original article

Causes of death certification of adults: an exploratory cross-sectional study at a university hospital in Riyadh, Saudi Arabia

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BACKGROUND AND AIMS: Saudi Arabia has no precise data on causes of death. We sought to ascertain the commonest causes of death as stated in death certificates of adults and evaluate the completeness of death certificates at a teaching hospital in Riyadh.

DESIGN AND SETTING: A cross-sectional study carried out at King Khalid University Hospital in Riyadh, Saudi Arabia, during the year 2008.

METHODS: All death certificates that were issued in 2008 were reviewed and data were checked by two reviewers. Causes of death were coded according to specially-designed codes.

RESULTS: The mean (SD) age of death was 63.9 (20.7) years. More than 80% arrived alive at the hospital. Among the 410 certificates, 62.2% had the first reported cause of death being classified as "inappropriate" and this tended to be slightly, but significantly more frequent among women. The first most common appropriately reported cause of death was malignancy of any type (7.3%) followed by ischemic heart diseases (4.9%). Accidents and fractures were more common in the younger age groups and among men.

CONCLUSIONS: This is the first study that documents the possible gaps among healthcare professionals in Saudi Arabia in their understanding of death and its certification based on the clinical assessment of the deceased. The findings needs to be validated by similar studies from other health care sectors. It is clear, however, that proven educational, system-related and legal interventions to improve the accuracy of death certification are strongly needed if the health care priorities are to be properly identified.

When a person dies, the death certificate provides a permanent legal record of the fact that "death" has occurred. At the global level, cardiovascular disease is reported as the most common cause of death among males and females (26.8% and 31.5%, respectively), followed by infections and parasitic diseases (16.8% and 15.7%, respectively) and cancer (13.4% and 11.4%, respectively).[1] Such global results cannot be generalized at regional and country levels without reservations because of the limited, incomplete and uncertain data in many parts of the world. While 44 of 52 countries in Europe had death registration data with coverage of 85% or more, only 2 of 21 East Mediterranean countries had that level of coverage. Saudi Arabia is not one of them.[2]

A simple search strategy of (SaudiTitle/Abstract AND ArabiaTitle/Abstract) AND (causesTitle/Abstract AND deathTitle/Abstract) identified 37 articles in PubMed, none of which was relevant to general causes of death in Saudi Arabia. Searching the grey literature identified two sources of information: the World Health Organization (WHO) press releases and the Saudi Arabian Ministry of Health (MOH) annual reports.

The WHO mortality country fact sheet in 2006 stated that the top causes of death among all age groups in Saudi Arabia were ischemic heart disease (17%) followed by hypertensive heart disease (9%), congenital anomalies (7%), lower respiratory infections (6%), road traffic accidents (6%) and diabetes mellitus (5%). This was based on data released in 2002.[3] In the MOH report for 2009, 31% of the deaths had ill-defined causes,

18% were attributed to injury, poisoning and external causes followed by 17% due to cardiovascular diseases, 9% to perinatal problems, 4.7% to respiratory disorders and 4.6% to neoplasms.[4]

In their assessment of the global status of cause of death data, Mathers et al identified Saudi Arabia as one of the countries that has no recent data (from 1990 or later).[5] Moreover, in the summary estimates for WHO member states for the year 2008, Saudi Arabia was classified in the pink zone which includes the countries where modelling based on nearby countries of the cause of death was used because the country's information on the cause of death were not available.[6] The 2011 noncommunicable disease fact sheet for Saudi Arabia (based on 2008 modelling estimates) suggested that the major causes of death are cardiovascular diseases (42%) and injuries (15%).[7]

In a United States study, death certification completion by physicians was poor with the optimal scoring range of only 23%.[8] In a Canadian study, the death certificate were filled out in an acceptable fashion in 68%.[9] In Australia, major errors were found in 16% of certificates.[10] A study from the UK showed that in the study sample, most (62.4 %) House Officers and (59.3%) of general practitioners were not confident about the cause of death and might modify their statements.[11]

In local or regional context, BinSaeed et al in Saudi Arabia found that the underlying cause of death was misdiagnosed in 80.3% of death reports.[12] In Bahrain, Abulfatih and Hamadeh reported death certificate causes of death were inaccurate in 60% of cases.[13] A study from Lebanon reported that 50% of death certificates did not carry a certifier signature and of those with such a signature, 21.6% lacked documentation of the underlying cause of death.[14]

The aims of the study were to identify the commonly reported causes of death as stated in death certificates and to examine the characteristics and completeness of death certificate data at King Khalid University Hospital (KKUH) which is the main teaching hospital at King Saud University, the oldest university in Saudi Arabia.

METHODS

After getting the approval of the Institutional Review Board of the College of Medicine at King Saud University to conduct the study and waiving the need for the next-of-kin consent, copies of death certificates issued at KKUH in 2008 for those over 12 years of age were retrospectively reviewed. In addition to the personal identification details of the deceased, items to be filled in a traditional death certificate are age, gender, nationality, diagnosis on entry to KKUH (if alive on admission), the causes of deaths and the underlying/contributing factors. No specific codes are used to complete the form. Death certification is usually carried out by two treating physicians without necessarily stating their qualification or position. No special codes for the causes of death are available on the death certificate.

The codes of death created and used in this study were: 1) cerebrovascular disease (stroke), 2) ischemic heart disease (heart attack), 3) heart disease not ischemic in nature (aortic aneurysm, heart failure, etc), 4) lower respiratory diseases (acute or chronic not including malignancies), 5) diseases of the urinary system, not including malignancies, 6) liver diseases not including malignancies, 7) malignancies of any types, 8) septicemia, 9) accidents/fractures, 10) multiple organ failure, 11) inappropriate, 12) not reported, and 13) others. These codes were meant to be in line with the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) Version for 2010.[15] The ICD-10, per se, was not used in this study for coding the causes of death of death because it was difficult to apply in retrospect. Terms like cardiorespiratory arrest, cardiac arrest, respiratory arrest, cardiorespiratory failure, and natural death were considered inappropriate as these terms describe the end stage of life and not the main cause of death. One author (YAA) extracted the data from the copies of death certificates and another author (SEA) checked for accuracy. The study reports the results in terms of rates, means standard deviations (SD) and *P* values. The chi-square test was used because the data were categorical.

RESULTS

Of 427 death certificates reviewed, 346 deceased (81%) arrived alive to the hospital; the remaining 19% arrived dead. Seventeen certificates had no data on the causes of death and therefore were excluded from further analysis. The age in 410 valid certificates ranged from 12 years to 110 years. The mean (SD) age was 63.9 (20.7) years and the most reported age at death was 70 years. Of the deceased, 56.8% were males, 84.8% were Saudi nationals and 81.7% of the people were admitted alive but died later in KKUH. The distribution of the deceased by age group and gender is shown in **Figure 1** and the most common causes of death are shown in **Table 1**. There were 20 death certificates in which the first cause of death was not coded specifically and was classified as "others". "Others" describe terms as acidosis, abdominal bleeding, colonic perforation, diabetes (with no details about the condition), gastrointestinal bleed-

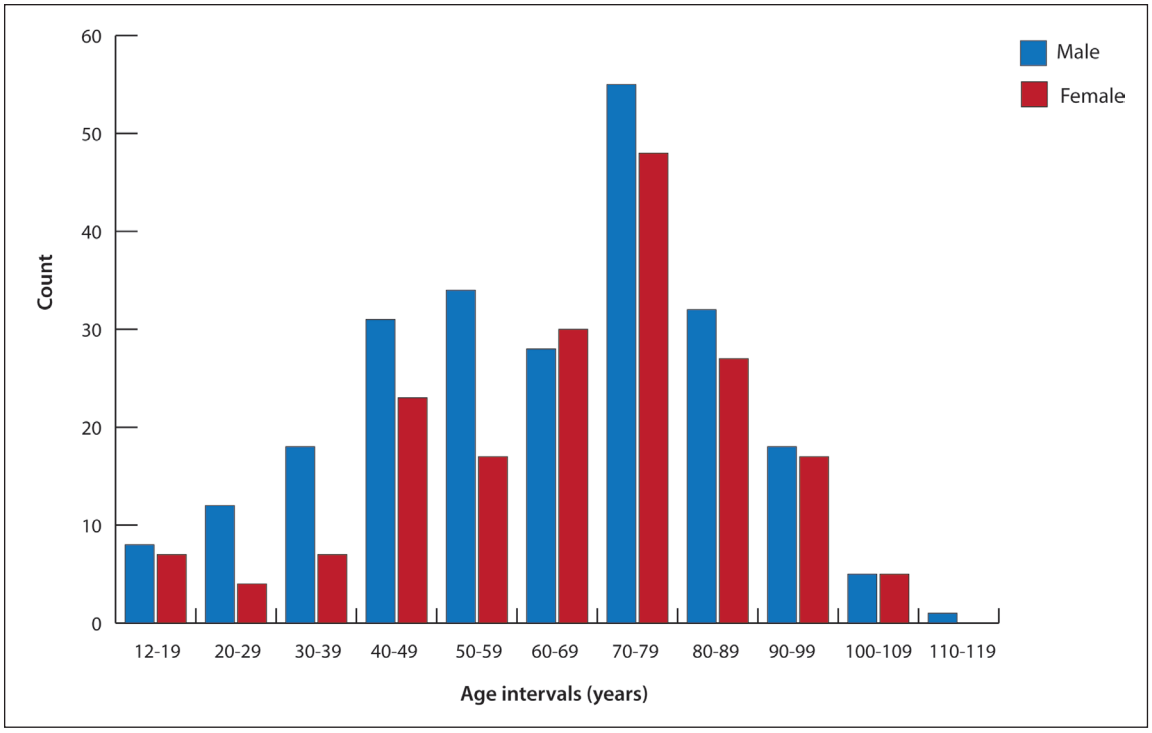

Figure 1.The distribution by age groups and gender of 427 death certificates at King Khalid University hospital, Saudi Arabia (2008).

ing, postoperative surgical procedure, thrombocytopenia, or simply as unknown causes.

When causes of death were assessed in relation to age groups it was found that all the most common causes of death were reported in older groups except accidents/fractures, which were more common causes of deaths in those 45 years of age or younger. In this series of patients, accidents/fractures occurred exclusively among men (**Figure 2**). Apart from that, none of the apparent gender-related differences was statistically significant including the "inappropriate terms" where chi-square=0.73, *P* value=0.4. **Table 2** compares the diagnosis at admission with the cause of death on the death certificate of the 335 patients who arrived alive and had a primary cause on the death certificate. The primary cause of death in the death certificate agreed with the diagnosis on arrival to the hospital in 20.9% of the cases. The agreement ranged from 15.4% in liver diseases (excluding cancers) to 33.8% for malignant neoplasm of any type. Almost 60% of those who arrived alive to the hospital had a primary cause of death that was "inappropriate" and that ranged from 50% of those diagnosed initially with septicemia to 64.7% of those diagnosed to have a disease of the urinary system (excluding cancers).

Table 1. The most common causes of death in a teaching hospital in Saudi Arabia (2008).

	Coded causes of death	No.	%
1	Malignant neoplasm of any types	30	7.3
2	Ischaemic heart disease (heart attacks)	20	4.9
3	Heart disease not ischaemic (aortic aneurysm, heart failure, etc)	20	4.9
4	Lower respiratory diseases acute or chronic	15	3.6
5	Accident(s) /Fracture(s)	15	3.6
6	Septicaemia	11	2.7
7	Cerebrovascular disease (strokes)	8	2.0
8	Multiple organs failure	7	1.7
9	Diseases or urinary system , not including cancers	5	1.2
10	Liver disease not including cancer	4	1.0
11	Inappropriate	255	62.2
12	Other(s) any cause that was not coded	20	4.9
	Total	410	100

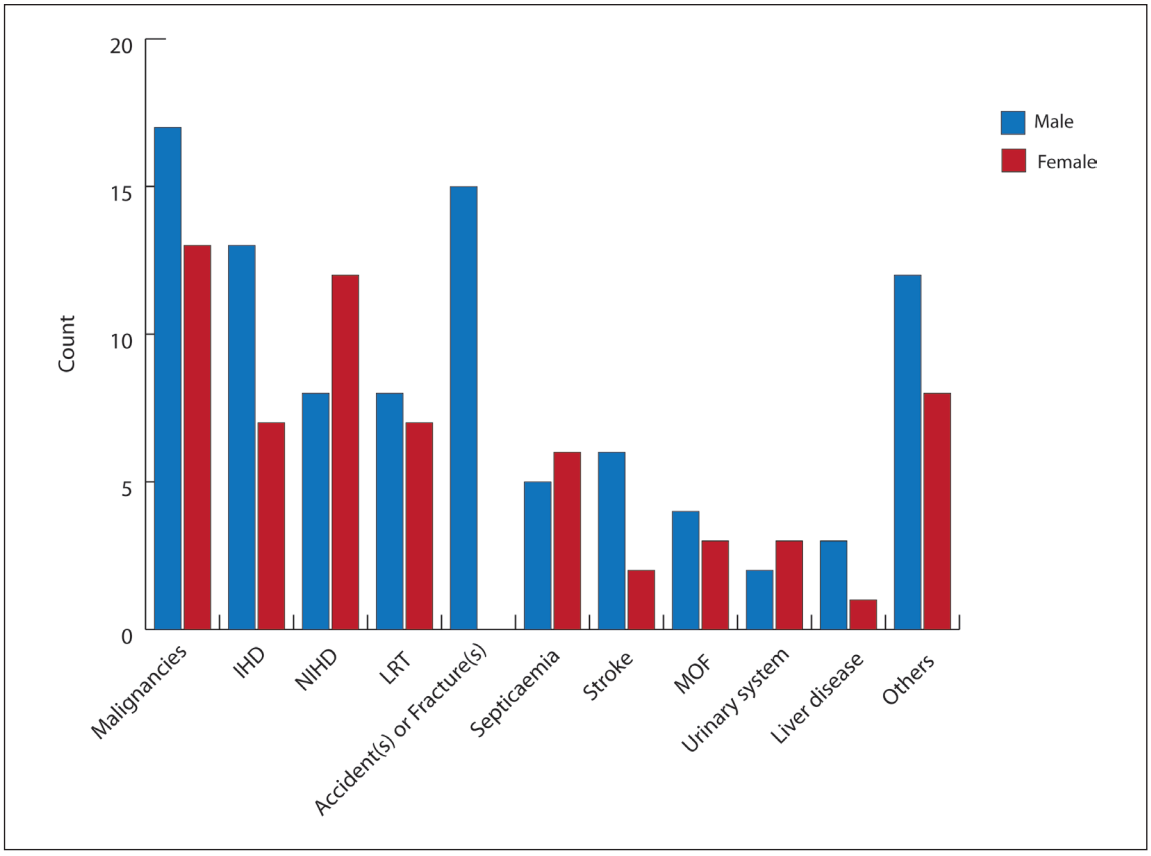

Figure 2. The most commonly and "appropriately" reported causes of death and gender of 155 death certificates at King Khalid University Hospital, Saudi Arabia (2008). Inappropriate causes in 255 death certificates (62.2% of all the deaths in 2008) were excluded. Neoplasm (malignant neoplasm of any types), IHD (Ischemic heart disease (heart attacks), NIHD (heart disease not ischaemic (aortic aneurysm, heart failure, etc), LRT (Lower respiratory diseases acute or chronic), strokes, MOF (multiple organ failure), urinary system (diseases of urinary system not including cancers), liver disease (liver disease not including cancer), others (reported causes that are not coded in the above).

DISCUSSION

Whether from concern, courtesy or curiosity, the common first questions that lay people would ask after learning of the death of another (such as "How did she die?" or "Why did he die?") are essentially probing for the cause of death.[16] Sadly enough, the medical profession is not yet able to provide full answers to such questions.

From the epidemiological point of view, death is one of the most objective outcome measures of the health of any society. It has long been recognized that accuracy in the statistical information on death and its causes will have its impact on preventive activities, on health care planning, on health economics and on identifying the priorities for health care delivery and research.[17-19] In the past decade, it has been realized that even at the level of a primary care centers, analyses of mortality data can provide useful insights for informing health needs assessment.[20] Primary care teams strongly believed that presenting data about mortality in their practice populations can enable them to reflect on their clinical policies.[21]

This study has documented a strongly held belief among health care professionals that the cause of death is not properly identified in the majority of certificates[16,22-24] and cover-up with loose or non-specific terms is often used. These terms describe the mode or mechanism of death (such as cardiopulmonary arrest or natural death) instead of the actual or "true" cause of death.[25] In our study, 62% of the issued death certificates carried such terms to describe the primary cause of death. The classification of "appropriate" causes of death was different from that in WHO and MOH reports. In fact the classification of diagnoses in each of these reports conflicts with the other, which has implications on identifying priorities for health

Table 2. The agreement of the diagnosis at admission with the primary cause of death at King Khalid University Hospital, Saudi Arabia (2008).

Diagnosis at admission	Primary cause of death at the death certificate						
	Same cause		Other cause(s)		"Inappropriate"		Total
	No.	%	No.	%	No.	%	No.
Malignant neoplasm of any type	23	33.8	10	14.7	35	51.5	68
Lower respiratory diseases acute or chronic	10	23.3	10	23.3	23	53.4	43
Ischaemic heart disease (heart attacks)	12	31.6	3	7.9	23	60.5	38
Heart disease not ischaemic (aortic aneurysm, heart failure, etc)	5	22.7	4	18.2	13	59.1	22
Cerebrovascular disease (stroke)	5	26.3	2	10.5	12	63.2	19
Diseases of urinary system, not including cancers	0	-	6	35.3	11	64.7	17
Accident(s) /fracture(s)	5	29.4	2	11.8	10	58.8	17
Septicemia	3	18.7	5	31.3	8	50.0	16
Liver disease, not including cancers	2	15.4	4	30.8	7	53.8	13
Not reported[a]	0	-	17	39.5	26	60.5	43
Others	5	12.8	6	15.4	28	71.8	39
Total	70	20.9	69	20.6	196	58.5	335

[a]Death certificates in which the primary cause of death is not reported were excluded from the analysis.

care delivery, research, planning and funding.

This state of affairs in various countries in the world has been attributed to a number of factors relating to the variable quality of undergraduate and postgraduate training.[26] There is evidence, however, to support that accuracy in completing death certificates does not improve if the certifier is a senior doctor and this would provide the need for a more effective postgraduate medical education.[11] The discrepancies between premortem and postmortem diagnoses were influenced by the type and size of hospital, the age and sex of the patient, the disease responsible for the patient's death[27] and the legislation governing death certification.[26] Qualitative research has identified clinical uncertainty on the part of the certifiers to contribute to the difficulty completing death certificates with certainty.[28]

Diverse efforts have been made to increase awareness and improve the training of practicing physicians on how to identify the cause of death and complete the death certificate, thereby reducing the inaccuracy in death certification. These interventions have included published material,[29] training packages and workshops,[26,30] introducing death certification in medical examinations and in continuing professional development activities.[26,31]

Some studies have suggested that such educational efforts might be successful[32-35] especially if the intervention is interactive.[36] Other reports had conflicting results. Despite the introduction of formal training in the undergraduate curriculum at the University of Leicester in the UK, only 55% of the death certificates were completed to a minimally accepted standard.[37] A recent systematic review restored confidence in the impact of cause-of-death education.[38] The review emphasized that education for certifiers of deaths should be recognised as a fundamental requirement for high quality mortality statistics. It stressed on the interactive format and on the importance of giving feedback regarding the quality of death certification to individual certifiers, training certifiers using the standardised curriculum from the World Health Organization-Family of International Classifications Network (WHO-FIC) has the potential to improve the consistency in death certification practices and subsequently the comparability of epidemiological data.

Other methods were suggested for reducing errors in completing the death certificates such as the need

for two certifiers and the need to cross check with relatives (proxy reports).[39] The latter was suggested as a method of improving the accuracy of mortality data and reducing "ill-defined" causes of death.[40,41] A large cohort study suggested that adjudication-based determination of the cause of death might be the "gold standard" especially for cardiovascular diseases and ill-defined causes of death.[42] The adjudication committee used all available data about the cause of death (hospital records, medical data obtained from family physicians or specialists, and proxy interviews). The amount of time and resources, however, required to assemble materials and clinicians for adjudication on a regular basis may be beyond the scope of clinical practice. In reference to adjudication, a recent study has shown that proxy reports (obtained by interviewing the next of kin, family member, or close friend) had similar or higher specificity and higher sensitivity (sensitivity=50%-89%) than death certificates (sensitivity=31%-81%) and was suggested as a better strategy for determining cause of death than mere reliance on death certificates.[43]

Should autopsy be revived in order to get accurate figures? Various studies have suggested that relying on clinical data in determining the cause of death can be seriously misleading and autopsy is still a very important procedure that has a vital role to play.[44-48] In 2005, a systematic review carried out to assess the discrepancy between clinical and autopsy diagnosis showed that a third of death certificates are likely to be incorrect and that half of autopsies identified causes of death that were not thought of.[49] Interestingly, the cases which give rise to discrepancies cannot be identified prior to autopsy.

Skeptics might argue that retrospective analysis of deaths reported to coroners in Australia between 2000 and 2007 showed that coronial investigations transformed basic understanding of cause of death in only a small minority of cases.[50] It should be borne in mind, however, that only selected "reportable" cases (e.g. suspected criminal cases) are referred to the coroner.[51] In other words, one cannot assume that this would be the case for the deaths that were not referred to the coroner.

National surveys have shown a high prevalence of cardiovascular risk factors among adults, namely, overweight and obesity (60%-72%),[52,53] hypercholesterolemia (22%-54%)[54,55] and hypertriglyceridemia (40%),[55] hypertension (26.1%)[56] diabetes mellitus (23.7%)[57] and metabolic syndrome (39.3%).[58] Moreover, a decade-long epidemiological follow-up study showed that the prevalence of these major chronic, non-communicable diseases is on the increase.[59] Nevertheless, cardiovascular events did not appear on the list of major killers. Although studies from different parts of the world identified cardiovascular events[1,60] as the leading causes of death, a large-scale study has suggested that coronary heart disease may be overrepresented as cause of death on death certificates.[61] National mortality statistics, which are based on death certificate data, may overestimate the frequency of coronary heart disease by 7.9% to 24.3% overall and by as much as two-fold in older persons. Discrepancies in initial death certificate diagnoses in sudden unexpected out-of-hospital deaths were demonstrated.[62]

Malignancy was the most common appropriately-identified cause of death in our study. This finding is consistent with two other studies (from Taiwan[60] and Saudi Arabia[12]) and was thought to reflect the ease of identifying it as a cause of death. Nevertheless, it has been nicely demonstrated by Becker et al, in his review of the leading causes of death, that when all cancer categories are grouped together they became the leading cause of death, accounting for 31% of all defined deaths among males and 23% among females.[63] When cancer categories were split they appeared in 4 of the top 10 causes of death in men and 3 in women. The paper proposed that this would be more informative and useful to policy makers.

This was an exploratory study; its findings need to be validated by studies for other health care sectors. It suggests, however, that in its current situation, the only use of the death certificate is to permit burial and legal procedures to be conducted. This is a major clinical and research gap that has to be addressed soon. If death certification is to have an impact on the health care system in this country, then massive and orchestrated educational and legislative efforts have to be exerted without delay.

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