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A Disclosure About Death Disclosure: Variability in Circulatory Death Determination

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ABSTRACT

Introduction. Circulatory-respiratory death declaration is a common duty of physicians, but little is known about the amount of education and physician practice patterns in completing this examination.

Methods. An online survey of physicians was conducted evaluating the rate of formal training and specific examination techniques used in the pronouncement of circulatory-respiratory death. Data, including the level of practice, training received in a formal death declaration, and examination components, were collected.

Results. Respondents were attending physicians (52.4%), residents (30.2%), fellows (10.7%), and interns (6.7%). Most respondents indicated they had received no formal training in death pronouncement; however, most reported self-perceived competence. When comparing examination components used by the study's cohort, 95 different examination combinations were used for death pronouncement.

Conclusions. Formal training in death pronouncement was uncommon and clinical practice varied. Implementation of formal training and standardization of the examination are necessary to improve physician competence and reliability in death declarations.

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INTRODUCTION

Clinicians working in hospitals unfortunately are faced with the declaration of death following circulatory-respiratory arrest. Determination of death following circulatory-respiratory arrest has been practiced for centuries, while formal criteria for the determination of death only recently has been developed. The Uniform Determination of Death Act (UDDA), written in 1981, simply defines death as "total failure of the circulatory-respiratory system or irreversible loss of all brain functions."[1] Currently, only one guideline for the declaration of circulatory-respiratory death exists, and it defines minimal acceptable standards for declaration: cardiopulmonary auscultation, central pulse assessment, pupillary reaction, and responsiveness to stimulation (Table 1).[2] Recently, additional evidence-based declaration standards have been proposed with the introduction of donation after circulatory death (DCD).[3]

Table 1. Recommended minimal acceptable standards for circulatory-respiratory death assessment.

Minimal acceptable clinical standards	Additional testing for consideration
1. Absence of breath sounds 2. Absence of heart sounds 3. Absence of spontaneous respirations and visible chest wall movement 4. Absence of palpable pulse 5. Loss of pulsatile arterial blood pressure through non-invasive measures 6. Coma with fixed and dilated pupils	1. Loss of pulsatile arterial blood pressure through arterial line monitoring 2. Absence of anterograde aortic flow on echocardiography 3. Isoelectric electroencephalogram 4. Absence of pulse by Doppler *Adapted from Shemie et al.*[2]

Autoresuscitation, defined as the spontaneous return of cardiovascular function following death, is an important consideration in death pronouncement.[4] Autoresuscitation can occur both following cardiopulmonary resuscitation (CPR) and in the absence of any resuscitation efforts, but has not been reported to occur beyond 10 minutes after cardiopulmonary arrest. The potential for this phenomenon would suggest that an observation period following apparent circulatory-respiratory arrest prior to a formal declaration of death is reasonable.

Death declarations in academic medical centers are often the responsibility of physicians-in-training, and the degree of formal training these physicians receive is unknown. Additionally, given the paucity of recommendations in a death pronouncement, the exact examination performed to determine death also is unclear. This lack of training and discomfort in completing the examination is illustrated in a recent editorial by a family medicine intern who describes his first encounter in a death pronouncement.[5]

We conducted a survey of physicians to determine the rates of formal training in death declaration and which specific examination techniques are used by physicians to declare a patient deceased. With this information, we aimed to develop an algorithm, based on existing literature and the definition of circulatory-respiratory death, to aid examiners in pronouncing a patient deceased.

METHODS

An electronic survey was developed using REDCap®, an online assessment tool and data repository. Data were collected and stored on the University of Kansas Medical Center site, available through grant support from the Clinical and Translational Science Awards program. The institutional review boards at each institution approved this study.

Participants. Physicians from three academic, tertiary care hospitals (two affiliated with the University of Kansas, one private) were invited via email to participate. Informed consent was waived as accessing the electronic survey was considered implied consent.

Procedure. Potential participants were identified by sending an introductory email with the common survey link to all individual department or division chairs and administrative assistants for distribution through their department email listserv to all attending physicians, fellows, residents, and interns. Participants were asked if and when they received training in a death pronouncement, their perceived competence in death pronouncement, and which examination components they assessed as part of the examination. Specific information requested through this survey is listed in Table 2.

Table 2. Survey tool.

What is your current level of practice?	• Intern • Resident • Fellow • Staff physician
What is your medical specialty?	• [fill in]
What medical facility are you affiliated with?	• Institution A • Institution B • Institution C
Have you ever received formal training in completing a death examination? (Not brain death)	• Yes • No
When did you receive this training?	• Medical school • Internship • Residency • Fellowship • As staff
Do you feel competent in the pronouncement of death (excluding brain death)?	• Yes • No
What components do you assess when completing a death examination? (choose all that apply) (Not brain death)	• Responsiveness to voice • Spontaneous respirations • Heart sounds • Peripheral pulse • Central pulse (i.e., carotid) • Pupillary light response • Corneal response • Oculocephalic response (Doll's Eyes) •Oculovestibular response (cold calorics) • Gag • Cough • Motor response to pain • Peripheral reflexes (i.e., patellar, biceps) • Other _____
Do you announce a time of death while in the patient's room?	• Yes • No
Have you ever pronounced a patient deceased who had not yet passed away?	• Yes • No

Statistical Analysis. A primary interest of the pilot survey was to summarize the clinical practice of determining death. The components assessed by physicians when determining death became the focus of the analysis. Five respondents did not select any exam components and completed less than 25% of the survey, and were not included in the analysis.

Neurologic responsiveness was defined as assessing any one of the following clinical examination components: responsiveness to voice, pupillary light response, corneal response, oculocephalic response, oculovestibular response, cough, gag, motor response to pain, or peripheral reflexes. Chi-square tests were used to compare trained and untrained respondents using particular components when determining death. A significance level of 0.05 was used and no corrections for multiple testing were made. The analysis was completed with SAS software, version 9.4 of the SAS System for Windows.

RESULTS

Overall distribution of the survey included 42 separate division or departmental chairs across the three study institutions, with physicians from 23 different departments/divisions responding, for an overall response rate of 54.8%. The specific number of survey recipients is unknown as individual distribution of the survey was not possible. Five respondents did not respond to any of the physical examination questions and were excluded from the final analysis.

Of the 225 respondents, most were attending physicians (n = 118, 52.4%), followed by residents (n = 68, 30.2%), fellows (n = 23, 10.7%), and interns (n = 15, 6.7%; Figure 1). The departments of neurology and anesthesiology were represented most highly in this study.

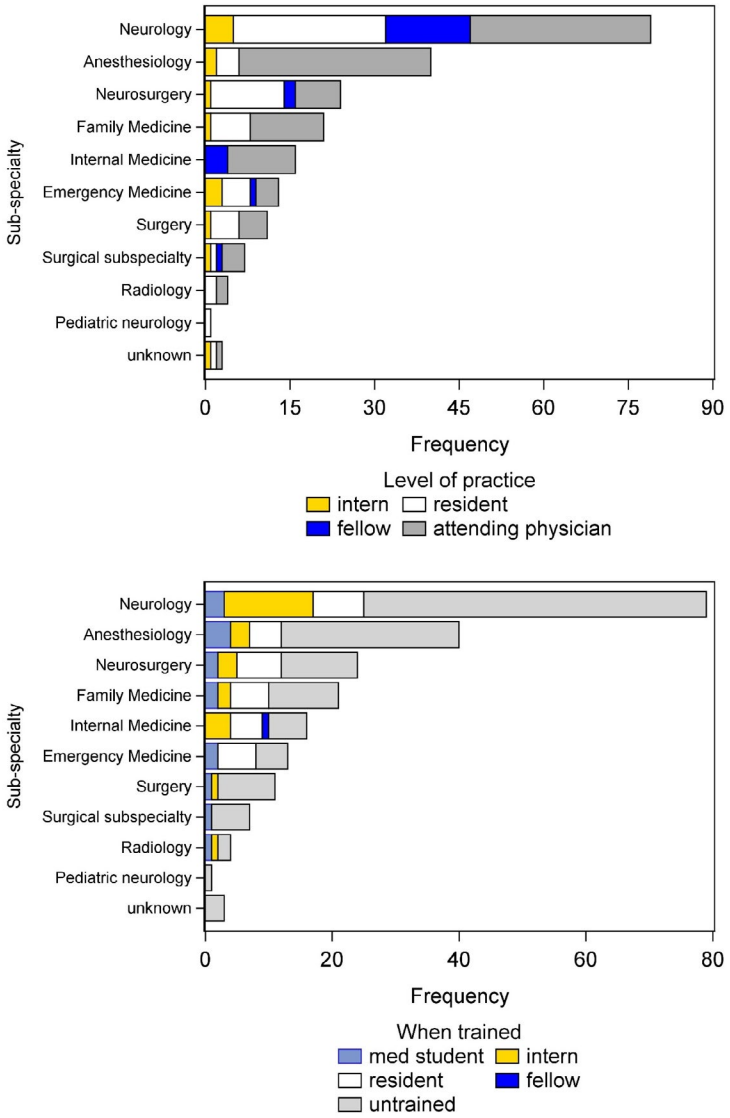

Figure 1. Sub-specialty representation, level of training, and timing of training amongst survey respondents.

Most physicians (62.7%) indicated they had received no formal training in performing a death pronouncement. For those who had formal education, training most often occurred during residency (45.2%) and internship (33.3%). Most respondents (78.7%) reported self-perceived competence in the determination of death. When separated by level of training, only 6.7% of interns (1 of 15 respondents) reported formal training in death declaration with 26% reporting self-competency (4 of 15 respondents). Conversely, 33% of residents and fellows and 36% of attending physicians reported formal training, while 82% and 77% self-reported competency, respectively.

The frequencies of examination techniques used by the study's cohort in the determination of death are listed in Table 3. Most respondents reported assessing breath sounds (97%), listening for heart sounds (90%), and checking central pulses (79%); while the majority of those surveyed reported some assessment of neurological responsiveness, with pupillary response being evaluated most often. Neurologists or neurosurgeons evaluated at least one component of the neurologic examination 85.6% of the time, while non-neurology specialties reported assessing at least one component of the neurologic examination 87.5% of the time. Somewhat surprisingly, there was no statistical difference in the frequency of a single physical examination component between those who were trained in death pronouncement and those who were not (Table 3), as indicated by the overlapping confidence intervals among the two groups. However, 95 different examination combinations were used to declare a patient deceased by the survey cohort.

Table 3. Examination components of circulatory-respiratory death determination.

	Trained in death declaration			
	Not trained, n = 138		Trained, n = 82	
Exam component	n (% of column)	95% CI	n (% of column)	95% CI
Respirations	132 (96%)	(90.8, 98.4)	81 (99%)	(93.4, 100.0)
Heart sounds	123 (89%)	(82.7, 93.8)	75 (91%)	(83.2, 96.5)
Central pulse	106 (77%)	(68.9, 83.6)	68 (83%)	(73.0, 90.3)
Pupils	90 (65%)	(56.6, 73.1)	58 (71%)	(59.6, 80.3)
Voice response	83 (60%)	(51.5, 68.4)	56 (68%)	(57.1, 78.1)
Peripheral pulse	75 (54%)	(45.7, 62.8)	45 (55%)	(43.5, 65.9)
Painful stimulus	65 (47%)	(38.6, 55.8)	41 (50%)	(38.7, 61.3)
Corneal response	57 (41%)	(33.0, 50.0)	34 (41%)	(30.7, 52.9)
Gag	37 (27%)	(19.6, 35.0)	25 (30%)	(20.8, 41.6)
Oculocephalic	36 (26%)	(19.0, 34.2)	16 (20%)	(11.6, 29.7)
Cough	28 (20%)	(13.9, 28.0)	15 (18%)	(10.6, 28.4)
Oculovestibular	22 (16%)	(10.3, 23.1)	10 (12%)	(6.0, 21.3)
Peripheral reflexes	15 (11%)	(6.2, 17.3)	7 (9%)	(3.5, 16.8)
Other finding	15 (11%)	(6.2, 17.3)	8 (10%)	(4.3, 18.3)

Large variation was seen across respondents in the reported use of a neurological examination in their assessment. Examination techniques included assessment of pupillary responses, corneal responses, gag reflex, oculocephalic reflex, cough reflex, and peripheral neurological reflexes. Forty-eight percent of all respondents reported the assessment of central responses to painful stimuli and formal assessment of coma.

When comparing the examination performed based on level of training, 100% of interns reported checking for breath sounds, while only 66.7% assessed heart sounds, and 26.7% checked peripheral pulses. Comparatively, greater than 90% of all other physician groups reported using all three of these examination components.

A substantial majority of respondents (75.2%) announced a time of death while in the patient's room. Two individuals (0.9%) reported incorrectly pronouncing a patient as deceased, but the circumstances of these pronouncements were otherwise unknown. Of interest, 11% of all physicians reported using means other than a clinical examination in death determination, such as ultrasound to confirm cardiac standstill (3.1%), evaluation using cardiac telemetry (3.1%), and absence of vital signs for greater than 15 minutes (0.4%).

DISCUSSION

Performing a complete and accurate examination for death determination is a necessary skill that should be learned early in medical training. Yet, the survey results suggested that formal training often was lacking. Physicians self-reported a variable degree of competence, with interns reporting less competence than more experienced physicians.

In the traditional hierarchy of academic medical education, death declaration has primarily been the responsibility of physicians-in-training at academic medical centers in the U.S. However, only one of the interns in this study reported receiving formal training in death declaration, and a substantial minority felt competent. Additionally, only one-third of all responding physicians reported formal training in death declaration throughout their medical career. Despite such a large gap in training, over two-thirds of respondents reported self-perceived competency when pronouncing death. Over time, competence appears to increase, which is likely a consequence of accumulated experience.

When performing a pronouncement, physicians reported performing many different examination combinations. This result emphasized the lack of standardization in clinical practice, and this inconsistency may indicate an insufficient understanding of the definition of circulatory-respiratory death, further complicating the development of a formal training program for new physicians.

Most of the respondents reported completing an assessment of breath sounds, heart sounds, and central pulses, while about half of those surveyed reported an assessment of the nervous system (i.e., pupillary response, corneal response). Interns were less likely to perform cardiac auscultation as compared to residents, fellows, or attending physicians.

Published acceptable minimum standards for circulatory death recommended assessment of responsiveness to pain and pupillary light reaction in addition to cardio-pulmonary auscultation and palpation of central pulses.[1] Only two-thirds of the cohort reported compliance with the neurological standard in this guideline. In contrast, the

UDDA defined death as either total failure of the circulatory-respiratory system or irreversible loss of all brain functions.[1] One could argue that the assessment of pain after identifying the absence of cardiac and pulmonary function does not make physiologic sense. Additionally, it is fully possible for a patient to have unreactive pupils (due to an upper brainstem, cranial nerve III lesions, or post-surgical pupillary abnormalities) but not be deceased.[6] These latter points may make the neurologic assessment in the setting of cardiopulmonary failure unnecessary to determine death.

Of note, it is important to emphasize that the definition of clinical death may not be documented formally or defined in the same manner in countries outside of the U.S., and these findings cannot be extrapolated to suggest international practice is similar, as no hospitals outside of the U.S. were surveyed.

In the U.S., death may be declared within a protocol for DCD in patients who are not brain dead but have a brain injury that they cannot survive. Discussion related to declaration in DCD was out of the scope of this paper; however, it is important to note that guidelines related to this process include a defined waiting period prior to the death pronouncement.[7] Such a waiting period was developed to account for the possibility of autoresuscitation, which is a rare but important phenomenon that should be considered during formal death declaration. In patients who have undergone CPR, autoresuscitation times have ranged from 30 seconds to 10 minutes.[3,4] In patients who did not receive CPR or underwent withdrawal of life sustaining therapies, times have ranged from seconds to three minutes.[8,9] These data suggested that a defined waiting period prior to death declaration in all patients is reasonable. In this study, two of the respondents indicated that they incorrectly had pronounced a patient deceased. The details behind such situations were not disclosed; however, it is plausible that autoresuscitation or simply an incomplete assessment of circulatory-respiratory function may have played a role.

Of interest, three-quarters of the respondents in this survey announced time of death while in the patient's room. Though time of death is legally necessary for documentation, no formal recommendation regarding an audible pronouncement exists. Calling out the time of death while in a patient's room may lead to unease amongst staff and undue psychological stress on the patient's family. We do not believe that stating the time of death aloud is necessary to complete a formal death pronouncement. On the same token, physicians cannot leave any uncertainty when performing a death pronouncement, and audibly indicating that the patient has died is necessary to prevent confusion by family members that are present for the clinical examination.

Study results indicated wide variability among physicians from multiple specialties in the degree of formal training on death determination and the examination performed. To help fill this gap, we propose an algorithm for circulatory-respiratory death pronouncement, based on the definition provided in the UDDA, existing evidence, and expert opinion, which is detailed in Figure 2. The authors are hopeful that providing a standardized method for death pronouncement, a clear mechanism for training can be developed, improving physician confidence and competence in this examination.

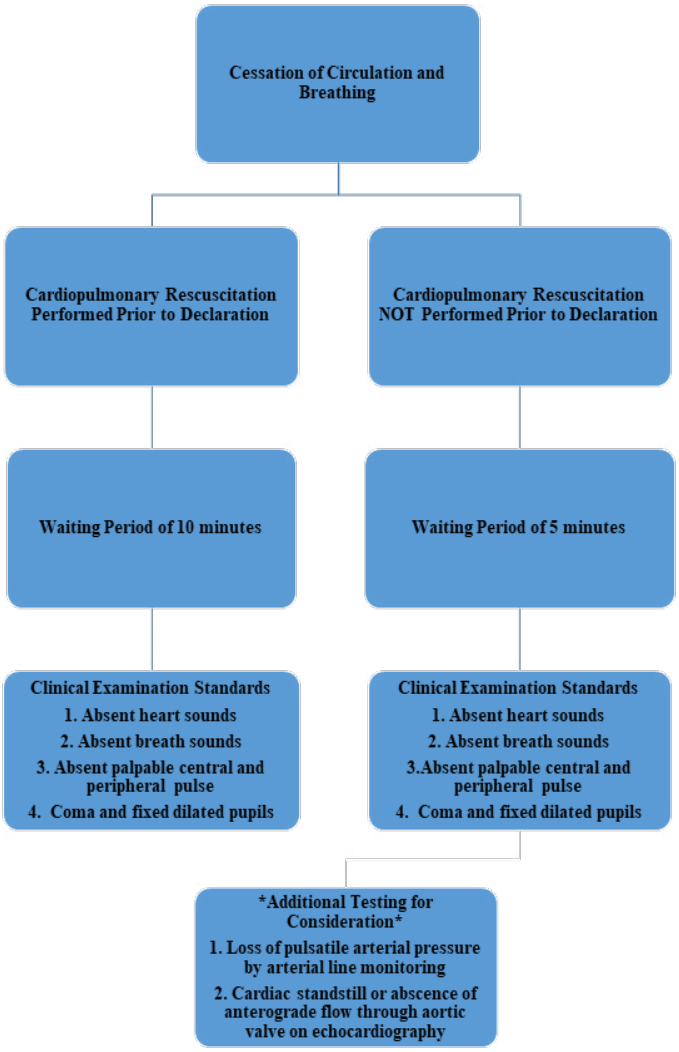

Figure 2. Proposed algorithm for circulatory-respiratory death declaration.

This survey-based study had limitations. The study design was dependent on individual department chairs, division heads, and administrators to distribute the email to the physician members of their department. Consequently, the responses are not from a random sample. As physicians-in-training and practicing physicians in the U.S. may have received some or all of their training outside of the U.S., information regarding differences in training based on location may be lacking, as this was not collected as a part of this survey. A low response rate impaired the ability to evaluate the current clinical practice completely across the study sites. There was the possibility that respondents misread components of the survey and inaccurately answered the questions as a result. Results were limited in the data analysis because not all providers answered every question included in the survey.

CONCLUSIONS

Formal training in death declaration often was missing and clinical practice varied among physicians in academic medical centers. Implementation of formal training in medical school or during internship is necessary to fill this important gap, eliminate discrepancies in practice, and guarantee the reliability of the death declaration.

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