

Brief Report

Accuracy of Death Certificate Completion

The Need for Formalized Physician Training

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Objective.—To assess the extent to which accuracy of death certificate completion varies with level of physician training and experience.

Design and Setting.—In a classroom setting, subjects were presented with six written cases of hospital deaths adapted from materials from the National Center for Health Statistics and were asked to complete the cause-of-death section of the New York City death certificate.

Participants.—A total of 12 practicing general internists, 21 internal medicine residents, and 35 senior medical students.

Outcome Measures.—The underlying cause of death recorded by each participant was compared with the correct cause determined by a nosologist. Agreement and disagreement were classified as major or minor depending on concordance within the 17 *International Classification of Diseases* categories.

Results.—Only one internist and five residents had received formal training in death certificate completion. The overall level of agreement between underlying cause of death reported by the three groups of participants and the correct cause was 56.9% for internists, 56.0% for residents, and 55.7% for medical students, although agreement varied with the type of case, ranging from 15% to 99%.

Conclusions.—If the misclassification observed in this pilot study were widespread, it would imply a substantial underreporting of mortality from both circulatory diseases and diabetes. These data strongly support the need to include training in death certificate completion as part of physician education.

(JAMA. 1996;275:794-796)

THE DEATH certificate is a public health surveillance tool that fulfills essential legal and social functions. Death certificate data are a major means of identifying public health problems and evaluating the effectiveness of programs developed to deal with them. The data provide an important basis for development of epidemiological studies in many areas, including heart disease and cancer, and help to identify high-risk populations and geographical differences in rates of selected causes of death. Allocation of public funds for disease prevention and research programs depends on interpretation of trends in mortality rates, while settling estates and payment of life insurance benefits require certified statements of fact and sometimes cause of death.

In the United States, every death must be reported to state authorities on a prescribed form designed for reporting of an "underlying cause of death." This is defined in the *International Classification*

of Diseases, Ninth Revision (ICD-9), as "the disease or injury that initiated the train of morbid events that led directly to death, or the circumstances of an accident or violence that produced the fatal injury."¹ The cause-of-death section is ordinarily completed by a licensed physician, but few physicians receive formal training in completing this section. Comstock and Markush² called lack of physician training one of the most fundamental difficulties with the current mortality system, but its consequences have rarely been investigated. Studies of the validity and accuracy of death certificates³⁻⁶ have usually dealt with the effect of nosologic misclassification rather than with the role of the physician. Some studies have compared causes of death assigned by different nosologists within the same country⁷ or between countries,⁸ whereas others have used existing medical records such as autopsy reports as a reference against which death certificate data are compared.^{9,10} However, there has been little research on the dynamics of the certification process and the extent of training of physician certifiers.

The National Center for Health Statistics (NCHS) makes available printed

materials and videocassettes directed to physicians on how to fill out death certificates, but these materials reach a relatively small number of physicians.¹¹ Medical journals occasionally publish articles on death certificate completion to increase the awareness of practitioners,¹² but the impact of these articles is unknown. Absence of formal training in death certification has led to an informal system whereby advice and guidance are variously provided by institutional medical records departments, nursing staff, house staff peers, and even funeral directors.

To gain insight into physician training needs, a pilot study was conducted to test the knowledge of general internists, medical residents, and senior medical students to assess how accurately they assign causes of death.

Methods

Six written clinical cases were adapted from a publication of the NCHS used for self-instruction of physicians on death certification.¹³ The cases were selected to represent typical rather than exotic situations. The cases were presented to each of 12 practicing general internists, six second-year and 15 third-year internal medicine residents, and 35 senior medical students. All subjects were volunteers who were recruited at staff meetings and classes in a large urban teaching hospital.

After reading the case descriptions, each physician or student was asked to complete the cause-of-death section on a copy of the New York City death certificate that included its printed instructions. Part I allows space for the immediate cause (final disease or condition resulting in death) and up to three antecedent conditions (conditions leading to immediate cause, listed sequentially); Part II is provided for mention of other significant conditions contributing to death. No other guidance was offered. The participants also completed questionnaires about their own backgrounds, including previous training or experience in filling out death certificates.

The completed certificates were then coded by a professional nosologist who had received training from the NCHS. All coding was done according to the

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Table 1.—Level of Agreement With the Correct Underlying Causes for Six Test Cases Achieved by Senior Medical Students, Medical Residents, and Internists*

Case	Major Agreement, No. (%)			Minor Agreement, No. (%)			Overall Agreement, %	Major Disagreement, No. (%)		
	Students	Residents	Internists	Students	Residents	Internists		Students	Residents	Internists
1	4 (11)	1 (5)	0	1 (3)	0	4 (33)	14.7	30 (86)	20 (95)	8 (67)
2	28 (80)	16 (76)	11 (92)	4 (11)	4 (19)	0	92.6	3 (9)	1 (5)	1 (8)
3†	23 (66)	15 (75)	10 (83)	9 (26)	5 (25)	2 (17)	94.1	3 (9)	0	0
4	17 (49)	8 (38)	8 (67)	17 (49)	13 (62)	4 (33)	98.5	1 (3)	0	0
5‡	17 (49)	5 (24)	9 (75)	0	0	0	45.6	18 (51)	16 (76)	3 (25)
5§	18 (51)	15 (71)	3 (25)	0	0	0	52.9	17 (49)	6 (29)	4 (75)
6	27 (77)	15 (71)	9 (75)	3 (9)	1 (5)	1 (8)	82.4	5 (14)	5 (24)	2 (17)
Total certificates	210	125	72	210	125	72	...	210	125	72
Overall, No. (%)§	117 (55.7)	70 (56.0)	41 (56.9)	34 (16.2)	23 (18.4)	11 (15.3)	72.7	59 (28.1)	32 (25.6)	20 (27.8)

*For students, n=35; for residents, n=21; and for internists, n=12.

†Only 67 subjects filled out certificates.

‡Assumes that the correct cause is alcoholism.

§Assumes that the correct cause is pancreatitis.

rules of the ICD-9.¹ For each case history, we applied the ICD-9 coding rules to the death certificate completed by each study participant, thereby arriving at the underlying cause of death that would have been recorded had the certificate been filed with the health department. We also examined the individual certificate entries and their order to identify possible patterns of errors or misunderstanding that might be emphasized in training courses for physicians.

To analyze the accuracy of death certificate completion we adapted the methodology of Kircher et al,¹⁰ who defined three levels of interrater agreement between assignments of underlying cause. We used as a key a correctly completed certificate provided by the NCHS. If a death certificate filled out by a study subject yielded an underlying cause of death for which the three-digit ICD-9 code was the same as the NCHS key, it was considered to be in "major agreement" with the key. If the cause was not identical to the key but fell within the same major disease category of the standard 17 major categories of the ICD-9, it was considered "minor agreement." If the underlying cause of death did not fall within the same major disease category as the key, it was considered a "major disagreement."

The full text of all six cases is published in the NCHS handbook.¹³ For brevity we present case 1 herein as an example and summarize cases 2 through 6.

Case 1.—An 80-year-old woman was admitted to the hospital from a nursing home for a temperature of 39.2°C (102.6°F). She first became a resident of the nursing home 2 years earlier after a cerebrovascular accident that left her with a mild residual left hemiparesis. Over the next year she became increasingly dependent on others to help her with activities of daily living, eventually requiring an indwelling Foley catheter. For the 3 days prior to admission she was noted to have lost her appetite and to have become increasingly withdrawn. On admission to the hospital her leukocyte count was $19.7 \times 10^9/L$, she had pyuria, and gram-negative rods were seen on a Gram stain of the urine. Ampicillin was administered intravenously. Blood cultures 2

days after admission were positive for *Pseudomonas aeruginosa*. Antibiotic therapy was changed to tobramycin and ticarcillin. Despite the antibiotics, intravenous fluid support, and steroids, the patient's fever persisted. On the fourth day after admission she became hypotensive and died.

For case 1, the correct sequence on the death certificate is bacteremia caused by urinary tract infection, due in turn to hemiplegia caused ultimately by cerebrovascular disease, which NCHS gives as the underlying cause.

Cases 2 Through 6.—The five other cases (along with the underlying causes of death) were as follows: case 2, an 87-year-old man with congestive heart failure (cause of death, acute myocardial infarction); case 3, a 55-year-old man with cardiovascular collapse during bypass surgery (acute myocardial infarction); case 4, a 68-year-old woman who developed a pulmonary embolism while hospitalized for acute myocardial infarction (acute myocardial infarction); case 5, a 48-year-old man with alcoholic pancreatitis (alcohol dependence syndrome); and case 6, a 73-year-old woman with non-insulin-dependent diabetes who developed nonketotic hyperosmolar coma (diabetes mellitus with hyperosmolar coma).

Results

All 68 participants completed every case, except one resident who completed five. One hour was sufficient time for most to complete all six cases. Table 1 shows the extent of agreement with the correct underlying cause of death for all six cases achieved by study participants, by level of training. For case 1, only 10 of 68 subjects' certificates (15%) yielded the correct underlying cause, and none included all of the significant or contributing conditions: for example, three subjects omitted bacteremia, two omitted urinary tract infection, and all nine omitted hemiplegia. Using the ICD-9 coding rules, the underlying cause most commonly reported by the participants was "other disorders of the urethra and urinary tract." This cause was assigned to 43 certificates (63%). On 19 of these, the sequence was given as "sepsis" or "septic shock" followed by "urinary tract infection," and stroke was not mentioned at all. Only one participant correctly entered hemiplegia in Part I. Sep-

ticemia was indicated as the underlying cause on nine of the 68 certificates, due mainly to out-of-order placement of antecedent conditions. However, none of these certificates mentioned the stroke, so that altering the order of entries still would not have resulted in correct assignment of the underlying cause.

Except for case 5, the three groups of participants showed similar levels of agreement. If the three groups of subjects are combined, the level of major agreement with the key ranged from five of 68 (7.4%) for case 1 to 55 of 68 (80.9%) for case 6. If major and minor agreement are grouped together, agreement ranged from 14.7% for case 1 to 98.5% for case 4. For all six cases combined, the level of major agreement with the correct cause of death was similar for internists, resident physicians, and students, and ranged from 55% to 57% for major agreement, 15% to 18% for minor agreement, and 26% to 28% for major disagreement (Table 1).

Twenty-three (66%) of the medical students had received no instruction whatever, and 19 of the 21 medical residents (91%) and 11 of the 12 internists (92%) first came into contact with death certificate procedures during their residencies. Only five of the 21 residents and only one of the 12 internists could recall being given written materials on death certification. Training experiences were largely received by word of mouth from varying sources. Of medical residents who had experience filling out death certificates, two thirds routinely consulted other physicians in their hospitals and one fourth took advice from funeral directors, whereas internists tended to consult their hospitals' medical records departments.

Comment

The variation in the extent of agreement between the subjects' death certificate entries and the correct cause-of-death sequences appears to reflect a lack of training in death certificate completion at all levels of medical experience.

A physician-training module for death certification should emphasize the cor-

Table 2.—Potential Consequence of Miscoding of Death Certificates in Six Case Studies*

ICD-9 Code	Disease Category	Case					
		1	2	3	4	5	6
001-139	Infectious/parasitic	9	0	0	0	0	0
140-239	Neoplasms	0	3	0	0	0	0
240-279	Endocrine/metabolic	0	0	2	1	0	56†
280-289	Hematopoietic	0	2	0	0	0	0
290-319	Mental disorders, including chronic alcohol syndrome	1	0	0	0	31†	0
320-389	Nervous system	2	0	0	0	0	0
390-459	Circulatory	10†	63†	64†	67†	1	5
520-579	Digestive	0	0	0	0	36	0
580-629	Genitourinary	45	0	0	0	0	7
780-799	Ill-defined	1	0	1	0	0	0
	Not completed	0	0	1	0	0	0
	Total Subjects	68	68	68	68	68	68

*Major disease categories for underlying causes selected by 68 subjects. ICD-9 indicates *International Classification of Diseases, Ninth Revision*.¹

†Correct category for each case history.

rect sequencing of events from immediate to underlying cause of death as well as their correct placement on the certificate; when to include a chronic illness such as diabetes in Part I and when to place it in Part II; how to enter other morbid conditions such as obesity and hyperlipidemia; and how to distinguish the so-called mode of death, such as hemorrhage, from a true underlying cause, such as atherosclerotic heart disease.

For case 5, there was not sufficient information in the case history to make a clinical judgment of the relative contribution of alcoholism to pancreatitis. Thirty-one subjects (46%) chose alcoholism as the cause of death, while the remainder ignored it and chose pancreatitis as the cause of death. Ideally, the patient's clinician, who would be fully informed about the patient, should complete the death certificate; if this is not possible, every effort should be made to obtain his or her input.

Table 2 illustrates the potential effect of the miscoding of these test cases on vital statistics. The certificates prepared for case 1, if generalized, would have artificially increased the observed death rates for genitourinary diseases at the expense of circulatory diseases. The errors in case 6 would have increased the rates of circulatory and genitourinary diseases at the expense of endocrine diseases. Since the adult mortality rate for circulatory diseases is by far the greatest of all 17 categories, these misclassification errors are not random and, if widespread, would bias reported death rates. It should be noted, however, that this is a pilot study with a small sample that was not intended to be representative of all medical students and physicians, nor do the cases represent all causes of death.

Many improvements have been made in the mortality surveillance system during the past 10 years. The Automated

Classification of Medical Entities has provided a tool for consistent assignment of underlying cause-of-death codes and has improved availability of multiple-cause-of-death information.¹⁴ Data files containing multiple causes of death as early as 1968 are now available to researchers,¹⁵ and analyses using these expanded dimensions of cause-of-death data have become routine in fields as diverse as infectious diseases^{16,17} and occupational health.¹⁸ Even though these improvements have been accomplished by creative application of new information technology systems, preparation of the essential source documents continues to be performed manually by physicians with little formal training in death certification procedures.

To improve physician completion of death certificates, formal instruction should be included in medical school and residency, for instance, using manuals developed for this purpose.¹⁹ If the decedent's physician is not available at time of death, he or she should be consulted whenever possible for details of the illness. Inconsistent entries should be rigorously queried by the health department using procedures established by NCHS,^{20,21} and autopsy results should be used routinely to update information, even after the death certificate is filed. Finally, software programs should be developed to guide physicians through the death certificate completion process and should be disseminated to hospitals for everyday use.

This publication was made possible by National Institutes of Health contract 263-MD-251049 (Dr Messite) and grants CA-17613, CA-32617, and CA-68384 (Dr Stellman).

The authors gratefully acknowledge the efforts of Francine Benjamin, MS, for conducting much of the field testing and Melody Davis for nosological coding.

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