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

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A mini-thesis submitted in partial fulfillment of the requirements for the degree Masters in Public Health in the School of Public Health,
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KEYWORDS

Death certification
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Educational intervention
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Underlying cause of death
Causal sequence
ABSTRACT

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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

Signed:______________________

May 2008
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CONTENTS

Title Page ........................................................................................................................................i
Keywords .......................................................................................................................................ii
Abstract ..........................................................................................................................................iii
Declaration ........................................................................................................................................v
Acknowledgements ..................................................................................................................vi
Contents ......................................................................................................................................vii
List of Tables ................................................................................................................................ix
List of Figures ................................................................................................................................ix

CHAPTER 1: INTRODUCTION ........................................................................................................1
PROBLEM .........................................................................................................................................3
PURPOSE ..........................................................................................................................................4
AIM ................................................................................................................................................4
OBJECTIVES ..................................................................................................................................4

CHAPTER 2: LITERATURE REVIEW ..........................................................................................6
  Background ......................................................................................................................................6
  Importance of Mortality Information ............................................................................................6
  Importance of death registration ...................................................................................................7
  Death registration process ............................................................................................................7
  Death registration process in South Africa ..................................................................................8
  Death Certificate ............................................................................................................................9
  Completion of Cause of Death Section of the Death Certificate ..............................................11
  ICD Classification ........................................................................................................................15
  Selecting the underlying cause of death .......................................................................................15
  Errors in death certification ..........................................................................................................16
  Studies on Accuracy and Completeness ......................................................................................20
  Validity studies on the relation between medical death certification and underlying cause coding ..........................................................22
  Intervention studies .....................................................................................................................24

CHAPTER 3: METHODOLOGY ..................................................................................................29
  3.1 Study design ..........................................................................................................................29
  3.1.1 Study Setting .....................................................................................................................29
  3.1.2 Study population ...............................................................................................................29
  3.2 Intervention .........................................................................................................................29
  3.3 Sampling ...............................................................................................................................30
  3.3.1 Sampling procedure ..........................................................................................................30
  3.4 Data collection ......................................................................................................................31
    Assessing completion of Model Death Certificates ..................................................................32
  3.5 Piloting ....................................................................................................................................33
  3.6 Validity ....................................................................................................................................33
  3.7 Contamination .......................................................................................................................34
  3.8 Co-intervention .....................................................................................................................34
  3.9 Blinding ...................................................................................................................................34
  3.10 Confounders .......................................................................................................................34
  3.11 Data analysis .......................................................................................................................35
    Acceptable cut-off point ...............................................................................................................35
  3.12 Ethical consideration ..........................................................................................................36
CHAPTER 4: RESULTS

Pre and Post-test Evaluation ................................................................. 37
Death Certificate Score ........................................................................ 45
Acceptable cut-off point for the Important (Major) Section of the DC ...... 48
Types of errors .................................................................................... 51

CHAPTER 5: DISCUSSION

Major errors .......................................................................................... 55
Use of Mechanisms of death................................................................. 57
Improper sequencing .......................................................................... 57
Competing causes ............................................................................... 58
Minor errors ......................................................................................... 58
Absence of time intervals ..................................................................... 58
Use of abbreviations/inappropriate information .................................... 59
Generalisability ................................................................................... 61
Limitations .......................................................................................... 62

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS .................. 64
6.1 Conclusion ....................................................................................... 64
6.2 Recommendations .......................................................................... 64
6.3 What can be done to improve the system? ....................................... 65
6.4 Further Research ............................................................................ 66

REFERENCES .................................................................................. 67

APPENDICES
Appendix A ......................................................................................... 72
Appendix B ......................................................................................... 73
Appendix C ......................................................................................... 76
Appendix D ......................................................................................... 79
Appendix E ......................................................................................... 82
Appendix F ......................................................................................... 85
Appendix G ......................................................................................... 86
Appendix H ......................................................................................... 87
LIST OF TABLES

Table 1: Characteristics of Medical Interns who participated in the study ............37
Table 2: Departments the medical interns worked in during the study ..................38
Table 3: Percentage of medical interns with previous experience in Death Certification ..........................................................39
Table 4: Reasons for Modifying Death Certificates .................................................40
Table 5 (a): Formal training received by the medical interns ..................................41
Table 5(b): Where medical interns received their training in death certification and adequacy of the training ..................................................41
Table 6: Exploring the scope for improvement in Death Certification amongst Medical Interns ..................................................................................42
Table 7: Presents the proportion of medical interns who were aware of written instruction about the method of death certification ...........................................43
Table 8(a): Death certificates scoring 12 or above on 9 questions of the pre-test .......45
Table 8(b): All participants” Overall, Major and Minor scores of “dummy” death certificates (DC) ........................................................................................................46
Table 8(c): Overall scores of “dummy” death certificates for the control and intervention group ................................................................................................................47
Table 8(d): Major scores of “dummy” death certificates (DC) for the control and intervention group ........................................................................................................47
Table 8(e): Minor scores of “dummy” death certificates for the control and intervention group ........................................................................................................48
Table 9: “Dummy” Death Certificates who scored 12 or above .............................49
Table 10(a): Error analysis - Overall Group N=24 ..................................................50
Table 10(b): Error analysis – Control Group N=11 ................................................50
Table 10(c): Error analysis – Intervention Group N=13 .........................................51
Table 11(a): Types of errors (Death Certificates scoring 0) .....................................52
Table 11(b): Types of errors (Death Certificates scoring 0) for the Control group and the Intervention group .................................................................52
Table 12: Knowledge about the Underlying Cause of Death ..................................53
Table 13: “Mechanisms of death” ........................................................................53

LIST OF FIGURES

Figure 1: Current Official Mortality System ...............................................................9
Figure 2: The South African Death Notification Form ..............................................13
Figure 3: Problems encountered during death certification ....................................40
Figure 4: Improvement in death certification ...........................................................42
Figure 5: Benefit from formal training .....................................................................44
Figure 6: Supervision of death certificates ..............................................................44
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
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
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
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 assess participants’ level of prior undergraduate training, knowledge of and previous experience in death certification.
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.
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.
Death registration process in South Africa

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).
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**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal number of deceased</td>
<td></td>
</tr>
<tr>
<td>Surname</td>
<td></td>
</tr>
<tr>
<td>Maiden Name</td>
<td></td>
</tr>
<tr>
<td>Forenames</td>
<td></td>
</tr>
<tr>
<td>D.O.B</td>
<td></td>
</tr>
<tr>
<td>D.O.D</td>
<td></td>
</tr>
<tr>
<td>Age at time of death</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Place of Death</td>
<td></td>
</tr>
<tr>
<td>Place of Registration of Death</td>
<td></td>
</tr>
<tr>
<td>Citizenship of deceased</td>
<td></td>
</tr>
<tr>
<td>Identity number</td>
<td></td>
</tr>
<tr>
<td>Surname</td>
<td></td>
</tr>
<tr>
<td>Relationship to deceased</td>
<td></td>
</tr>
<tr>
<td>Postal address</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td></td>
</tr>
<tr>
<td>Date of birth</td>
<td></td>
</tr>
<tr>
<td>Certificate by attending medical practitioner/professional nurse</td>
<td></td>
</tr>
<tr>
<td>Date of issue</td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td></td>
</tr>
<tr>
<td>Certificate by district surgeon/forensic pathologist</td>
<td></td>
</tr>
<tr>
<td>Date of issue</td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td></td>
</tr>
<tr>
<td>Certificate by coroner</td>
<td></td>
</tr>
<tr>
<td>Date of issue</td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td></td>
</tr>
<tr>
<td>Certification by coroner and registrar</td>
<td></td>
</tr>
<tr>
<td>Date of issue</td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td></td>
</tr>
<tr>
<td>Certification by registrar, coroner and registrar</td>
<td></td>
</tr>
<tr>
<td>Date of issue</td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td></td>
</tr>
</tbody>
</table>

*Certifies that records received in due time.*
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
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).

**Errors in death certification**

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
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 aetio logically 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 health 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.
<table>
<thead>
<tr>
<th>Types of Errors</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major</strong></td>
<td></td>
</tr>
<tr>
<td>Mechanism of death listed without an underlying cause</td>
<td>Mechanism or nonspecific condition listed as the underlying cause of death</td>
</tr>
<tr>
<td>Improper sequencing</td>
<td>Sequence of events does not make sense; underlying cause of death not listed on the lowest completed line of Part I</td>
</tr>
<tr>
<td>Competing causes</td>
<td>Two or more casually unrelated, etiologically specific diseases listed in Part I</td>
</tr>
<tr>
<td><strong>Minor</strong></td>
<td></td>
</tr>
<tr>
<td>Abbreviations</td>
<td>Abbreviations used to identify diseases</td>
</tr>
<tr>
<td>Absence of time intervals</td>
<td>No time intervals listed in Part I</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Percentage</th>
<th>Total</th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max</td>
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</tr>
<tr>
<td>Median</td>
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</tr>
<tr>
<td>Min</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mean age</td>
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<td>University of Stellenbosch(US)</td>
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</tr>
<tr>
<td>University of Cape Town(UCT)</td>
<td>22</td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>University of the Free State (UFS)</td>
<td>9</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>University of the Witwatersrand(WITS)</td>
<td>13</td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>University of KwaZulu Natal(UKZN)</td>
<td>25</td>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>University of Pretoria(UP)</td>
<td>9</td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>University of Transkei(UNITRA)</td>
<td>3</td>
<td></td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Date internship started</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01/01/2006</td>
<td>16</td>
<td></td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>01/01/2007</td>
<td>81</td>
<td></td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>01/05/2007</td>
<td>3</td>
<td>32</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
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 medical interns worked in during the study**

<table>
<thead>
<tr>
<th>Department</th>
<th>Percentage</th>
<th>Total</th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaesthesiology</td>
<td>20</td>
<td>6</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Orthopaedics</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Paediatrics</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Surgery</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Internal Medicine</td>
<td>10</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Gynaecology and Obstetrics</td>
<td>20</td>
<td>6</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Family Medicine</td>
<td>17</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Psychiatry</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>30</strong></td>
<td><strong>16</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

Table 2 shows that the largest proportions of respondents worked in anaesthesiology (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

<table>
<thead>
<tr>
<th>Ever completed a DC before</th>
<th>Percentage</th>
<th>Number</th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>88</td>
<td>32</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>32</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of death certificates ever completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>More than 25</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Find completing the death certificate straightforward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ability to provide all non-medical details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

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.
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>
<thead>
<tr>
<th>Table 4: Reasons for Modifying Death Certificates</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not to distress relatives</td>
<td>3</td>
<td>90</td>
<td>7</td>
<td>30</td>
</tr>
<tr>
<td>Not to require a postmortem</td>
<td>3</td>
<td>93</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>Concern about stigma</td>
<td>10</td>
<td>83</td>
<td>7</td>
<td>30</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Table 5(a): Formal training received by the medical interns</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formal training</strong></td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Place where medical interns trained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical School</td>
</tr>
<tr>
<td>Intern year of residency</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Table 5(b): Where medical interns received their training in death certification and adequacy of the training</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>University of Stellenbosch(US)</strong></td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td>University of the Witwatersrand(Wits)</td>
</tr>
<tr>
<td>University of KwaZulu Natal(UKZN)</td>
</tr>
<tr>
<td>University of Pretoria(UP)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adequacy of training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Unsure</td>
</tr>
</tbody>
</table>

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

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 from relatives, funeral directors etc.’ |             |        |
| Yes                                                           | 64          |        |
| No                                                            | 32          |        |
| Unsure                                                        | 4           |        |
| ‘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>
<thead>
<tr>
<th>Table 7: Presents the proportion of medical interns who were aware of written instruction about the method of death certification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Death Certification Guidelines</strong></td>
</tr>
<tr>
<td>South African Guidelines</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>WHO &amp; CDC Guidelines</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
</tbody>
</table>

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

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
**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>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>W</th>
<th>V</th>
<th>z</th>
<th>Prob&gt;z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescore</td>
<td>32</td>
<td>0.98879</td>
<td>0.374</td>
<td>-2.042</td>
<td>0.97943</td>
</tr>
</tbody>
</table>

Table 8: Shapiro-Wilk W test for normal data

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>
<thead>
<tr>
<th>Control (N=11)</th>
<th>Intervention (N=13 )</th>
<th>Pearson chi2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>0.1460</td>
<td>0.702</td>
</tr>
</tbody>
</table>

Table 8(a): Death certificates scoring 12 or above on 9 questions of the pre-test

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)

<table>
<thead>
<tr>
<th>Total (N=24) All participants</th>
<th>Score on All sections of DC</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Post-Pre Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Score=30</td>
<td>Mean</td>
<td>13.5</td>
<td>24.9</td>
<td>11.4</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>1.2</td>
<td>0.7</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>( t=-9.9 ) degrees of freedom=23 ( p&lt;0.0001 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score on Important (Major)</td>
<td>Pre-test</td>
<td>8.5</td>
<td>14.4</td>
<td>5.9</td>
</tr>
<tr>
<td>sections of DC</td>
<td>SD</td>
<td>0.8</td>
<td>0.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Maximum Score=18</td>
<td>( t=-6.8 ) degrees of freedom=23 ( p&lt;0.0001 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score on Less Important (Minor)</td>
<td>Pre-test</td>
<td>5.0</td>
<td>10.4</td>
<td>5.4</td>
</tr>
<tr>
<td>sections of DC</td>
<td>SD</td>
<td>0.5</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Maximum Score=12</td>
<td>( t=-11.0 ) degrees of freedom=23 ( p&lt;0.0001 )</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Score on All sections of DC (Maximum Score=30)</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Post-Pre Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group (N=11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>15.5</td>
<td>25.3</td>
<td>9.8</td>
</tr>
<tr>
<td>SD</td>
<td>1.5</td>
<td>1.1</td>
<td>1.7</td>
</tr>
<tr>
<td>t=-5.7, degrees of freedom=10, p=0.0002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Group (N=13)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>11.8</td>
<td>24.5</td>
<td>12.7</td>
</tr>
<tr>
<td>SD</td>
<td>1.8</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>t=-8.5, degrees of freedom=12, p&lt;0.0001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Score on Important (Major) sections of DC (Maximum Score=18)</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Post-Pre Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group (N=11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>10.1</td>
<td>14.5</td>
<td>4.4</td>
</tr>
<tr>
<td>SD</td>
<td>0.9</td>
<td>0.8</td>
<td>1.3</td>
</tr>
<tr>
<td>t=-3.4, degrees of freedom=10, p=0.0071</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Group (N=13)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>7.2</td>
<td>14.4</td>
<td>7.2</td>
</tr>
<tr>
<td>SD</td>
<td>1.2</td>
<td>0.6</td>
<td>1.1</td>
</tr>
<tr>
<td>t=-6.7, degrees of freedom=12, p&lt;0.0001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
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>
<thead>
<tr>
<th>Score on Less Important (Minor) sections of DC (Maximum Score=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Group (N=11)</td>
</tr>
<tr>
<td>Pre-test</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>SD</td>
</tr>
<tr>
<td>t=-7.3</td>
</tr>
<tr>
<td>Intervention Group (N=13)</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>SD</td>
</tr>
<tr>
<td>t=-7.9</td>
</tr>
</tbody>
</table>

**Table 8(f): Comparison of mean difference of the Pre- and Post-intervention**

<table>
<thead>
<tr>
<th>Comparison of: Overall Difference</th>
<th>N</th>
<th>Mean Difference</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>13</td>
<td>12.7</td>
<td>5.4</td>
</tr>
<tr>
<td>Control</td>
<td>11</td>
<td>9.8</td>
<td>5.7</td>
</tr>
<tr>
<td>t=1.2671</td>
<td>degrees of freedom= 22</td>
<td>p=0.2184</td>
<td></td>
</tr>
</tbody>
</table>

**Difference on Important (Major) sections of DC**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>13</th>
<th>7.2</th>
<th>1.07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>11</td>
<td>4.4</td>
<td>1.30</td>
</tr>
<tr>
<td>t=1.7186</td>
<td>degrees of freedom= 22</td>
<td>p=0.09997</td>
<td></td>
</tr>
</tbody>
</table>

**Difference on Less Important (Minor) sections of DC**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>13</th>
<th>5.5</th>
<th>0.69</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>11</td>
<td>5.5</td>
<td>0.74</td>
</tr>
<tr>
<td>t=0.0069</td>
<td>degrees of freedom= 22</td>
<td>p=0.9946</td>
<td></td>
</tr>
</tbody>
</table>

**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>
<thead>
<tr>
<th>Table 9: “Dummy” Death Certificates who scored 12 or above</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Overall Group</td>
</tr>
<tr>
<td>Control Group</td>
</tr>
<tr>
<td>Intervention Group</td>
</tr>
</tbody>
</table>

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.
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

<table>
<thead>
<tr>
<th>Type of errors</th>
<th>Case Scenario 1</th>
<th>Case Scenario 2</th>
<th>Case Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Diff</td>
</tr>
<tr>
<td>Major</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanism only</td>
<td>18%</td>
<td>8%</td>
<td>-10%</td>
</tr>
<tr>
<td>Improper sequencing</td>
<td>23%</td>
<td>4%</td>
<td>-19%</td>
</tr>
<tr>
<td>Competing causes</td>
<td>36%</td>
<td>4%</td>
<td>-32%</td>
</tr>
<tr>
<td>Minor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absence of time</td>
<td>55%</td>
<td>8%</td>
<td>-47%</td>
</tr>
<tr>
<td>Use of abbreviations</td>
<td>27%</td>
<td>8%</td>
<td>-19%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Type of errors</th>
<th>Case Scenario 1</th>
<th>Case Scenario 2</th>
<th>Case Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Diff</td>
</tr>
<tr>
<td>Major</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanism only</td>
<td>20%</td>
<td>18%</td>
<td>-2%</td>
</tr>
<tr>
<td>Improper sequencing</td>
<td>20%</td>
<td>9%</td>
<td>-11%</td>
</tr>
<tr>
<td>Competing causes</td>
<td>50%</td>
<td>9%</td>
<td>-41%</td>
</tr>
<tr>
<td>Minor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absence of time</td>
<td>60%</td>
<td>9%</td>
<td>-51%</td>
</tr>
<tr>
<td>Use of abbreviations</td>
<td>40%</td>
<td>0%</td>
<td>-40%</td>
</tr>
</tbody>
</table>

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%).
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%).

![Image](western-care)

Table 10(c): Error analysis – Intervention Group N=13

<table>
<thead>
<tr>
<th>Type of errors</th>
<th>Case Scenario 1</th>
<th></th>
<th>Case Scenario 2</th>
<th></th>
<th>Case Scenario 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Diff</td>
<td>Pre</td>
<td>Post</td>
<td>Diff</td>
</tr>
<tr>
<td>Major</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanism only</td>
<td>17%</td>
<td>0%</td>
<td>-17%</td>
<td>67%</td>
<td>15%</td>
<td>-52%</td>
</tr>
<tr>
<td>Improper sequencing</td>
<td>25%</td>
<td>0%</td>
<td>-25%</td>
<td>33%</td>
<td>0%</td>
<td>-30%</td>
</tr>
<tr>
<td>Competing causes</td>
<td>25%</td>
<td>0%</td>
<td>-25%</td>
<td>42%</td>
<td>8</td>
<td>-34%</td>
</tr>
<tr>
<td>Minor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absence of time</td>
<td>50%</td>
<td>8%</td>
<td>-42%</td>
<td>58%</td>
<td>8%</td>
<td>-50%</td>
</tr>
<tr>
<td>Use of abbreviations</td>
<td>17%</td>
<td>0%</td>
<td>-17%</td>
<td>42%</td>
<td>8</td>
<td>-34%</td>
</tr>
</tbody>
</table>
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”.

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

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>
<thead>
<tr>
<th>Table 13: “Mechanisms of death”</th>
<th>Control (N=11)</th>
<th>Intervention (N=13)</th>
<th>Pearson chi2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart failure</td>
<td>Correct</td>
<td>Correct</td>
<td>0.5106</td>
<td>0.475</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>8</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>10</td>
<td>10</td>
<td>0.8392</td>
<td>0.360</td>
</tr>
<tr>
<td>Asphyxia</td>
<td>11</td>
<td>11</td>
<td>1.8462</td>
<td>0.174</td>
</tr>
<tr>
<td>Kidney failure</td>
<td>9</td>
<td>11</td>
<td>0.0336</td>
<td>0.855</td>
</tr>
<tr>
<td>All answers correct</td>
<td>6</td>
<td>7</td>
<td>0.0012</td>
<td>0.973</td>
</tr>
</tbody>
</table>
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 al., 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% vs 4.8%); and improper sequencing (15.8% vs 6.6%). Villar and Pérez-Méndez (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 Pérez-Mendéz (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


Appendix A

Appendix A: Problem analysis diagram: Death Certification by Medical Practitioners

- Insufficient Training
- Inaccurate information
- Insufficient Information
- Not attending physician
- Coding
- Underlying cause
- Cause of death Statistics
- No access to medical history
- Medico legal requirement
- Ignorance about importance of information
- Stigma surrounding the cause of death
- Transformation and statistical manipulation of data – incorrect coding and transcribing

Data source

Harriers – Demands from family
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 □
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.

---

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 HIV 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 ☐
Please complete the death certificate.

<table>
<thead>
<tr>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMMEDIATE CAUSE. Final disease or condition resulting in death</strong></td>
</tr>
<tr>
<td>a. Staphylococcal pneumonia with empyema Due to (or as a consequence of)</td>
</tr>
<tr>
<td>7 Days</td>
</tr>
<tr>
<td>b. Severe malnutrition Due to (or as a consequence of)</td>
</tr>
<tr>
<td>Months</td>
</tr>
<tr>
<td>c.</td>
</tr>
<tr>
<td>d.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART 2. Other significant conditions contributing to death but not resulting in the underlying cause given in Part 1.</th>
</tr>
</thead>
</table>

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 registered professional nurse
4. Interview of family member
5. Other (Specify)
Appendix C

CAUSE OF DEATH DATA SHEET (Check One ☑ Please) Study 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
11. Did you receive any formal training in writing the cause of death statement or death certificate?
   Yes [ ] No [ ]
   If yes where?
   Medical school [ ] Intern year of residency [ ] Other [ ]

12. Was this training adequate to make you comfortable with your ability to fill out death certificates correctly?
   Yes [ ] No [ ] Unsure [ ]

13. Do you think that there is room for improvement in the manner in which you complete a death certificate?
   Yes [ ] No [ ] Unsure [ ]
   If yes, which of the following do you consider could improve your performance?
   (a) ‘having more time to devote to it’
      Yes [ ] No [ ] Unsure [ ]
   (b) ‘having less pressure from relatives, funeral director, etc. to produce the certificate quickly’
      Yes [ ] No [ ] Unsure [ ]
   (c) ‘having more readily available information to aid completion’
      Yes [ ] No [ ] Unsure [ ]
   (d) ‘making the format more amenable to logic completion’
      Yes [ ] No [ ] Unsure [ ]

14. Are you aware of the South African guidelines for filling out a death certificate?
   Yes [ ] No [ ]

15. Are you aware of any other guidelines for filling out a death certificate?
   Yes [ ] No [ ]

15. Do you think you would benefit from some kind of formal training in filling out a death certificate?
16. Do you think you need to be supervised on your first few death certificates until you get familiarized with protocol?

Yes [ ] No [ ]

Please Turn Over
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 a 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
Oranjezicht
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:____________________________
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.
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.
**Case scenario 3**

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.

Dehydration

Gastro Enteritis

1-2 Days

3 Days
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
Appendix H: Box Plot

Overall Pre-test Scores