

The accuracy of death certificates

Implications for health statistics

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Summary. The death certificate is an important source of data on disease incidence, prevalence and mortality. It should therefore be as accurate and complete as possible. Death certificates from 433 autopsied hospital patients were reviewed and matched against the results of post-mortem examinations. Significant discrepancies between the two documents were observed in 50% of patients. In 25%, the immediate cause of death was incorrectly stated on the certificate, having been assigned to a different organ system in the majority of those cases. In 33%, there was disagreement on major disease other than the immediate cause of death. In 9%, the death certificate was signed before the autopsy was performed. The extent of disagreement was largely independent of whether the certificate was signed before or after the autopsy. We conclude that: (1) there is a significant discrepancy between autopsy diagnoses and entries on death certificates; (2) disagreement is not due to unavailability of autopsy data at the time of completion of the certificate; (3) death certificates should be completed or amended utilizing data gained at autopsy.

Key words: Death certificate – Autopsy – Diagnostic discrepancy – Health statistics

Introduction

Health statistics, in particular national mortality statistics, and data on disease prevalence in society, are derived largely from death certificates. In completing death certificates, physicians shape the content of these important files, destined to play a key role in decision making processes regarding the distribution of resources in the fields of medicine and health. It is therefore of vital importance that death certificates be as accurate and complete as possible. Inaccurate, vague or incomplete certificates provide misleading data regarding diseases and

causes of death in society. The general consensus among workers in health statistics and epidemiology is that death certificates represent a key source of information on causes of death (Kircher 1990).

Several papers have addressed the accuracy of death certificates. Utilizing different approaches and methodologies, these studies have concluded that the death certificate may not be a reliable source of information regarding causes of death and, therefore, not ideally suited as a source for decision making in public health (Barclay and Phillips 1962; Mitchell et al. 1971; Cameron and McGoogan 1981a; Gobbato et al. 1982; Edwards Dismuke and VanderZwaag 1984; Kircher et al. 1985). A complete post-mortem examination, in conjunction with pertinent clinical information, is undoubtedly the best available standard against which to evaluate the accuracy of death certificates. In certain aspects, Iceland, with its homogeneous population, comprehensive health care and virtually complete disease registration, is ideally suited to investigations of the epidemiology of disease and the accuracy of its registration. As it has elsewhere (Roberts 1978), the autopsy rate in Iceland has declined during the past two decades. Yet approximately 30% of all deaths in the country are still subjected to an autopsy. The aim of this investigation is to elucidate the agreement between death certificates and the results of post-mortem examination.

Materials and methods

We analysed, retrospectively, all autopsies performed during two entire years, 10 years apart, 1976 and 1986, at the Department of Pathology, University of Iceland. This institution is responsible for over 85% of all autopsies in Iceland. Excluding stillbirths, perinatal deaths and forensic cases, a total of 434 hospital autopsies were analysed. Copies of death certificates, written by the patients' hospital physicians, were obtained from the Statistical Bureau of Iceland. We matched death certificates with provisional and final autopsy reports and compared the following parameters: (1) overall diagnostic discordance; this was further subdivided according to whether the disagreement was on the (1a) immediate cause of death or on (1b) other major diseases. In cases of discrepancy

Table 1. Discrepancies between entries on death certificates and post-mortem diagnoses

	1976	1986	Total
Total number of autopsies	190	243	433
Overall disagreement	97 (51%)	120 (49.4%)	217 (50.1%)
Disagreement on cause of death	47 (24.7%)	63 (25.9%)	110 (25.4%)
assigned to incorrect organ system	35 (18.4%)	46 (18.9%)	81 (18.7%)
assigned to correct organ system	12 (6.3%)	17 (7.0%)	29 (6.7%)
Disagreement on other major diseases	64 (33.7%)	81 (33.3%)	145 (33.5%)

Table 2. Discrepancies between entries on death certificates and post-mortem diagnoses, separated as to whether the death certificate was dated before (before autopsy) or on the same day as, or later than, the provisional autopsy report (after autopsy)

	1976		1986		Total	
	Before autopsy	After autopsy	Before autopsy	After autopsy	Before autopsy	After autopsy
Total number of autopsies	22	168	16	227	38	395
Overall disagreement	12 (54.5%)	85 (50.6%)	8 (50%)	112 (49.3%)	20 (52.6%)	197 (49.9%)
Cause of death	4 (18.2%)	43 (25.6%)	4 (25%)	59 (26%)	8 (21%)	102 (25.8%)
Other major diseases	10 (45.5%)	54 (32.1%)	7 (43.8%)	74 (32.6%)	17 (44.7%)	128 (32.4%)

regarding the cause of death, we ascertained whether the discrepant causes of death had been assigned to the (1c) same or different organ system. We defined *immediate cause* of death as "... that injury or disease which kills a person at a particular time and place" (Wetli et al. 1988). The immediate cause, so defined, was then matched against item I_(a), "Direct cause", on the International Form of Medical Certificate of Cause of Death (WHO 1979). We defined *major disease* as any disease that might "... initiate a series of events that lead directly to an immediate cause of death" (Wetli et al. 1988). Major disease, so defined, was matched against item I_(c), "Underlying antecedent cause", and/or item II, "Other significant conditions contributing to the death but not related to the disease or condition causing it", on the International Form. We further investigated the difference in concordance as to whether the death certificate was signed (2a) before the autopsy or (2b) on the same day or subsequent to the autopsy. We also noted whether the death certificate (3) indicated that an autopsy had been performed. The chi-squared test was used for statistical analysis.

Results

The total number of autopsies was 434, 190 from 1976 and 244 from 1986. In 1 instance, a death certificate could not be obtained. Thus, 433 autopsies, 190 from 1976 and 243 from 1986, remained for analysis. There were 222 females and 211 males. Table 1 shows the number and percentage of discrepant diagnoses. A major overall discrepancy between the death certificate and the autopsy diagnosis was evident in 50% of cases. In 25.4% of the total, the cause of death was incorrectly stated on the death certificate when compared to the post-mortem result. There was no statistically significant difference between the results for the two years ($P > 0.5$). Table 2 shows the concordance between autopsy report and death certificate, separated as to whether the death certificate was signed before or after the autopsy. There was no statistically significant difference in overall concordance when broken down into certificates signed before or after autopsy ($P > 0.5$). For other major diseases, the reduction in disagreement after (32.4%) when com-

pared with before (44.7%) issue of the death certificate was apparent but not statistically significant ($0.50 > P > 0.10$). In 410 cases (94.6%) the death certificate indicated that an autopsy had been performed. In 3 cases (0.7%), "no" was written as an answer to the question if an autopsy had been done when in fact it had been performed and in 20 cases (4.6%), the question was left unanswered.

Discussion

The death certificate is a source of important data on the incidence, prevalence and mortality of disease. The allocation of financial resources within the health sector is governed by information largely derived from this single source. Thus, cardiovascular disease and cancer, the most common diseases causing death in modern society, appropriately receive the largest share of funds for medical research.

It is therefore highly desirable that the physician generating such a crucial set of data should have at his/her disposal all pertinent clinical and pathological information related to a person's illness and death. Equally desirable, having received this information, the physician should use it when drafting the death certificate. Of all the data available to a physician writing the death certificate, the post-mortem diagnosis is the single most important source of information. Despite its limitations, the autopsy remains the standard against which the correctness of premortem diagnoses may best be assessed.

Several investigators, each utilizing approaches somewhat different from the other, have observed discrepancies between diagnoses entered into death certificates and diagnoses generated at autopsy. Kircher and associates (1985) compared death certificates and autopsy reports on 272 patients. In over half (55%), the cause of death as stated on the death certificate differed from that on the autopsy report. In over half of those (29%

of the total), the discrepancy led to relocation of the cause of death to a different Major Category in the International Classification of Diseases. In 26%, the cause of death was correctly assigned to an organ but ascribed to a different disease within that organ. Engel et al. (1980) found disagreements of varying significance in 51% of patients. Malignant neoplasms were under-reported and vascular diseases over-reported, each by approximately 10%. Barclay and Phillips (1962) found that death certificates overstated the incidence of some cancers, particularly those of the gastrointestinal tract, by 8.9–13.3%, and understated others (oral cavity, prostate and breast) by 11–16.7%. They concluded that the death certificate was an unreliable indicator of cancer incidence. Mollo et al. (1986) obtained similar results. Gobato et al. (1982) analysed 1405 patients in whom a malignant tumour had been found at autopsy, concluding that death certificates could not be relied on as a source of data in cancer epidemiology. Analogous discrepancies have been confirmed with regard to non-malignant conditions. Thus, the reporting on death certificates of chronic obstructive lung disease (Mitchell et al. 1971) and pulmonary embolism (Rossman 1974; Edwards Dismuke and VanderZwaag 1984) deviates significantly from that found at autopsy.

The present study reveals similar discrepancies between data on death certificates and the results of autopsies. We found overall major disagreement in 50% of cases. In 25.4%, the disagreement was on the immediate cause of death and in 33.5% on other major diseases that might or might not be causally related to the immediate cause.

The autopsy rate in Iceland has declined from about 35% of all deaths in the country (Hallgrímsson 1981) in the 1970s, to about 30% in the 1980s. The reasons for this decline, observed in most countries (Cameron et al. 1977; Brunner and Schilling 1984; Caplan 1984; Nemetz et al. 1987; Editorial (JAMA) 1988), are many and complex and will not be detailed here except in one aspect; the introduction into clinical medicine of advanced investigating techniques, particularly in the field of imaging. These diagnostic modalities, namely ultrasound, computed tomography and magnetic resonance imaging may have rendered the autopsy obsolete in the eyes of some practitioners of clinical medicine. Several recent investigations have refuted this impression (Goldman et al. 1983; Kircher 1990; Jonasson and Björnsson 1991). In fact, the present study found that the overall accuracy of premortem diagnoses as expressed on death certificates remained unchanged between the years 1976 and 1986. In the intervening years, non-obstetric ultrasound and computed tomography were introduced into, and gained widespread use in, Iceland. The contribution of these techniques probably accounts for the improvement, between the two years, in the detection of "other major diseases", particularly small neoplasms. Another common perception, that a prolonged hospital stay improves clinical diagnostic accuracy, has not been borne out (Cameron and McGooan 1981a; Battle et al. 1987).

Assuming that clinicians request a post-mortem ex-

amination to clarify their patients' illness, it is surprising that they appear not to utilize the information generated by the autopsy as they complete death certificates. Technical reasons may occasionally require that a death certificate be completed before an autopsy. This is the likely explanation for the 8.7% of cases (Table 2) where the certificate was dated before the day of the autopsy. The remaining 91.3% cannot be thus explained. Here, important, and available, information was not utilized. Even if a provisional autopsy report, based on gross findings, may not reach the physician for 1–2 days, verbal communication will suffice. Others (Engel et al. 1980; Hill and Anderson 1988; Kircher 1990) have observed this apparent disregard of autopsy results. This underutilization is further underscored by our finding that overall diagnostic discordance remained virtually unchanged on certificates dated the same day as, or later than, the autopsy. We believe that these results do not necessarily signify physicians' disinterest in their patients' illness and death. Rather, our findings emphasize the low priority accorded the death certificate, including a lack of awareness of its importance in the generation of health statistics.

It has been maintained that the death certificate both over- and underdiagnoses diseases and that the net effect might be zero. Data, however, suggest that losses and gains do not cancel each other out (Engel 1980). The inaccuracies of death certificates and the greater sensitivity and specificity of autopsy information strongly suggest that the autopsy should be an integral part of the data base of mortality statistics. A post-mortem examination provides the best available information on the causes of death as well as the frequency of specific diseases at the time of death. (Anderson 1978; Kircher et al. 1985) The autopsy should therefore be the final stage in clinical investigation, not simply a means of correcting wrong diagnoses. Further, the autopsy remains unsurpassed as a tool for the monitoring of diagnostic techniques and for defining clinical skills (Cameron and McGooan 1981b; Anderson and Hill 1989). Finally, we recommend that before they are entered into health statistics, death certificates should be updated in accordance with the results of the autopsy.

In conclusion

We observe that: (1) death certificates are in significant disagreement with results of post mortem examinations; (2) disagreement is largely independent of dates of issue of death certificates and provisional autopsy diagnoses; (3) in order to enhance their accuracy, death certificates should be completed with autopsy data at hand and/or amended when these become available.

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