ASSESSMENT OF THE ACCURACY OF DEATH CERTIFICATION AT TWO REFERRAL HOSPITALS

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هدف الدراسة : تعتبر شهادة الوفاة مصدراً ثراً للمعلومات المستخدمة في عمل الإحصائيات عن حالات الوفيات في جميع أنحاء العالم ولتقويم العوامل الصحية المؤثرة على السكان . لذلك ركزت هذه الدراسة على معرفة مدى انسجام صحة المعلومات بين تقارير الوفاة والسجلات الطبية المحفوظة عن المتوفين في مستشفيين هما مستشفى الملك خالد الجامعي ومستشفى الملك فهد للحرس الوطني بالرياض .

الطريقة: تمت مراجعة مستقلة لعينة عشوائية ضمت 157 ملفاً من ملفات المتوفين لعام 2004 في المستشفيين لمعرفة السبب المؤدي للوفاة والمذكور في هذه الملفات ومن ثم مقارنته مع ماذكر في تقارير الوفاة والتدقيق في صحة الترجمة من الإنكليزية إلى العربية.

النتائج :تبين أن السبب المؤدي إلى الوفاة قد شخص خطأ في 80,3% من إجمالي تقارير الوفاة. وبمقارنة النتائج بين المستشفيين اتضح عدم وجود فرق ذي أهمية إذ كانت القيمة ($p>0.05$) . كما أن صحة تقارير الوفاة في كلا المستشفيين بلغت 81,8% في تقارير الوفاة الصادرة لمتوفين بسبب أورام خبيثة . وفي الجانب المقابل ، تبين أن ترجمة سبب الوفاة المكتوب في تقارير الوفاة في مستشفى الملك فهد للحرس الوطني كانت صحيحة بنسبة 86,1% من إجمالي تقارير الوفاة ، بينما كانت الترجمة صحيحة في مستشفى الملك خالد الجامعي بنسبة 25% فقط وهذا الفرق له أهمية كبيرة من الناحية الإحصائية حسب القيمة ($p<0.0001$) .

الخلاصة: تظهر النتائج المذكورة التباين الحاصل بين ماهو موجود في السجل الطبي وبين ماهو موجود في تقرير الوفاة بالنسبة لسبب الوفاة . كما أن صحة ترجمة سبب الوفاة قد تفاوت بين المستشفيين . ومن هنا تبرز حاجة فعلية لاتخاذ إجراءات مناسبة لتحسين نوعية شهادة الوفاة الصادرة .

الكلمات المرجعية : تقييم تقارير الوفاة وصحة التقارير وتقرير الوفاة وشهادة الوفاة

***Background**: Death certification is a vital source of information used in mortality statistics worldwide to assess the health of the general population.This study focuses on the consistency of information between the death reports and the clinical records (files) of deceased patients in two hospitals: the King Khalid University Hospital (KKUH) and King Fahad National Guard hospital (KFNGH) in Saudi Arabia.*

***Methods:** A random sample of the records of 157 deceased patients' registered in 2002 in the two hospitals was retrospectively reviewed independently to determine the underlying cause of death and compare them with death reports. It was also to check the accuracy of the translation from English in to Arabic.*

***Results:** It was found that the underlying cause of death was misdiagnosed in 80.3% of the death reports. When the two hospitals were compared, no significant difference was observed ($p>0.05$). In addition, 81.8% of the accurate (correct) death reports in both hospitals were of patients who had died of a malignant disease. However, the translation of the underlying cause of death in KFNGH was correct in 86.1% of the death reports, while in KKUH it was only 25%, which is highly statistically significant ($p<0.0001$).*

***Conclusion:** With the limitation of studying only a small number of cases, these results indicate a discrepancy between the file and death reports in relation to the cause of death. Also, the*

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translation of the cause of death was inconsistent in the two hospitals. Hence, there is a real need to adopt suitable measures to improve the quality of death certification.

***Key Words**: Death certification, Accuracy, Assessment & Death reports.*

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INTRODUCTION

Death certification is a public health surveillance tool and a valuable source of information at both national and local levels. The benefits of death certification are varied and include the proof of legal death, a monitor of the health of the general population, health planning and the setting of priorities for disease prevention. Accurate death certification is also very important in clinical trials, outcome review studies and as a deterrence of crime.[1,2]

Despite the range and importance of the roles that the statistics of the certification of mortality fulfill, the researchers and the physicians who employ these statistics often do not pay adequate attention to their measurements and conceptual characteristics. This is primarily due to fact that many of them lack adequate training in this skill, resulting in inaccuracies, which undermine the quality of the data derived from death certificates.[3,4]

The World Health Organization (WHO), as well as other organizations, produced rules and guidelines for the coding of mortality and morbidity. Nevertheless, in most developing countries, death registration is unsystematic and largely random.[1] This is mainly due to diagnostic problems with death certificates, even in countries that encourage autopsies.[3] In Saudi Arabia, however, the problem is compounded by the discouragement of autopsies except when there is suspicion of criminal intent or suicide.

This problem can be resolved with the use of an accurate definition of death, and the terms used in connection with death, the unification of certificates and their correct completion, as well as coding and computerized registries.

Most definitions of death are rather unsatisfactory: The United Nations Statistics defines death as "the permanent disappearance of all signs of life".[5] The United Kingdom defines death as "the irreversible cessation of all integrated functions of the human organism as a whole, mental or physical". The latter definition seems more accurate than the first one.[6] The differentiation between the primary cause, secondary cause, mode and manner of death is crucial. The definitions of these terms are mentioned in Appendix 1.[4]

Differences in the forms used in certification cause misclassifications. An international standard system of certifying the cause of death has been adopted by almost all countries. Originally derived from the British procedure, the WHO now recommends the cause of death (Appendix 2),where the concept of the underlying (primary) cause of death is often a source of confusion for certifying physicians. The underlying cause of death is the disease that triggered the chain of events leading to the patient's death and without which death would not have occurred. It must appear on the lowest completed line of part I and should be as etiologically specific as possible. The manner of death (as stated in Appendix 1) and nonspecific conditions are not etiologically specific and are, therefore, not acceptable as an underlying cause of death. In many cases, it is neither necessary nor appropriate to complete all 3 lines in part I. An immediate or intermediate cause of death may not be identifiable in all cases. An underlying cause of death can stand alone as the only complete line in part I.[4] Part II is often used by physicians as a convenient place to record secondary pathologies, whereas in actual fact, these often do not truly contribute to death. Part II, however, is most often used legitimately for old patients where multiple pathologies may be present making it hard to determine what the main causes of death were.[7]

Existing Process of Death certification

There are a number of steps in the process of issuing a death certificate in Saudi Arabia. These differ in each hospital. In KKUH, the physician in charge (e.g. consultant or resident) fills the death report in Arabic and English which is then signed by two physicians, one of whom is a consultant. It is worth mentioning that there are separate Arabic and English forms and that the completion is handwritten. The English report is kept in the file, but the Arabic form is sent to the mortuary. A copy of the Arabic death report is

then sent to the Office of Mortuaries and Births, an administrative wing of the Ministry of Interior, by the relative(s) of the deceased for the issue of a death certificate.

In KFNGH, the physician in charge (e.g. consultant or resident) fills the report by hand. Afterwards, this report is sent to the medical records department where it is typed and translated into Arabic by qualified translators. This form is then sent to the physician who wrote it in the first place for his signature. The original death report is kept in the file and a copy is given to the relative(s) of the deceased. Finally, (as above) this copy is sent to the Office of Mortuaries and Births, in the Ministry of Interior for a death certificate to be issued.

To make the process of gathering information from certificates for the purpose of statistical information easier, the WHO has classified all diseases to be used both in clinical diagnosis and on death certificates in its book "International Classification of Disease (ICD)". Each of the many thousands of named conditions are given a four-digit ICD number which can be used for data recording and retrieval, and are used all over the world. In addition to the disease names, there are also the 'E-codes', which have more medico-legal relevance (e.g. drowning, stabbing, falls, traffic accidents etc). The latest version of the ICD classification is ICD-10 which has been translated into Arabic, but unfortunately, is not used in Saudi Arabia.[7,8] However, as more disease-specific registries and hospital medical records are computerized, an increasing number of investigators will begin to use these databases as the standard for evaluating the statistics of the quality of certification. This method saves time, is less costly, can be used routinely and on a large scale.[9]

As the research studies in this region are limited with varying results,[1,3,10] this study on death certification in two hospitals (KKUH and KFNGH)) in Riyadh, Saudi Arabia was carried out with the objectives of finding out: (1) whether the primary and secondary causes of death in the medical record match those written in the English version of the death certificate, (2) whether the translation of the primary and secondary causes of death from English to Arabic is correct. Our hypothesis is that the causes of death in the files match those found on the death certificates in English, and that the translation of the cause of death from English to Arabic is correct.

METHODS

Study sample

Data was obtained retrospectively from 818 clinical records (files), English and Arabic death reports that were registered in 2002. They were selected randomly from two hospitals, King Khalid University Hospital (KKUH) and King Fahad National Guard Hospital (KFNGH) in Riyadh, Saudi Arabia. The sample size was 157 cases of death, 101 of which were taken from KFNGH and 56 cases from KKUH using the following inclusion/exclusion criteria.

Inclusion/Exclusion criteria

The inclusion criteria were: deceased patients 13 years of age and above, with files at the above hospitals, who died in the year 2002 of medical causes (natural deaths) after admission to a hospital ward. The exclusion criteria were: pediatric patients (below 13 years of age), patients with no files, who died from iatrogenic or traumatic causes, before admission to a hospital ward.

Variables and measurement

The following information was obtained for each case from their 3 records, (i) original file, (ii) English, and (iii) Arabic death reports: Demographic characteristics of the deceased, e.g. sex, age, nationality. Variables related to the cause of death, e.g. date and time of death, reason for last admission, the primary (underlying) and secondary causes of death in the 3 records and the consistency between them. Variables related to the filling of the 3 records, e.g. date of filling the records and the rank of the person who filled these records (e.g. consultant, resident, etc).

Assessment method

The primary and secondary causes of death from the original file were assessed independently by a reviewer (Forensic pathologist) who had no knowledge of the details of the death reports. Later, another reviewer (Epidemiologist) matched the causes of death (primary and secondary) with the causes indicated in the English and Arabic reports. The accuracy of the translation of the death reports from English into Arabic was also checked. The consistency of information between the file, English and Arabic death reports on the primary and secondary causes of death was coded as follows: Match, do not match or one or both death reports are missing. In addition, the primary

causes of death indicated in the file were coded by designing a system based on such classification systems as the ICD-10 and other reports.[11] However, the primary causes of death in the English and Arabic death reports could not be coded owing to the variations in the writings. The following case illustrates the specific criteria used by the reviewers to ascertain the sequence of morbid conditions in order to determine the primary (underlying) cause of death.

A man, who was known to have hypertension, developed ischemic heart disease and died from a massive myocardial infarction years later. The reviewer decided the sequence of morbid conditions as follows: Myocardial infarction, ischemic heart disease and hypertension. Hypertension was taken as the primary (underlying) cause of death, with myocardial infarction and ischemic heart disease as secondary causes of death. Furthermore, if the above patient suffered from other associated illnesses that did not directly lead to his death (e.g. diabetes mellitus), it would also be considered by the reviewer as a secondary cause of death.

Statistical analysis

The data was analyzed using SPSS software for Windows, version 12.0. Chi-square test was used to observe an association between two groups of variables.

RESULTS

Characteristics of the sample

Out of the 157 cases studied, 85 (54.1%) were males and 72 (45.9%) were females. The median age at death was 60; the median values for males and females were 66 and 56 years respectively; the range was 15-91 years. The Saudi/non-Saudi ratio was 13.28:1.00. The demographic characteristics of the study sample from each hospital are given in table 1.

Consistency between the causes of death

Upon assessing the consistency between the primary cause of death in both files and the English death report, the following was observed: out of the 157 cases, the primary causes matched in 22 (14%) while they did not in 126 (80.3%) cases. There were no death reports for the remaining 9 (5.7%) cases. Six cases were in KFNGH and the remaining 3 cases were in KKUH. It was noticed that 59.1% of the matched cases were females. Out of the 126 cases that did not match, 62 cases (49.2%) were misclassified (secondary cause of death was mistaken for the primary and vice-versa). The secondary causes of death in the files and the English death reports

***Table 1**: Demographic characteristics of samples in the two hospitals*

Characteristics	KFNG Count (%)	KKUH Count (%)
Gender:		
Female	37 (36.6)	35 (62.5)
Male	64 (63.4)	21 (37.5)
Nationality:		
Saudi	98 (97.0)	48 (85.7)
Non-Saudi	3 (3.0)	8 (14.3)
Age at death (years):		
13-37	3 (3.0)	11 (19.6)
38-62	37 (36.6)	36 (64.3)
63+	61 (60.4)	9 (16.1)

***Table 2**: Comparison of consistency between causes of death and accuracy of translation in the two hospitals*

Characteristics	KFNG Count (%)	KKUH Count (%)	X^2-value	p-value
Primary cause of death in file and English death report:			0.089	0.76
Match	13 (12.9)	9 (16.1)		
Do not match	82 (81.2)	44 (78.6)		
Inapplicable	6 (5.9)	3 (5.4)		
Secondary cause(s) of death in file and English death report:			0.019	0.88
Match	25 (24.8)	16 (28.6)		
Do not match	48 (47.5)	35 (62.5)		
Inapplicable	28 (27.7)	5 (8.9)		
Translation of primary cause of death is:			56.25	<0.0001
Correct	87 (86.1)	14 (25.0)		
Not correct	7 (6.9)	32 (57.1)		
Inapplicable	7 (6.9)	10 (17.9)		
Translation of secondary cause(s) of death is:			51.72	<0.0001
Correct	63 (62.4)	8 (14.3)		
Not correct	10 (9.9)	37 (66.1)		
Inapplicable	28 (27.7)	11 (19.6)		

*Inapplicable=one or both death reports were missing or not filled.

matched in 41 (26.1%) cases, whereas in 83 (52.8%) cases, they did not match. The translation of the primary cause of death was correct in 101 (64.3%) cases, and the translation of secondary cause of death was correct in 71 (45.2%) cases. There was no statistical association between the matching of (i) primary cause, (ii) secondary cause of death, and type of hospital (X^2 =0.089, p=0.76; X^2 = 0.019, p=0.88). However, there was a high statistical significant association between the correctness of translation of (i) primary, (ii) secondary cause of death, and type of hospital (X^2 =56.25, p<0.0001; X^2 = 51.72, p<0.0001) (Table 2).

Time-related measures

The delay in filling the English death report (Table 3) showed that 29.8% of the death reports in KFNGH were written on or after the fourth day after the patient had been declared dead. In contrast, only 1.8% (1 case) in KKUH was written in that period. Also, 30.7% of cases in KFNGH bore no dates, and a surprising 78.6% of cases in KKUH were not dated. Oddly enough, three death reports in KKUH were written before the date of death: this situation will be explained later. This time lag ranged from 0 to 461 days in KFNGH and 31 (31 days before death) to 354 days in KKUH. However, none of the primary causes of death in the English death report matched the causes in the file when there was a delay of more than seven days.

Rank related measures

There was great disparity between the two hospitals with regard to the rank of the writer of the English death report. In KKUH, 76.8% were residents and in KFNGH 13.9% were consultants, and 11% were residents (Table 4). Moreover, 19.6% of the English death reports in KKUH had no signatures. In contrast, 59.4% of those in KFNGH were not signed. A study of the effect of the rank of the physician on the misclassifications revealed that 50% of the residents misclassified the causes of death, while only 7.1% of the consultants made that error (p=0.022). However, there was no significant difference between the residents and consultants in the matching of primary cause of death in the file with the death report in English.

***Table 3**: Delay in filling the English death report and time of death in the two hospitals*

Characteristics	KFNG Count (%)	KKUH Count (%)
Time interval*		
<0 days**	0(0.0)	3 (5.4)
On the same day	11 (10.9)	3 (5.4)
1-3 days	23 (22.8)	2 (3.6)
4-7 days	17 (16.8)	0 (0.0)
8-14 days	5 (5.0)	0 (0.0)
15-30 days	3 (3.0)	0 (0.0)
> 30 days	5 (5.0)	1 (1.8)
Missing DR or with no date	37 (36.6)	47 (83.9)
Time of death:		
00:00-08:00	28 (27.7)	16 (28.6)
08:01-16:00	36 (35.6)	20 (35.7)
16:01-23:59	37 (36.6)	19 (33.9)
Missing time	0 (0.0)	1 (1.9)

*Time interval between date of death and date of English death report (in days).
**>0 days=the date of filling the English death report (DR) preceded the date of death

***Table 4**: Rank of the person involved with English death report (DR) in the two hospitals*

Characteristics	KFNG Count (%)	KKUH Count (%)
Rank of person who wrote the English death report:		
Consultant	14 (13.9)	0 (0.0)
Resident	11 (10.9)	43 (76.8)
Doctor of unknown rank	16 (15.8)	2 (3.6)
Not signed or no DR	60 (59.4)	11 (19.6)

Specific diseases

On calculating each primary cause of death, it was found that 20.4% of cases had died from chronic liver diseases (e.g. hepatitis, cirrhosis, and malignancy), 19.6% from different malignancies and 15.3% from hypertension. A high proportion (81.8%) of the cases where the primary cause of death in the file matched the English death report was malignancy-related.

Modes of death written in the primary cause of death in the English death report were calculated and the following was observed. In 72.3% of the death reports in English, cardiopulmonary arrest (CPA) was put as the primary cause of death in KFNGH, while it was 28.6% in KKUH. Also, shock was written in 3% of the reports in KFNGH, but was in 17.9% of the reports in KKUH. Of the unsigned English death reports, 71.8% had CPA as the primary cause of death (Table 5).

***Table 5**: Primary causes of death in the files in the two hospitals*

Primary cause of death from file	KFNG Count (%)	KKUH Count (%)
Cardiovascular:		
Ischemic heart disease	4 (4.0)	3 (5.4)
Hypertension	17 (1.8)	7 (12.5)
Vascular heart disease	0 (0.0)	1 (1.8)
Deep vein thrombosis	1 (1.0)	3 (5.4)
Others (cardiomyopathy, aneurysm, etc.)	1 (1.0)	0 (0.0)
Respiratory:		
Pneumonia and other infections	6 (5.9)	0 (0.0)
Pulmonary embolism	0 (0.0)	2 (3.6)
Obstructive lung disease	2 (2.0)	0 (0.0)
Restrictive lung disease	0 (0.0)	2 (3.6)
Malignancy	4 (4.0)	3 (5.4)
Gastrointestinal:		
Chronic liver disease	25 (24.8)	7 (12.5)
GI bleeding	1 (1.0)	0 (0.0)
Colon carcinoma	1 (1.0)	3 (5.4)
Other malignancies (pancreatic, gastric, etc.)	6 (5.9)	6 (10.7)
Others (pancreatitis, ischemia colitis, obstruction, etc.)	1 (1.0)	1 (1.8)
Genitourinary:		
Infection, inflammation	3 (3.0)	0 (0.0)
Malignancy	3 (3.0)	1 (1.8)
Neurological:		
Cerebrovascular accident	4 (4.0)	0 (0.0)
Infections (TB, meningitis, etc.)	3 (3.0)	1 (1.8)
Malignancy	2 (2.0)	2 (3.6)
Metabolic and hormonal:		
Diabetes	6 (5.9)	0 (0.0)
Endocrine gland disorders	1 (1.0)	0 (0.0)
Nutritional disorders	1 (1.0)	0 (0.0)
Blood and blood forming organs disorders	4 (4.0)	4 (7.1)
Connective tissue diseases (e.g. SLE)	0 (0.0)	4 (7.1)
Other malignancies (e.g. breast cancer)	3 (3.0)	4 (7.1)
Other	1 (1.0)	1 (1.8)
Unknown	1 (1.0)	1 (1.8)
Total	**101 (100.0)**	**56 (100.0)**

Errors after re-reviewing

After re-reviewing the primary causes of death in the files, it was discovered that there was a significant association between the errors committed and the hospital where they had been written (p=0.005). The reviewers committed errors in 12.5% of the files in KKUH and 32% of the files in KFNGH, but all of the errors committed were due to misclassification, not to misdiagnosis of the primary cause of death. In addition, 47.5% of these errors were related to the cardiovascular system.

DISCUSSION

Analysis of the information recorded on death certificates is one of the oldest and most extensive public health surveillance systems. Virtually all mortality statistics deal with only the underlying (primary) cause of death, with scant attention paid to most of the other conditions mentioned on death certificates.

In this study, the figures above showed that agreement between the initial writer of the death report and the reviewer on the underlying cause of death was poor in 80.3% of the death reports of both hospitals. This can be explained by the fact that most physicians do not know how to complete these death reports because there are no courses and/or lectures on this subject in Saudi Arabia. It was noted that there was more agreement where females were concerned probably because the nature of the underlying fatal disease (e.g. breast cancer) in these cases was clear. In addition, the translation of the causes of death from English to Arabic was markedly better in KFNGH because the translation was done by employees who had specialized in "Medical Terminology".

The delay in writing the death reports by the initial recorder in KFNGH can be attributed to the multi-step system of writing death reports, as mentioned earlier. While in KKUH no death

reports were written later than three days after the declaration of death since the death reports are usually filled by the physician immediately after death (except for one case which may have been an error committed by the initial writer or the reviewer). However, the three death reports that were written before the death of the patient in KKUH, could be attributed to the use of rubber stamps to record the date on the death reports. Some of the dates on the stamps were not changed regularly resulting in these peculiar situations. Other studies[3] found that agreement between the reviewer and initial writer increased with the advancing rank of the writers, but this was not noticed in our study. However, it was noticed that misclassifications committed by the initial writer decreased with higher rank. With regard to the underlying causes of death, it was found that cardiac (23.5%) and liver (20.4%) diseases were the main killers in our sample. As expected, and as other studies found,[11] there was greater agreement between the initial writer and reviewer on deaths due to malignant neoplasms because it was easy to determine the underlying cause of death.

Even though most physicians are confronted with the task of completing death certificates, many do not have adequate training to do so. Designing and implementing suitable educational interventions in continuing medical education sessions, formal training, annual courses and interactive workshops in death certification have been suggested to improve accuracy in this area.[12-15]

In conclusion, the results of this study show that the death certification at two referral hospitals in Riyadh city was not accurate. There is, therefore, a need to improve accuracy by adopting foolproof measures: (1) The use of a unified system of death certification for all hospitals; (2) Provision of courses for all graduate students of medicine on how to write a death report and determine the cause of death in both languages (English and Arabic); (3) Reduction of delays in the certification of death; (4) Adoption of the ICD-10 codes in the certification of the causes of death in all hospitals; (5) The use of computerized forms instead of handwritten ones; (6) The induction of ACME (Automatic Classification of Medical Entry) in death certification.[9,16]

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Appendix 1: Definitions of death

Term	Definition
Primary (underlying cause of death)	The injury or disease initiating the train of events leading to death and its classifiable according to the International Classification of Diseases (ICD) system.
Secondary causes(s) of death	The intermediate and/or immediate cause(s) of death which is/are a result of (or secondary to) the primary cause of death.
Mode of death	A physiologic derangement or biochemical disturbance by which a cause of death exerts its lethal effect (e.g. cardiac arrest, respiratory arrest).
Manner of death	A classification of death based on the type of conditions that caused death and the circumstances under which they occurred (e.g. natural, homicidal, suicidal, accidental or undetermined).

Appendix 2: *Cause of Death*

PART I. Enter the chain of events-diseases, injuries, or complications-that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary. IMMEDIATE CAUSE (Final disease or condition a. _____ resulting in death) Due to (or as a consequence of): Sequentially list conditions, b. _____ if any, leading to the cause Due to (or as a consequence of): listed on line a. Enter the UNDERLYING CAUSE c. _____ (disease or injury that Due to (or as a consequence of): initiated the events resulting in death) LAST d. _____	Approximate Interval: Onset to death _____ _____ _____ _____ WAS AN AUTOPSY PERFORMED? ☐ Yes ☐ No WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? ☐ Yes ☐ No
PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PART I	