima S, Morikawa Y, Nishijo M, Tabata M, Semma M, Miura K, Kagamimori S (1997). Ischaemic Heart Diseases Deaths in a Japanese Rural Area Evaluated by Clinical Records. *J Epidemiol,* **7**:71-76.

National Center for Health Statistics (NCHS) (2004). Physicians' Handbook on Medical Certification of Death 2003 Revision. U.S Department of Health and Human Services Centers for Disease Control and Prevention NCHS. Hyattsville, Maryland. DHHS Publication No (PHS): 2003-1108.

Peach HG, Brumley DJ (1998). Death Certification by Doctors in Non-metropolitan Victoria. *Aust Fam Physician,* **27**(3):178-82.

Pain CH, Aylin P, Taub NA and Botha JL (1996). Death Certification: Production and Evaluation of a Training Video. *Med Educ,* **30**: 434-439.

Payne D (2000). Death Keeps Irish Doctors Guessing. *BMJ,* **321**:468.

Pritt BS, Hardin NJ, Richmond JA and Shapiro SL. (2005) Death Certification Errors at an Academic Institution. *Arch Pathol Lab Med,* **129**:1476-1479.

Rao C, Lopez AD, Yang C, Begg S, and Ma J (2005). Evaluating National Cause-of-Death Statistics: Principles and Application to the Case of China. *Bull World Health Organ,* **83**: 618-625.

Ramos RM and Majo Cortes MC (1996). Evaluation of Seminars on International Criteria of Medical Certification of Cause of Death. *Aten Primaria,* **18**(6): 324-326.

Smith-Sehdev AE, Hutchins GM (2001). Problems with Proper Completion and Accuracy of the Cause-of-Death Statement. *Arch Intern Med,* **161**:277-284.

Sellinger CJ, Ellis RA and Harrington MG (2007). A Good Death Certificate: Improved Performance by Simple Educational Measures. *Postgrad Med J,* **83**:285-286.

Sibai AM (2004). Mortality Certification and Cause-of-Death Reporting in Developing Countries. *Bull World Health Organ,* **8**(2): 83-93.

Slater DN (1993). Certifying the Cause of Death: an Audit of Wording Inaccuracies. *J Clinic Pathol,* **46**: 232-234.

Stark M (2003). Literature Review of Death Certification Procedures – international aspects. *Journal of Clinical Forensic Medicine,* **10**:21-26.

Suarez CL, Lopez MC, Gill CJ, and Sanchez NC (1998). Learning and Satisfaction in the Workshops of Pre and Post-graduate Medicine for the Improvement of the Accuracy of Certifications of Causes of Death. *Rev Esp Salud Publica,* **72**(3):185-95.

Swain GR Ward GK Hartlaub PP (2005). Death Certificates: Let's Get It Right. *Am Fam Physician,* **71**: 652, 655-656.

Swartout HO and Webster RJ (1940). To What Degree are Mortality Statistics dependable? *American Journal of Public Health,* **30**:811.

Tsung-Hsueh L, Tai-Pin S, Meng-Chih L, Ming-Chih C, Chen-Kun L (2001). Diversity in Death Certification: A Case Vignette Approach. *Journal of Clinical Epidemiology,* **54**:1086-1093.

Villar J and Pèrez-Mèndez L (2007. Evaluating an Educational Intervention to Improve the Accuracy of Death Certification among Trainees from Various Specialties. *BMC Health Services Research,* **7**:183-188.

Weeramanthri T, Beresford B (1992). Death certification in Western Australia – classification of major errors in certificate completion. *Aust J Public Health,* **16**(4):431-4.

Weeramanthri T, Beresford W, and Sathianathan V (1993). An Evaluation of an Educational Intervention to Improve Death Certification Practice. *Aust Clin Rev,* **13**(4):185-9.

World Health Organisation (WHO), (1992). *International Statistical Classification of Disease and Health Related Problems. Tenth Revision,* 2 edn. GENEVA; World Health Organisation.

Zumwalt RE and Ritter MR (1989). Incorrect Death Certificates: an Invitation to obfuscation. *Postgrad Med,* **81**:245-254.

Appendix A

Appendix A: Problem analysis diagram: Death Certification by Medical Practitioners
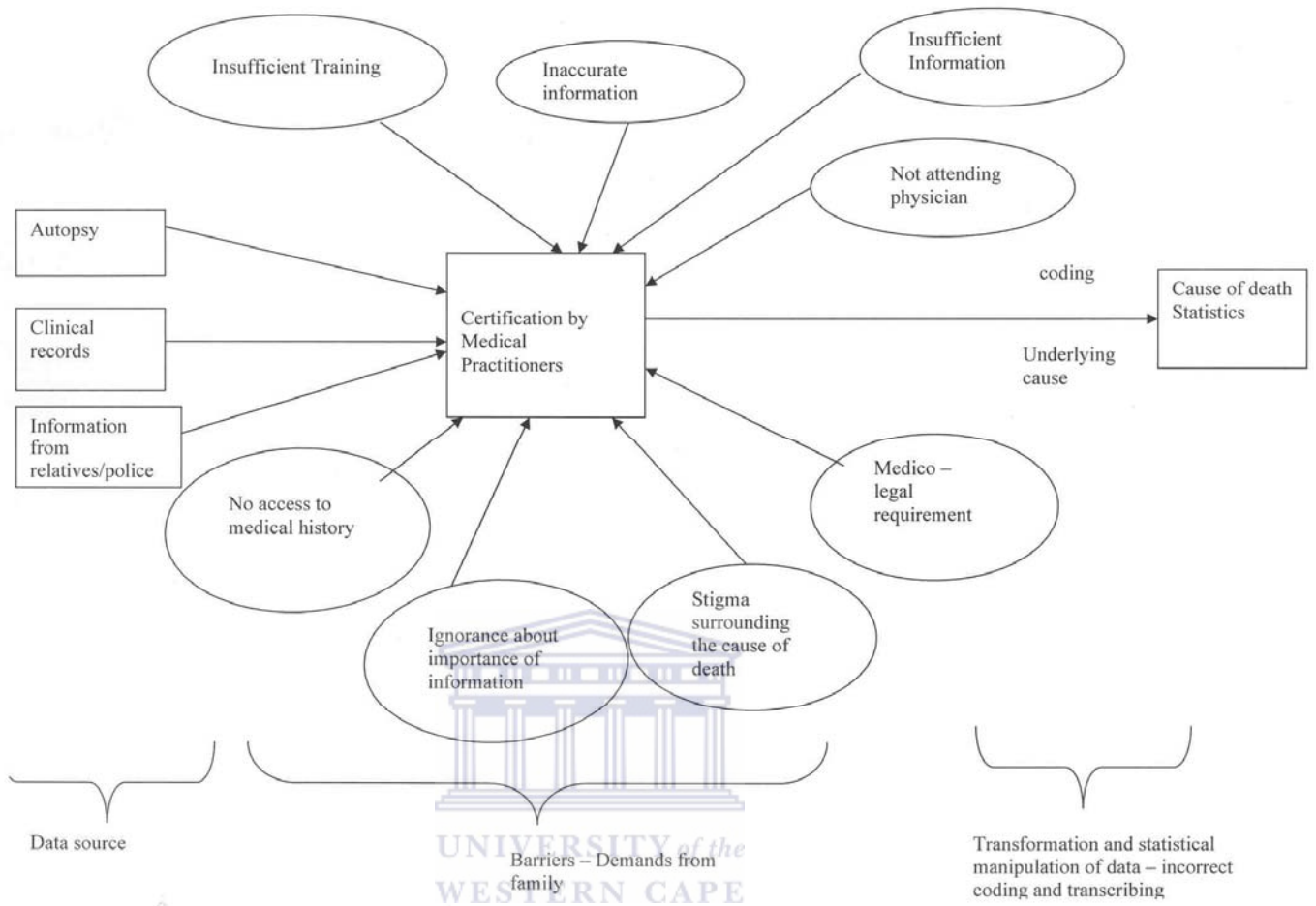
Appendix B: Case Scenarios for Pretest

Case scenario 1

A 34 year-old male was admitted with severe shortness of breath. He had a 9 month history of unintentional weight loss, night sweats and diarrhea. An Elisa test and confirmatory Western Blot test for HIV were positive. T-lymphocyte tests indicated a low T helper-suppressor ratio. A lung biopsy was positive for *Pneumocystis carinii* pneumonia (PCP), indicating a diagnosis of acquired immunodeficiency syndrome (AIDS). The patient's pneumonia responded to therapy, and was discharged. The patient had two additional admissions for PCP. Seventeen months after the patient was first discovered to be HIV positive, he again developed PCP but did not respond to therapy. He died 2 weeks later.

State whether this patient died from Natural ☐ or Unnatural ☐ causes.

Should this case be referred to forensic pathology? Yes ☐   No ☐

G MEDICAL CERTIFICATE OF CAUSE OF DEATH

		Approximate interval between onset and death (Days/Months/Years)	FOR OFFICE USE ONLY
			ICD-10

PART 1. Enter the disease, injuries or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.

IMMEDIATE CAUSE (Final disease or condition resulting in death)
a. *Pneumoncystis Carinii* Pneumonia — **2 Weeks**
Due to (or as a consequence of)

Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE last (Disease or injury that initiated events resulting in death)
b. Acquired Immunodeficiency Syndrome — **17 Months**
Due to (or as a consequence of)

c. Human Immunodeficiency Virus — **Over 17 Months**
Due to (or as a consequence of)

d. ....
Due to (or as a consequence of)

PART 2. Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1. ....

If a female, was she pregnant 42 days prior to death? (✓):   Yes ☐   No ☐

If stillborn, please write mass in grams ☐☐☐☐

Do you consider the deceased to be   African ☐   White ☐   Indian ☐   Coloured ☐   Other ☐ (Specify)...........

Method of ascertainment of cause of death:

1. Autopsy   2. Opinion of attending medical practitioner ☐   3. Opinion of attending medical practitioner on duty ☐

4. Opinion of registered professional nurse ☐   5. Interview of family member ☐

6. Other ☐ (Specify) ....

Case scenario 2

A 42-year-old man with a 10 year history of cirrhosis due to alcohol abuse develops spontaneous bacterial peritonitis. Septic shock develops because of *Escherichia coli* bacterium, and the man dies within hours after admission to hospital.

State whether this patient died from Natural ☐ or Unnatural ☐ causes.

Should this case be referred to forensic pathology? Yes ☐ No ☐

Please complete the death certificate.

G MEDICAL CERTIFICATE OF CAUSE OF DEATH			FOR OFFICE USE ONLY

PART 1. Enter the disease, injuries or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.

Approximate interval between onset and death (Days/Months/Years)

ICD-10

IMMEDIATE CAUSE (Final disease or condition resulting in death)
a. Spontaneous Bacterial Peritonitis | 1 Day
Due to (or as a consequence of)

Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE last (Disease or injury that initiated events resulting in death)
b. Cirrhosis of the Liver | 10 Years
Due to (or as a consequence of)

c. Alcohol Abuse | Over 10 Years
Due to (or as a consequence of)

d. ......
Due to (or as a consequence of)

PART 2. Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1. ......

If a female, was she pregnant 42 days prior to death? (✓): Yes ☐ No ☐

If stillborn, please write mass in grams ☐☐☐☐

Do you consider the deceased to be   African ☐   White ☐   Indian ☐   Coloured ☐   Other ☐ (Specify)......

Method of ascertainment of cause of death:

1. Autopsy   2. Opinion of attending medical practitioner ☐   3. Opinion of attending medical practitioner on duty ☐

4. Opinion of registered professional nurse ☐   5. Interview of family member ☐

6. Other ☐ (Specify)......

Case scenario 3

A 6 month old female infant has been admitted with severe pneumonia and an empyema. He has had a cough for about a week. The child is wasted. A chest drain is inserted under local anaesthetic. Staph aureus is grown from the pus. Appropriate antibiotics are commenced. His mother has AIDS, but the infant was negative for HIC DNA (PCR test). Mantoux is positive. Over the next two days she deteriorates, developing respiratory failure. There is no ICU bed. On Day 4 of the admission she dies.

State whether this patient died from Natural ☐ or Unnatural ☐ causes.

Should this case be referred to forensic pathology? Yes ☐ No ☐

74

Please complete the death certificate.

G MEDICAL CERTIFICATE OF CAUSE OF DEATH

		Approximate interval between onset and death (Days/Months/Years)	FOR OFFICE USE ONLY ICD-10

PART 1. Enter the disease, injuries or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.

Staphylococcal pneumonia with empyema

IMMEDIATE CAUSE (Final disease or condition resulting in death)
a. .... 7 Days
Due to (or as a consequence of)

Severe malnutrition

Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE last (Disease or injury that initiated events resulting in death)
b. .. Months
Due to (or as a consequence of)

c. ....
Due to (or as a consequence of)

d. ....
Due to (or as a consequence of)

PART 2. Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1. ....

If a female, was she pregnant 42 days prior to death? (✓):   Yes ☐   No ☐

If stillborn, please write mass in grams ☐☐☐☐

Do you consider the deceased to be   African ☐   White ☐   Indian ☐   Coloured ☐   Other ☐   (Specify)............................

Method of ascertainment of cause of death:

1. Autopsy   2. Opinion of attending medical practitioner ☐   3. Opinion of attending medical practitioner on duty ☐

4. Opinion of registered professional nurse ☐   5. Interview of family member ☐

6. Other ☐   (Specify)...

Appendix C

CAUSE OF DEATH DATA SHEET (Check One ☑ Please)   **S**tudy no [   ][   ][   ]

1. Name of the department you work in:
_____   [   ]

2. Name of the Medical School where you studied:

_____   [   ]

3. When did you start your internship?_____/_____/_____   [   ][   ] [   ][   ][   ]

4. **Gender:**   **Male** [1]   **Female** [2]   [   ]

5. Date of birth: ____/____/_____   [   ]

6. Have you ever completed a death certificate before?   [   ][   ][   ][   ]
   Yes [1]   No [2]

                                                                    [   ]

7. How many death certificates have you filled in?
   Less than 10 [1]   11 - 25 [2]   more than 25 [3]

8. Did you find it straightforward?   [   ]
   Yes [1]   No [2]

   If No, what was difficult?   [   ]
   _____

9. Were you able to provide all the non-medical details such as education and
occupation?   [   ]
      Yes [1]   No [2]

10. Might you modify what you consider to be the true "Cause of Death"
statement on a death   certificate for any of the following reasons?   [   ]

   (a) 'so as not to distress relatives?
   Yes [1]   No [2]   Unsure [3]   [   ]

   (b) 'so as not to require a post mortem?
   Yes [1]   No [2]   Unsure [3]   [   ]

   (c) 'because it does not fit in with the current format of the certificate?'
   Yes [1]   No [2]   Unsure [3]   [   ]

   (d) 'because there was a concern about stigma?'
   Yes [1]   No [2]   Unsure [3]

76

(e) 'any other reason?' Please specify._____ ☐

11. Did you receive any formal training in writing the cause of death statement or death certificate?

Yes ☐ 1   No ☐ 2 ☐

If yes where?

Medical school ☐ 1   Intern year of residency ☐ 2   Other ☐ 3 ☐

12. Was this training adequate to make you comfortable with your ability to fill out death certificates correctly?

Yes ☐ 1   No ☐ 2   Unsure ☐ 3 ☐

13. Do you think that there is room for improvement in the manner in which you complete a death certificate?

Yes ☐ 1   No ☐ 2   Unsure ☐ 3 ☐

If yes, which of the following do **you** consider could improve your performance?

(a) 'having more time to devote to it'

Yes ☐ 1   No ☐ 2   Unsure ☐ 3 ☐

(b) 'having less pressure from relatives, funeral director, etc. to produce the certificate quickly'

Yes ☐ 1   No ☐ 2   Unsure ☐ 3 ☐

(c) 'having more readily available information to aid completion'

Yes ☐ 1   No ☐ 2   Unsure ☐ 3 ☐

(d) 'making the format more amenable to logic completion'

Yes ☐ 1   No ☐ 2   Unsure ☐ 3 ☐

14. Are you aware of the South African guidelines for filling out a death certificate?

Yes ☐ 1   No ☐ 2 ☐

15. Are you aware of any other guidelines for filling out a death certificate?

Yes ☐ 1   No ☐ 2 ☐

15. Do you think you would benefit from some kind of formal training in filling out a death

☐

certificate?

Yes ☐ 1   No ☐ 2

16. Do you think you need to be supervised on your first few death certificates until you get familiarized with protocol?

Yes ☐ 1   No ☐ 2   ☐

Please Turn Over

UNIVERSITY OF THE WESTERN CAPE
School of Public Health

Private Bag X17 ● **BELLVILLE** ● 7535 ● South Africa
Tel: 021- 959 2809, Fax: 021- 959 2872

**Title: Evaluation of an educational intervention to improve the accuracy of death certification amongst medical interns.**

INTRODUCTION

Dear Participant,

My name is Desiree Pass, I'm an senior research technologist at the Burden of Disease Research Unit of the Medical Research Council (MRC). I will be evaluating an educational intervention to motivate accurate certification and provide clear guidance on the certification process for my Masters in Public Health mini thesis at the University of the Western Cape. You are hereby invited to take part in this research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully. Talk to others about the study if you wish.

The death certification process serves several purposes:

1. It is essential preliminary to registration of a death, and therefore to the burial or cremation, the funeral and the mourning of the person who has died;
2. It is also a protection against the disposal of bodies without professional inquiry of the need for further investigation;
3. It is also the main source of the national mortality statistics which are important for public health and health care.

Adequate completion of death certificates is essential to ensure the usefulness and reliability of the individual death certificate as well as the aggregate mortality statistics that's derived from it.

PURPOSE OF THE STUDY

Since only a few studies have been found in the literature about the problems doctors encounter when completing death certificates and no studies on training of doctors in death certification in South Africa, this study will determine what factors prohibit doctors from filling it in properly and more should be known about current death certification practice, so that practical steps can be taken to improve the quality of the data. Doctors will understand the importance of cause of death data and the value of completing death certificates properly, this study aims to develop and evaluate an educational intervention for use in training of death certification.

PROCEDURE OF THE STUDY
Participants will be asked to complete a questionnaire and model death certificates that includes 3 case scenarios (vignettes) with death as final outcome. During the post-test all participants will be given another 3 case scenarios to complete.

PARTICIPANT'S RIGHTS DURING THE STUDY

Participation in the study is voluntary. Participants will be free to withdraw from the study at any stage without having to state a reason for withdrawing. There will be no adverse consequences if the participants refuse or withdraw.

ETHICAL APPROVAL

The study has received ethical approval from the Higher Degrees Commission of the University of the Western Cape.

SOURCES OF ADDITIONAL INFORMATION

If you have any questions or need more information, please feel free to contact:

Desiree Pass
Burden of Disease Research Unit
Medical Research Council
P O Box 19070
Tel no: (021) 938 0331
Fax no: (021) 938 0310
Email: desiree.pieterse@mrc.ac.za

Prof Jon Rohde
3 Moray Place
Orangezicht
Cape Town
8001
Tel No: (021)465-0569
Email: jrohde@msh.org

CONFIDENTIALITY

The confidentiality of the participants will be guaranteed at all times. The completed questionnaires will be placed in an envelope and sealed. Only the researcher and supervisor will see the information. Participants will not be required to write their names on the questionnaire.

INCENTIVE

All participants will be rewarded 1 CPD point for participating in the study.

CONSENT

I will be grateful if you would complete the consent form indicating your willingness to participate in this study.

Yours sincerely

D O Pass

Appendix D: - Continued

CONSENT FORM

Title: Evaluation of an educational intervention to improve the accuracy of death certification amongst medical interns.

I hereby confirm that I have read and understand the information sheet for the above study that aims to

evaluate an educational intervention designed to facilitate accurate death certification and to provide

clear guidance on the death certification process.   I have had the opportunity to consider information,

ask questions and have had these answered satisfactorily.

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
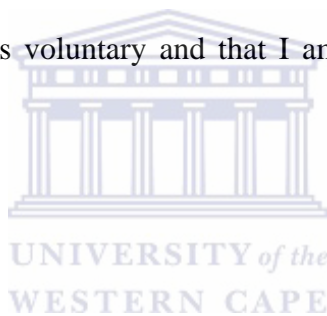
I hereby agree/disagree to take part in the above study. (Please tick one box)

YES
NO

Name of Doctor:_____

Signature:_____   **Date:**_____

Appendix E: Post-test Case scenarios

Case scenario 1

A 34 year-old male was admitted with severe shortness of breath. He had a 9 month history of unintentional weight loss, night sweats and diarrhea. An Elisa test and confirmatory Western Blot test for HIV were positive. T-lymphocyte tests indicated a low T helper-suppressor ratio. A chest X-ray showed pulmonary cavitations suggestive of tuberculosis. Tuberculosis was confirmed by a positive sputum smear, indicating a diagnosis of acquired immunodeficiency syndrome (AIDS). The patient did not respond to standard tuberculosis treatment. His condition deteriorated rapidly and he died a month later.

State whether this patient died from Natural ☐ or Unnatural ☐ causes.

Should this case be referred to forensic pathology? Yes ☐ No ☐

Please complete the death certificate.

G MEDICAL CERTIFICATE OF CAUSE OF DEATH

PART 1. Enter the disease, injuries or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.

Approximate interval between onset and death (Days/Months/Years)

FOR OFFICE USE ONLY — ICD-10

IMMEDIATE CAUSE (Final disease or condition resulting in death)
a. **Pulmonary Tuberculosis** — 1 Month
Due to (or as a consequence of)

Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE last (Disease or injury that initiated events resulting in death)
b. **Acquired Immunodeficiency** — 1 Month
Due to (or as a consequence of)

c. **Human Immunodeficiency** — Over 9 months
Due to (or as a consequence of)

d. ....
Due to (or as a consequence of)

PART 2. Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1. ....

If a female, was she pregnant 42 days prior to death? (✓): Yes ☐ No ☐

If stillborn, please write mass in grams ☐☐☐

Method of ascertainment of cause of death:

1. Autopsy
2. Opinion of attending medical practitioner ☐
3. Opinion of attending medical practitioner on duty ☐
4. Opinion of registered professional nurse ☐
5. Interview of family member ☐
6. Other ☐ (Specify) ....

Please Turn Over

Case scenario 2

A 48 year old male developed cramping epigastric pain which radiated to his back shortly after dinner on the day prior to admission. This was followed by nausea and vomiting. The pain was not relieved by positional changes or antacids. The pain persisted and 24 hours after the onset the patient sought medical attention. He had a 10 year history of excessive alcohol consumption and a 2 year history of recurrent episodes of similar epigastric pain. The patient was admitted with a diagnosis of an acute exacerbation of chronic pancreatitis. Radiological findings showed a duodenal ileus and pancreatic calcifications. Serum amylase was 4,032 units per litre. The day after admission the patient seemed to improve. However, that evening he became restless, disorientated and hypotensive. Despite vasopressors and intravenous fluids, the patient remained hypotensive and died. Autopsy findings revealed many areas of fibrosis in the pancreas with the remaining areas showing multiple foci of acute inflammation and necrosis.

State whether this patient died from Natural ☐ or Unnatural ☐ causes.

Should this case be referred to forensic pathology? Yes ☐ No ☐

Please complete the death certificate.

G MEDICAL CERTIFICATE OF CAUSE OF DEATH

| | | Approximate interval between onset and death (Days/Months/Years) | FOR OFFICE USE ONLY ICD-10 |

PART 1. Enter the disease, injuries or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.

IMMEDIATE CAUSE (Final disease or condition resulting in death)
a. **Acute exacerbation of chronic pancreatitis** — 3 Days
Due to (or as a consequence of)

Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE last (Disease or injury that initiated events resulting in death)
b. **Chronic Pancreatitis** — 2 Years
Due to (or as a consequence of)

c. **Chronic Alcoholism** — 10 Years
Due to (or as a consequence of)

d. ....
Due to (or as a consequence of)

PART 2. Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1. ....

If a female, was she pregnant 42 days prior to death? (✓): Yes ☐ No ☐

If stillborn, please write mass in grams ☐☐☐☐

Method of ascertainment of cause of death:

1. Autopsy   2. Opinion of attending medical practitioner ☐   3. Opinion of attending medical practitioner on duty ☐

4. Opinion of registered professional nurse ☐   5. Interview of family member ☐

6. Other ☐ (Specify) ....

Case scenario3

A 3 month old child is brought to the emergency room, but is clearly dead on admission. She had a history of vomiting and diarrhea for three days, and appears severely dehydrated, with a sunken fontanel and sunken eyes. The child had been looked after by her grandparents, because the mother is ill. No signs of any injury were found on the body.

State whether this patient died from Natural ☐ or Unnatural ☐ causes.

Should this case be referred to forensic pathology ? Yes ☐ No ☐

Please complete the death certificate.

G MEDICAL CERTIFICATE OF CAUSE OF DEATH		Approximate interval between onset and death (Days/Months/Years)	FOR OFFICE USE ONLY ICD-10
PART 1. Enter the disease, injuries or complications that caused the death. Do not enter the mode of dying, such as cardiac or respiratory arrest, shock, or heart failure. List only one cause on each line.			
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Dehvdration — Due to (or as a consequence of)	1-2 Davs	☐☐☐
Sequentially list conditions, if any, leading to immediate cause. Enter UNDERLYING CAUSE last (Disease or injury that initiated events resulting in death)	b. Gastro Enteritis — Due to (or as a consequence of)	3 Davs	☐☐☐
	c. .... Due to (or as a consequence of)		☐☐☐
	d. .... Due to (or as a consequence of)		☐☐☐
PART 2. Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1.			☐☐☐

If a female, was she pregnant 42 days prior to death? (✓): Yes ☐ No ☐

If stillborn, please write mass in grams ☐☐☐☐

Method of ascertainment of cause of death:

1. Autopsy   2. Opinion of attending medical practitioner ☐   3. Opinion of attending medical practitioner on duty ☐

4. Opinion of registered professional nurse ☐   5. Interview of family member ☐

6. Other ☐ (Specify) ....

Appendix F: Didactic Session

Completion of the Death Notification Form (Appendix F)

Dr L Burger
Division of Forensic Medicine, Department of Forensic Pathology
Health Science Faculty, University of Stellenbosch
D Pass, Prof D Bradshaw, Dr P Groenewald
Burden of Disease Research Unit
Medical Research Council

Overview

- Public health importance of death certification
- Death notification form – B1663
- Concept of underlying cause of death
- Natural vs. Unnatural causes
- Terminology
- Difficult situations
  - HIV
  - Dead on arrival

Appendix G: Educational Material

Details for specific causes

Alcohol and tobacco use
If, in your opinion, the chronic use of alcohol, tobacco or other substance by the decedent caused the death, report it in part 1, if they contributed to death report them in part II (acute alcohol poisoning is an unnatural cause/forensic pathology).

Cardiovascular Disease
- Avoid ill-defined terms, e.g. cardiorespiratory failure, heart disease.
- Try to include the following information in cardiovascular cases:
  – Mention the disease process, e.g. atherosclerosis, vasculitis, thrombo- embolism;
  – Site, if localised, e.g. cerebral, cardiac;
  – Acute or chronic, where relevant;
  – Any complications, e.g. myocardial infarction, pericardial tamponade, myocardial rupture, cerebral infarction;
  – Date of onset.

Neoplasms
- Whether benign, malignant or unknown behaviour;
- The primary site if known;
  – Site(s) of metastases and primary site;
- If the primary site is unknown: **"Primary Unknown" Must be documented;**
- The morphological type if known;
- Site(s) of metastases and primary site if known;
- The expression "metastatic from site" defines the primary site(s);
- The expression "metastatic to site" defines the secondary site(s);
- Avoid non-specific terminology such as "carcinomatosis", "carcinosis", "growth", "malignancy", etc;
- Identify leukemia as "acute", "sub-acute" or "chronic", and define the involved cell type.

Diabetes
Specify if diabetes mellitus, insulin dependent, non insulin dependent or other. Include date of onset.

Infectious diseases
- Include additional information about the aetiology;
- Include additional information on the causative organism.

Old age, senility
Include a clear and aetiological sequence for cause of death, since age is reported on the certificate, terms like senescence, senility and old age do not represent aetiology.

Pneumonia and Bronchopneumonia
- State the cause of any antecedent condition that led to the pneumonia;
- Identify the causative organism;
- Identify if the condition is primarily hypostatic or due to aspiration (of blood, food, meconium, etc).
- If the pneumonia has been caused by debility or inactivity please state the condition leading to the inactivity or debility.

When must a case be referred to Forensic Pathology?
Any case that fall within one of these categories must at least be discussed with a forensic pathologist.
- External influences acted on the body, be it physical or chemical. This includes stab wounds, gunshot wounds, road traffic incidents, falls, poisoning, lightning injuries, dog bites, anaphylactic reactions, and overdoses.
- Death while under the influence of general, local or regional anesthetic.
- Sudden and unexpected deaths, including cot deaths.
- An act of omission where a doctor, relative or others could have prevented a death, but failed to act appropriately.

HIV
- If (proven) HIV is the underlying cause of death it must be specified on the lowest line.
- The immediate and intermediate causes must also be specified on the lines above HIV.
- "Suspected HIV" may be included on the notification.

Pregnancy
- The pregnancy status in the 42 days prior to all female deaths must be noted in the space for additional information.
- Maternal causes of death should be specified in Part 1 if identified as a cause or a contributing cause in Part 2.

Smoking
Smoking status of the deceased should be noted as "Yes" if started more than 5 years ago and **continued smoking** for more than 6 months.

Resources available
1. South African Training manual for the death notification form (BI 1663) 1999.
   http://www.doh.gov.za/nhis/vital/docs/deathmanual.html
2. Continuing education in vital statistics
   http://www.dshs.state.tx.us/vs/field/funcredt.htm
3. National Association of Medical Examiners online tutorial:
   http://www.thename.org/CauseDeath/COD_main_page.htm
4. The Virtual Autopsy
   http://www.le.ac.uk/pa/teach/va
5. South African Medical Association (SAMA) Website
   http://www.samedical.org
6. E-learning website for Death Certification
   http://ec.europa.eu/comm/eurostat/deathcert/

Burden of Disease Research Unit

GETTING RIGHT THE FACTS OF DEATH

INSTRUCTIONS FOR COMPLETING THE MEDICAL PART OF THE DEATH NOTIFICATION

Completing the Death Notification properly is one of the last things the Doctor can do for the Patient

Why is the DEATH NOTIFICATION FORM (DNF) important?
- The death certificate provides legal evidence of death.
- It enables the patient's family to register the death and make arrangements for the disposal of the body.
- Accurate cause of death information from death notifications is used to compile statistics to evaluate and improve the health of the population. It is a useful tool to plan social and health interventions.

Who completes the BI-1663?
- Only a medical practitioner or appointed health professional, a Forensic Medical Officer, or Forensic Pathologist may complete sections D & G.
- The certifying doctor is however responsible for the completeness of the whole Death Notification.

What happens if a person dies outside of a health facility?
- If there are obvious signs of foul play, the case must be referred to Forensic Pathology.
- In other cases, try to get a history from the Emergency Medical Technician (ambulance attendant), relatives or friends of the diseased.
- Check the hospital file for chronic or terminal diseases.
- Do a complete external examination of the unclothed body.
- Ask Senior Colleagues for advice.
- Make notes for the file.
- Consult Forensic Pathology if still uncertain.
- Complete the BI-1663 if you are satisfied.

Terminology to avoid
Ill-defined / non-specific conditions such as:
  Old age
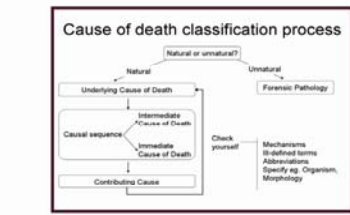 Headache
  "Natural causes"

Mechanisms of death such as:
  Heart failure
  Kidney failure
  Dehydration
  Hypoxia
  Sepsis

Abbreviations such as:
  DM II
  MI
  MS
  HONK

Completing Section G - MEDICAL CERTIFICATE OF CAUSE OF DEATH

BI-1663 CHECKS
- Is the handwriting legible?
- Are there any abbreviations?
- Does it show the causal sequence that led to death in Part 1?
  - Causal sequence must be in correct order
    - Immediate cause (not mode of dying) on top line
    - Intermediate causes below
    - Underlying cause on lowest line.
  - Condition on last line (Underlying cause) must be a potentially fatal disease and the earliest in chain of events leading to death
- Does it show the duration of each cause where appropriate?
- Are the contributing causes (never the underlying cause) shown in Part 2 where appropriate?

Appendix H: Box Plot

Overall Pre-test Scores