Death Certification: Errors and Interventions

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Objective: Death certificates are legal documents containing critical information. Despite the importance of accurate certification, errors remain common. Estimates of error prevalence vary between studies, and error classification systems are often unclear. Relatively few studies have assessed the frequency at which death certification errors occur in US hospitals, and even fewer have attempted a standardized classification of errors based on their severity. In the current study, our objective was to evaluate the frequency of death certification errors at an academic center, implement a standardized method of categorizing error severity, and analyze sources of error to better identify ways to improve death certification accuracy.

Design: We retrospectively reviewed the accuracy of cause and manner of death certification at our regional academic institution for 179 cases in which autopsy was performed between 2013–2016. We compared non-pathologist physician completed death certificates with the cause and manner of death ultimately determined at autopsy.

Methods: Errors were classified via a 5-point scale of increasing error severity. Grades I-IIc were considered minor errors, while III-V were considered severe. Sources of error were analyzed.

Results: In the majority of cases (85%), death certificates contained ≥ one error, with multiple errors (51%) being more common than single (33%). The most frequent error type was Grade I (53%), followed by Grade III (30%), and Grade IIb (18%). The more severe Grade IV errors were seen in 23% of cases; no Grade V errors were found. No amendments were made to any death certificates following finalization of autopsy results during the study period.

Conclusion: This study reaffirms the importance of autopsy and autopsy pathologists in ensuring accurate and complete death certification. It also suggests that death certification errors may be more frequent than previously reported. We propose a method by which death certification errors can be classified in terms of increasing severity. By understanding the types of errors occurring on death certificates, academic institutions can work to improve certification accuracy. Better clinician education, coordination with autopsy pathologists, and implementation of a systematic approach to ensuring concordance of death certificates with autopsy results is recommended.

Keywords: Death certification; Electronic death registration; Death record; Cause of death, Manner of death

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Death certificates are legal documents containing essential information used to arrange end of life affairs, compile health statistics, study population-based mortality, and influence public health policy. Errors in death certification are common, with frequencies ranging from 17.7%–96% in hospital-based studies.[1-5] Errors occur even at institutions where autopsy pathologists trained in death certification are an available resource. Such errors can range in severity from spelling errors and incomplete demographic information to reporting the wrong cause and/or manner of death altogether. Relatively few studies have assessed the frequency at which death certificate errors occur in US hospitals, and even fewer have attempted a standardized classification of errors based on their severity. In the current study we evaluated both the overall frequency and severity of death certification errors occurring at an academic institution through comparison of clinician-completed death certificates with the cause and manner of death ultimately determined at autopsy.

Methods

This retrospective study evaluated the accuracy of cause (including parts I and II) and manner of death certification at our institution in deaths in which autopsy was ultimately performed between January 2013 to December 2016. All patients were > 18 years-of-age and either had a presumed natural manner of death based on the known clinical circumstances, or else a medical examiner/coroner was notified and had released jurisdiction prior to autopsy. All autopsies were consented to via a permit signed by the legal next-of-kin and a University of Wisconsin Hospital (UWHC) non-pathologist physician.

Study Setting

UWHC is a 505-bed tertiary care hospital at which 500-550 autopsies are conducted annually; roughly half of these autopsies are "medical" cases in which the decedent expired within the hospital, at a long-term or hospice care facility, or at home while under the care of a physician, and whose manner of death is typically presumed to be natural. In such cases, a hospital physician without specialized forensic training is generally tasked with completing the death certificate based on the available clinical information within 6 days of the date of death pronouncement.[6] Even in cases in which autopsy is performed, deaths at our center are certified by treating clinicians rather than hospital autopsy pathologists in accordance with state statutory requirements.[6-7]

Following "medical" autopsies at our institution, a preliminary report of autopsy findings and diagnoses (PAD) is issued within 2 working days of the postmortem examination and made available for clinician review within the patient's electronic medical record (EMR). The PAD summarizes key gross external and internal examination findings, as well as available clinical history. A final report of autopsy findings and diagnoses (FAD) is subsequently issued within 30 working days of autopsy, ie., following review of autopsy histologic sections and any ancillary testing results. As per the National Committee on Vital Health Statistics recommendation, the FAD documents the cause of death, any other significant conditions that contributed to death, and the manner of death.[8] Extended turn-around times for FADs may occur in cases requiring send-out testing, outside consultation, or extended neuropathologic analysis; however, such cases represent a minority.

Death Certificate Criteria

All death certificates were formatted in accordance with the US Standard of Death.[9] As per Centers for Disease Control and Prevention (CDC) and College of American Pathologists (CAP) recommendations, cause of death (COD) statements included in Part I of the death certificate were assessed for whether they accurately captured the lethal chain of events (i.e., disease, injury, or complication) that directly caused death.[9-10] Conditions were required to be listed in the appropriate chronological order, with the condition occurring closest to the time of death first and underlying cause of death last. Conditions listed in Part II of the death certification statement were expected to be other significant conditions (OSC) contributing to death but not directly resulting in the underlying cause listed in Part I. A 'mechanism of death' was considered to be a non-specific physiologic derangement brought about by the cause of death, including terminal events such as cardiac arrhythmias and respiratory arrest; while mechanisms did not need not be reported on the death certificate, if included, they were expected to be accompanied by an underlying cause of death.[10] The manner of death (MOD) was considered to refer to the circumstances surrounding death and could be classified as one of the following: natural, homicide, suicide, accidental, or undetermined.[9-10]

Death Certificate Review

The cause (ie., Part I/COD and Part II/OSC) and manner of death (ie., MOD) certified by treating clinicians on death certificates was compared to the cause and manner of death ultimately determined on the basis of postmortem examination as documented in final autopsy reports. In cases of discrepant certification, the postmortem examination findings were considered to be the gold standard. A pathologist certified by the American Board of Pathology in both anatomic and forensic pathology and a senior level pathology resident accepted for forensic fellowship training independently reviewed the death certificates and autopsy reports for each case. Each pathologist assigned the appropriate grade(s) for any errors identified, and the results were compared. Discrepancies in error classification between the two pathologists were discussed, and final error grades were agreed upon following review of the clinical information in those cases. Error proportion and frequency were analyzed and reported.

Error Classification

Errors were assigned a grade on an increasing severity scale of 0-V; the error grading scale was predetermined (Table 1). Grades I-IIc were considered minor errors, and grades III-V were considered severe errors. Cases with more than one error were assigned multiple grades as necessary. Cases containing errors that potentially fit into more than one category were assigned only one grade per individual error; for instance, if a condition that should have been included in the Part I/COD was misclassified as a Part II/OSC, this would be designated as a grade IIc error only, rather than also tracking it as being a major missed COD diagnosis, ie., a grade III error. In general, the lowest potential error grade that addressed a given scenario was applied. In cases in which the particular type of malignancy or etiologic agent of an infection was included in the final autopsy report but the death certificate was vague (eg., 'carcinoma' or 'pneumonia' not otherwise specified), a grade IIb error was assigned. In cases in which a mechanism of death was listed as COD on the death certificate (eg., intracerebral hemorrhage) and not further specified—though the underlying COD was designated in the autopsy report (eg., intracerebral hemorrhage arising due to cerebral amyloid angiopathy)—a grade IVa error was assigned.

Results

A total of 182 cases met inclusion criteria for the study. Three cases had unclear or incomplete information regarding cause and manner of death certification, preventing accurate comparison of the death certificate with autopsy findings, and these were omitted from further review. In sum, death certificates and autopsy reports were reviewed and errors tallied for 179 cases. Overall, the majority (85%; n=153/179) of non-pathologist physician completed death certificates contained one or more errors, and multiple errors (51%; n=91/179) were more commonly seen than single errors (33%; n=59/179). There were 26 (14.5%) death certificates that contained no errors, and 59 (33.0%) that contained one error. Of the multiple errors, 71 (39.7%) contained two errors, 19 (10.6%) contained three errors, and 4 (2.2%) contained four errors. There were no death certificates identified containing more than four errors. Of the death certificates with multiple errors, the majority (78%;71/91) contained two errors, 21% (19/91) contained three errors, and 4% (4/91) contained four errors.

In terms of error severity, the number of death certificates with both minor and major errors (35%; n=62) was roughly equal to the number containing only minor errors (34%; n=61). There were far fewer major error-only death certificates (17%; n=30). The most frequent error type identified was grade 1 (53%; n=94); these errors most commonly arose due to omission of OSC conditions such as obesity, smoking, or hypertension. Grade III errors (30%; n=53) and grade IIb errors (18%; n=33) were the second and third most common error types, respectively. Grade III errors most commonly arose due to failure to list the underlying condition/disease that initiated the lethal cascade of events. Examples included failure to designate that focal segmental glomerulosclerosis was the disease process necessitating renal transplant, failure to designate that rheumatic valvular disease was the etiology of the congestive heart failure, failure to designate that pulmonary hypertension arose due to systemic sclerosis, and failure to specify that the cardiac arrhythmia arose due to autonomic nervous system dysfunction secondary to an Arnold Chiari malformation. From a public health perspective, documenting the underlying cause of death is critical, as the most effective strategy is to prevent the occurrence of the disease or injury that ultimately precipitates the complex chain of events leading to death. Less commonly, Grade III errors arose due to major diagnoses unsuspected prior to autopsy. Examples included pulmonary mucormycosis, bacterial endocarditis, acute ischemic colitis, acute intestinal pseudo-obstruction, aortic dissection, and acute pancreatitis.

The remaining error grades had the following frequencies: grade IIa (15%; n=26), grade IIc (15%; n =26), grade IVa

Table 1. Grading of Clinician Death Certification Errors

Grade	Description
0	No Errors
I	OSC omitted or inappropriately attributed
IIa	Part I diagnoses in illogical order or inclusion of diagnosis in COD better classified as an OSC
IIb	Nonspecific diagnoses listed as COD or OSC
IIc	Missed OSC diagnoses or condition that should have been listed in COD included as OSC
III	Major missed COD diagnoses
IVa	No acceptable underlying COD (i.e. mechanism only)
IVb	Wrong COD
V	Wrong MOD

OSC: Other significant conditions contributing to death listed in Part II of death certificate; COD: lethal chain of events that directly led to death listed in Part I of death certificate; MOD: manner of death as determined by circumstances surrounding the death (i.e. natural, accident, suicide, homicide, or undetermined)

(10%; n=18), grade IVb (13%; n = 23). Grade IIa errors were identified in 26 cases (15%) and were most frequently due to illogical order of the Part I diagnoses rather than inclusion of diagnoses in Part I unrelated to the COD or better classified as an OSC. The more severe errors, Grade IVa (10%; n=18) and Grade IVb (13%; n=23), were identified in 23% of the cases reviewed. No errors in manner of death (Grade V) were identified, and no amendments were made to any of the death certificates following finalization of autopsy results during the study period. In general, deaths due to neoplastic disease tended to show better concordance between death certification and autopsy results than other diseases/conditions. Deaths in patients with multiple comorbidities/complications and generally complex pathogenic sequences of events leading to death tended to have poorer concordance.

Discussion

Death certificates are the basis from which disease prevalence data and national morbidity and mortality data are derived in the United States.[3,11-12] Thus, death certification accuracy is key in ensuring that governmental prioritization of public health priorities and allocation of health funding for a multitude of conditions such as coronary heart disease, dementia, and various infections—to name a few—is appropriate.[13-16] Autopsy remains the standard against which clinician death certification accuracy is assessed.[3,1-12,17-18] Despite many diagnostic medical advances, recent studies still report autopsy to reveal major missed diagnoses in roughly 17.7%–29% of cases.[3,17-19] Even in cases in which autopsy was not performed, review of death certificates and corresponding medical records by autopsy pathologists reportedly reveals certification errors in up to 48%¬96% of cases, of which 34%–51% are major errors.[2,11,20] These results are comparable to those seen in our series; 85% of the non-pathologist physician completed death certificates at our institution contained one or more errors; of these, 52% contained major missed diagnoses. Our results reaffirm the importance of autopsy as a key tool in accurately identifying and documenting conditions contributing to death.

Both nationally and internationally, it has been reported that medical students and non-pathology residents are poorly trained in death certification.[1,4,21-23] In one survey of 590 residents from various US institutions, 76% reported having received no formal training in death certification principals, and when asked to complete a cause of death statement based on a sample scenario of a hospital urosepsis death, 77% performed suboptimally, with 45% incorrectly attributing the death to a cardiovascular event.[21] At our institution, death certification inaccuracies cannot be attributed to resident inexperience per se, as only fellows and attending faculty are tasked with certification; however, the death certification training provided to trainees who ultimately become fellows and attending faculty is admittedly limited. Unlike most other medical specialties, pathology residents and forensic fellows do typically receive

training in death certification. Given this expertise, it might seem that having the autopsy pathologist rather than non-pathology physicians certify death would be the easiest way to ensure death certification accuracy and maintain concordance between autopsy and death certificate results. Unfortunately. in some states, statutes limit this ability. For instance, Wisconsin statutory requirement specifies that when an individual "under the care of a physician dies from the illness or condition for which the care is given…the physician shall complete and sign a medical certification for the death."[6] Only if the physician caring for the patient is "absent" or else gives written permission is the autopsy pathologist allowed to certify the death.[7]

As in our study, unexpected findings at autopsy reported after the death has been certified can account for some discrepancies; however, in such cases the death certificate can always be amended. It is understood that the cause of death is the best medical opinion of the certifier at the time, and that this opinion may necessarily change if additional information later becomes available. In our state, the original certifying physician may amend a death certificate for up to 1 year following death pronouncement without needing a court order.[12,24] In the current study, no amendments were made to any death certificates between the years 2013–2016. It is suspected this deficit is attributable to lack of clinician time and/or understanding of the significance of death certification.[25] Per CDC, should autopsy findings become available that would change the cause(s) of death originally reported, the certifying physician should amend the original death certificate immediately.[9]

The majority of the errors detected on review of death certificates at our institution, however, were not due to novel findings at autopsy, but rather omissions of known conditions or illogical sequencing of known events leading to death. Standardization of grading is critical to better recognize the types of errors more frequently made, so that preventive strategies may be devised.[2] Currently, there is no commonly accepted grading scheme to categorize the type and severity of death certification errors, though some models have been previously proposed.[1-5,11,18,20] In devising the grading scale used in our study, we elected not to categorize grammatical, spelling, handwriting, abbreviation use, or lack of time interval specification in Part I/II as errors. Although such clerical errors may signify inexperience or carelessness on the part of the medical certifier, the overall impact was viewed as limited when compared to substantive errors regarding the cause and manner of death. Additionally, as many states have transitioned to electronic death certification systems utilizing computer entry with auto-prompts, the impact of such clerical errors may have been partially or largely mitigated.

Prior studies have differed in their definitions of major versus minor certification errors. In at least one study, erroneous or omitted 'other significant conditions' (ie., Part

II diagnoses) were categorized as major errors.[11] We felt that as these conditions were distinctly separate from the lethal cascade of events that directly led to the death (ie., Part I diagnoses), they should be more appropriately designated as minor errors. Conversely, errors regarding the manner of death were entirely omitted from the data reported in several studies.[1,3-5,18,20] Because errors in manner of death may have severe legal implications and would definitely warrant an amendment to the death certificate, these errors were incorporated into our grading scale as the most severe error type (ie., grade V error). We found addressing comorbidities that contributed to death to be one of the more challenging aspects of designing a grading scale, due to the fact a single comorbidity could be considered either major or minor depending on the unique clinical circumstances of that case. For instance, the omission of hypertension as a comorbidity could be considered a major error in a patient who had a stroke versus a minor error in a death due to a patient who died from complications arising from metastatic carcinoma.

In addition to standardizing death certification grading criteria and augmenting the ability of autopsy pathologists to certify medical deaths in cases in which autopsy is performed, our study also suggests that on-going house staff education and a formalized death certification review process are strongly indicated. We recommend that all house staff be required to participate in at least one interactive death certification educational workshop over the course of their training.[2,5,23,26] To ensure that basic death certification principals are reinforced and that all key medical diagnoses and findings are incorporated into the death, medical certifiers are strongly encouraged to take the opportunity to discuss death certificates with the clinical care team during rounds and at applicable conferences (eg., specialty-specific 'Morbidity and Mortality' conferences).[2] It is recommended that as with other institutional quality improvement initiatives, there likewise be a local quality improvement committee knowledgeable in death certification issues that reviews each certificate in conjunction with the medical history and—in cases of error—notifies the certifier of the issue and requested amendment.[2,11] Such an approach would help to not only ensure accurate coding at the state/national level of mortality causes from death certificate data, but also—in cases of autopsy—track diagnostic errors that could potentially suggest preventable causes of hospital death.[18-19] Autopsy pathologists may serve as a valuable reference for clinicians with specific death certification queries, and overall can play an integral role in promoting death certification accuracy and education amongst house staff, attending staff, and the greater medical community.[3]

Acknowledgements

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