Published in final edited form as:

Pediatrics. 2017 July ; 140(1): . doi:10.1542/peds.2017-0087.

Variations in Cause-of-Death Determination for Sudden Unexpected Infant Deaths

Carrie K. Shapiro-Mendoza, PhD, MPH[a], **Sharyn E. Parks, PhD, MPH**[a], **Jennifer Brustrom, PhD**[b], **Tom Andrew, MD**[c], **Lena Camperlengo, DrPH**[a], **John Fudenberg, D-ABMDI**[d], **Betsy Payn, MA**[b,e], and **Dale Rhoda, MSPH**[b,f]

[a]Division of Reproductive Health, Centers for Disease Control and Prevention, Atlanta, Georgia

[b]Battelle, Seattle, Washington

[c]Office of the Chief Medical Examiner, Concord, New Hampshire

[d]Clark County Office of the Coroner/Medical Examiner, Las Vegas, Nevada

[e]Department of Psychiatry, University of Washington, Seattle, Washington

[f]Biostat Global Consulting, Worthington, Ohio

Abstract

OBJECTIVES—To quantify and describe variation in cause-of-death certification of sudden unexpected infant deaths (SUIDs) among US medical examiners and coroners.

METHODS—From January to November 2014, we conducted a nationally representative survey of US medical examiners and coroners who certify infant deaths. Two-stage unequal probability sampling with replacement was used. Medical examiners and coroners were asked to classify SUIDs based on hypothetical scenarios and to describe the evidence considered and investigative procedures used for cause-of-death determination. Frequencies and weighted percentages were calculated.

RESULTS—Of the 801 surveys mailed, 60% were returned, and 377 were deemed eligible and complete. Medical examiners and coroners classification of infant deaths varied by scenario. For 3

Address correspondence to Carrie K. Shapiro-Mendoza, PhD, MPH, Division of Reproductive Health, Centers for Disease Control and Prevention, MS F74, 4770 Buford Highway, NE, Atlanta, GA 30341. ayn9@cdc.gov.

Dr Shapiro-Mendoza led the conceptualization and design of the study, analyzed and interpreted the data, drafted the initial manuscript, and revised the manuscript; Dr Parks Brown participated in interpretation of the data and critically reviewed the manuscript; Drs Brustrom and Andrew and Mr Fudenberg assisted with study design and survey development and reviewed drafts of the manuscript; Dr Camperlengo conceptualized and designed the study, participated in interpretation of the data, and critically reviewed the manuscript for important intellectual content; Ms Payn assisted with study design and survey development, led the overall implementation of the study, and reviewed drafts of the manuscript; Mr Rhoda designed the sampling approach, selected the sample, calculated the survey weights, and oversaw the analysis of the survey data; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

FINANCIAL DISCLOSURE: Dr Brustrom, Ms Payn, and Mr Rhoda were employed by Battelle while the CDC contract was being performed to collect the data used in this manuscript; the other authors have indicated they have no financial relationships relevant to this article to disclose.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

scenarios portraying potential airway obstruction and negative autopsy findings, 61% to 69% classified the death as suffocation/asphyxia. In the last scenario, which portrayed a healthy infant in a safe sleep environment with negative autopsy findings, medical examiners and coroners classified the death as sudden infant death syndrome (38%) and SUID (30%). Reliance on investigative procedures to determine cause varied, but 94% indicated using death scene investigations, 88% full autopsy, 85% toxicology analyses, and 82% medical history review.

CONCLUSIONS—US medical examiners and coroners apply variable practices to classify and investigate SUID, and thus, they certify the same deaths differently. This variability influences surveillance and research, impacts true understanding of infant mortality causes, and inhibits our ability to accurately monitor and ultimately prevent future deaths. Findings may inform future strategies for promoting standardized practices for SUID classification.

Medical examiners and/or coroners (ME/Cs) rely on a comprehensive review of medical records, death scene investigation, and postmortem examination to determine cause of death for death certification.[1] For infant deaths, a detailed description of the sleeping environment and evidence of airway obstruction are especially important to distinguish between sudden infant death syndrome (SIDS), accidental suffocation, and other causes that are not immediately apparent.[1,2] However, because these sudden unexpected infant deaths (SUID) often occur during sleep and are usually unwitnessed, a clear description of the circumstances surrounding death is not easily obtained. Moreover, although death investigation guidelines[3–5] exist, the degree to which investigators follow these guidelines in a standardized manner is uncertain.[6] Inconsistent reporting practices have implications for research and surveillance. Lack of standardized practices for investigation and cause-of-death determination result in inconsistent mortality estimates, which hinder accurate evaluation of temporal trends in mortality or changes in potentially hazardous factors. Because death certificate data are used to track state and national SUID trends, it is critical that death certificates be filled out accurately.

US mortality data from 1999 to 2001 suggest that ME/Cs are classifying fewer SUID cases as SIDS in favor of other causes, such as unknown or unspecified causes and unintentional sleep-related suffocation (eg, asphyxiation from overlay, entrapment, or soft objects and loose bedding).[7,8] Reasons for this diagnostic shift are not fully understood but likely reflect changes in diagnostic preferences, stricter adherence to SIDS definitions, and improved death scene investigations.[8, 9]

We surveyed ME/Cs to increase our understanding about how death certifiers interpret investigation findings and report SUID. Our study objectives were as follows: (1) to describe and quantify variation in reporting by asking ME/Cs to classify SUID based on hypothetical case scenarios, (2) to describe and quantify the types of evidence used by death certifiers in determining cause of death for SUID, and (3) to determine the frequency of case investigation procedures used to make SUID cause-of-death determinations. Accurate estimates can result in improved availability and allocation of resources to develop effective interventions. Understanding cause-of-death determination practices could lead to improved knowledge about infant mortality causes, and it would help pediatric providers convey more reliable information about SUID causes and risk factors to parents and other infant caregivers.

METHODS

We conducted a cross-sectional study of US ME/Cs from January to November 2014. To obtain a nationally representative sample, we estimated that 2000 individuals certify infant deaths in the United States (R. Hanzlick, MD, Past President of the National Association of Medical Examiners, personal communication, 2013), and randomly selected a sample of 801 certifiers, or 40% of this group. The sampling approach used a 2-stage unequal probability design with replacement, with counties as the primary sampling units. In the first stage, counties were randomly selected up to 3 times from a list including all US counties and the District of Columbia. Each county's probability of selection was proportional to the number of SUID in 2005–2009. SUID included infant deaths (<1 year old) with an underlying cause-of-death code R95 (SIDS), R99 (unknown cause), or W75 (accidental suffocation and strangulation in bed). In counties with zero SUID, the probability of selection was smaller than that for any county with 1 or more SUIDs and was proportional to the number of births in that county in 2005–2009. Contact information for ME/C offices was primarily obtained from the National Public Safety Information Bureau Database, purchased through SafetySource.com, and secondarily from Internet searches. From each selected county, a list of individuals responsible for certifying infant deaths was created by contacting the county or state offices. In the second sampling stage, individual certifiers were randomly selected from the list of certifiers for their county. Probability of selection was uniform within counties, and each individual could only be selected once (no replacement). One certifier was selected for counties selected into the sample once; 2 were selected for counties selected twice, and 3 were selected for counties selected 3 times. For counties in which infant deaths were certified at the state level, the state-level medical examiners were incorporated into the frame for that county. For counties with fewer ME/Cs than the total sampled, we used a replacement protocol, which selected the next appropriate county in the order sampled.

Selected ME/Cs received a survey by mail and a $10 incentive. Two weeks after the initial mailing, a thank you/reminder postcard was sent to encourage survey completion and thank those who had completed the survey. Follow-up calls were made to individuals who did not return their survey. Altogether, 801 ME/Cs were invited to participate in the survey.

The survey included questions about ME/Cs' demographic characteristics, hypothetical case scenarios, reporting practices, and knowledge and opinions about SUID (Supplemental Information). All questions and case scenarios were written in consultation with a small team of ME/Cs. Scenarios were representative of actual SUID cases. The survey was pretested and modified based on feedback from a convenience sample of 9 ME/Cs. ME/Cs who pretested the survey, or who were consulted during survey development, were ineligible to participate.

ME/Cs were asked to complete the cause-of-death section of a death certificate for 4 different hypothetical infant death case scenarios (Supplemental Information). To quantify responses, we grouped reported causes of death into 9 major categories: SIDS, suffocation/

asphyxia, SUID, undetermined/unknown, SIDS versus SUID, SIDS or SUID versus suffocation, explained (not suffocation), pending/defer to pathologist, and nonspecific causes (respiratory arrest). We considered the underlying cause of death first, but when the underlying cause was nonspecific (eg, respiratory arrest), other cause-of-death fields were considered.

To understand the decision-making practices used when determining cause of death as suffocation, overlay, wedging, and neck compression or hanging, ME/Cs were asked, "Which evidence or factors might cause you to make a cause-of-death determination of … [suffocation, overlay, wedging, and neck compression or hanging]" (Supplemental Information).

To understand interpretation and reporting practices, participants were asked, "To make a determination of cause of death for sudden unexpected and unexplained infant deaths in your jurisdiction(s), how frequently are each of the following procedures used?" (Supplemental Information). For each listed procedure, possible responses were "completed routinely," "completed on a case-by-case basis," "never completed," or "not sure."

Survey responses were weighted in a multistep process to make analyses representative of the US infant-death certifier population. First, a base weight was calculated using sampling probabilities for the county and for the respondent within the county. Next, weights were adjusted for nonresponse within 10 deciles of numbers of births per county over the 5-year period used to establish sampling probabilities. Because ME/Cs from counties with more births were more likely to respond to the survey, we adjusted weights to approximate a constant response rate across deciles. Next, the weights were poststratified so that respondents from counties with zero recorded infant deaths over the 5 years used for sampling probabilities would account for 3.6% of the weight in the survey. Those counties accounted for 3.6% of all US births during that 5-year period. The remaining counties accounted for 96.4% of the weight in the survey. Finally, the weights were scaled to total 2000, the estimated number of professionals who certify US infant deaths.

Frequencies, weighted percentages, and 95% confidence intervals (CIs) were calculated to describe the distribution of responses for all categorical variables. All 95% CIs for proportions accounted for the complex sample design by using analysis weights, a finite population correction, and limits calculated with the modified Wilson procedure.[10] Sampling was conducted with Stata version 12 and analyses were conducted with Stata version 14 (StataCorp LLC, College Station, TX). This survey was approved by the Institutional Review Board of Battelle Memorial Institute.

RESULTS

Of the 801 surveys mailed, 483 (60.3%) were returned and 377 (47.1%) were deemed eligible and complete. Ineligible respondents were those who indicated they did not make manner and cause-of-death determinations ($n = 46$) or who refused to participate ($n = 50$). Surveys with extensive missing information or that were returned after the study deadline were excluded ($n = 10$).

Most ME/Cs were ≥50 years old and male (Table 1). Among medical examiners, 97% reported postgraduate study, whereas 3% reported having a 4-year college degree or less. Among coroners, 32% reported postgraduate study, and another 21% reported having a 4-year college degree. Nearly 47% of coroners reported having less than a 4-year college degree. Approximately one-third of the study population had more than 15 years of experience as a ME/C and 59% reported working in a county coroner office. The size of the jurisdiction served varied, with 24% of ME/Cs serving small jurisdictions, 44% serving medium-sized jurisdictions, 25% serving large jurisdictions, and 7% not responding.

The cause-of-death determinations for each case scenario are shown in Table 2. For scenarios 1 to 3, 64% to 77% of ME/Cs classified the cause of death as suffocation or asphyxia. Other cause-of-death classifications were reported <15% of the time. SIDS was rarely reported (<2%). For scenario 4, the most frequently reported classifications were SIDS (38%) and SUID (30%). Less than 1% used suffocation or asphyxia to describe this case scenario. When examined by educational attainment, patterns remained similar. However, for Scenario 4, approximately a quarter of ME/Cs with postgraduate study classified the case as undetermined/unknown, whereas those with less education more frequently reported the case as no response or pending/defer to the pathologist.

In a question unrelated to the scenarios regarding general practices, 50% (95% CI 39%–61%) reported using SIDS as a cause for death certification. Those who used the term SIDS reported a variety of definitions that included, but were not limited to, those published by Beckwith, [11] Krous et al, [12] and Willinger et al.[1]

The type of evidence that certifiers indicated might lead them to make a cause-of-death determination of suffocation, overlay, wedging, and neck compression or hanging varied by cause (Table 3). For suffocation, the 3 most frequently reported types of evidence or factors in determining cause of death were a blanched lividity consistent with nose and mouth obstruction (81%), a statement that the infant's nose and mouth were obstructed (78%), and the infant laying on pillows or soft bedding (74%). The 3 most frequently reported evidence or factors for making an overlay determination were a statement from the bed-sharer that overlay occurred (81%), a lividity pattern consistent with reported circumstances (78%), and sharing a sleep surface (77%). For the determination of wedging as the cause of death, the infant body still in wedged position (88%), a lividity pattern consistent with reported circumstances (78%), and positive signs of asphyxia (71%) were the 3 most frequently reported evidence or factors. Finally, for determination of neck compression or hanging as the cause of death, the infant body still in compress or hanged position (88%), ligature or other compression marks on neck (85%), and a lividity pattern consistent with reported circumstances (76%) were the factors or evidence most frequently selected.

Routine use of procedures to make cause-of-death determinations for SUIDs also varied (Table 4). Ninety-four percent of ME/Cs selected routine completion of death scene investigations. More than 80% of ME/Cs selected review of medical records, complete autopsy, and toxicology analyses as routine procedures they used to make a SUID determination. Metabolic screening was another commonly selected procedure done routinely or on a case-by-case basis (81% of the time). Radiology and histology were selected as being routinely completed ~60% of the time. Genetic testing (7%) and genetic tests for cardiac channelopathies (6%) were among the procedures least often completed, and these procedures were never completed by approximately one-third of ME/Cs (30% and 36%, respectively). When examined by educational attainment, patterns remained similar (data not shown).

DISCUSSION

This national survey of ME/Cs increases our understanding of death certifiers' processes for interpreting investigation findings and reporting SUID causes. Given 4 different SUID case scenarios, ME/Cs did not universally agree on how to classify these deaths. Important differences were not observed by education level. For 3 scenarios, approximately two-thirds to three-quarters of ME/Cs agreed that either suffocation or asphyxia was the appropriate cause-of-death determination. In the last scenario, nearly all ME/Cs agreed that the cause of death was not suffocation or asphyxia, and deaths were reported by using 1 of 3 terms: SIDS, SUID, and undetermined/unknown. Findings from this scenario and a follow-up question revealed that ME/Cs do not universally use the term SIDS to classify unexplained infant deaths. Our analyses also indicated that certifiers do not consider the same types of evidence to classify deaths as suffocation, overlay, wedging, and neck compression or hanging.

Finally, procedures routinely used to make a cause-of-death determination were highly consistent among survey respondents. It is encouraging that most ME/Cs reported using a combination of a death scene investigation, autopsy, and review of the medical record when making a cause-of-death determination for SUID, the 3 essential elements of a SUID investigation.[1] It is important to note that the 4 scenarios did not have correct answers. The survey was designed to elicit and represent the full range of responses death certifiers typically use for SUID. The variability in our results helps to demonstrate the importance of having a standardized process for certifying these deaths and the importance of getting certifiers to agree on a minimal set of criteria to define suffocation/asphyxia among infants.

Our finding that ME/Cs do not universally use SIDS as a cause-of-death determination is consistent with other reports.[6,13,14] Those who do designate SIDS as a cause of death apply a variety of definitions. Findings about the variation in procedures used to make cause-of-death determinations are consistent with a recent National Academy of Sciences (NAS) report.[15] The report, although not specific to SIDS, SUID, or infant deaths, reported variability in case investigation practices and concluded that inconsistent practices were because of a lack of standardized practices and training as well as the variety of US ME/C jurisdictional system types.

Our results differ from the Brooks and Gill[16] study that examined the frequency of infectious disease testing among SUID investigations. In that study, >95% of ME/Cs reported routinely performing histology and >90% reported routinely performing viral studies (ie, culture or molecular diagnostics) for SUID. Differences in findings may relate to differences in study design and response rates. The Brooks and Gill[16] study was restricted to US ME/C offices serving populations >300000 people and had a 29% response rate.

Our study has several strengths, including a sampling design that represents ME/Cs from all US states and the District of Columbia, a large sample size (nearly 400), a sample representative of the underlying population of death certifiers with respect to the distribution of the SUID, and a sample representative of individual death certifier practices rather than office practices. Notwithstanding, we also recognize some limitations. First, the response rate was less than optimal, although better than other recent surveys of this population.[16, 17] More specifically, the response rate was lower when the certifier selected into the sample was a state-level medical examiner. However, given the variability in responses to questions, it is unlikely that nonresponse bias would change the interpretation of our findings. Also, the study population demographic composition is similar to the demographic composition of the general ME/C population that certifies infant deaths.[6] A second limitation is that scenarios were hypothetical, and the reported responses may not reflect actual practices in real situations. Finally, response options about evidence and factors considered in making a cause-of-death determination may not have fully captured a death certifier's decision-making process. For example, some ME/Cs may attribute SIDS risk factors such as prone sleeping and bed-sharing as factors in the sleep environment that likely led to death by suffocation, even with limited scene evidence about these factors causing airway obstruction. However, responses were based on a list of preselected options, and participants could choose “other” and specify other evidence or factors not listed.

It was outside the study's scope to fully understand why reported responses were selected and what these responses meant to the death certifier. For example, when a participant selected positive signs of asphyxia as a type of evidence they considered when making a cause-of-death determination, it is unknown if the certifier perceived this evidence as consistent with or diagnostic of a particular classification. We also do not know how participants defined positive signs of asphyxia, although in the first scenario they were told that ocular petechiae was an example of a positive sign. Understanding the decision-making process of the death certifier merits further study.

This survey allowed us to quantify the magnitude of variation in cause-of-death determination and investigation practices for SUID among ME/Cs. Findings highlight the lack of a uniformly applied and systematic approach to cause-of-death determination despite repeated calls for such.[2,15] Death certifiers need to develop mutually acceptable criteria and definitions to make cause-of-death determinations reliably and accurately, especially to differentiate suffocation and asphyxia from other SUID causes.[18–21] The NAS report highlights several factors that negatively impact progress toward developing and disseminating standardized best practices related to medicolegal investigation, including variation in medicolegal death investigation systems, unequal levels of expertise, and lack of resources for medicolegal professionals (eg, facilities, equipment, staff, and training).[15] Until we address these limitations, accurate and reliable cause-of-death determination for SUID will remain a challenge.

Several promising strategies, if implemented, could address the limitations and improve practices. First, the accreditation processes for the National Association of Medical Examiners and the International Association of Coroners and Medical Examiners could place greater emphasis on standardizing the review of SUID. Second, per NAS recommendations, the number of board-certified forensic pathologists who determine cause of death could be increased. Although coroners often refer cases to forensic pathologists for autopsy, there are no built-in measures to ensure that the cause-of-death determinations by the pathologist align with the final death certification cause reported by the coroner. Third, medicolegal offices could hire and train more certified medicolegal death investigators. On June 21, 2016, the National Commission on Forensic Science voted unanimously to adopt recommendations requiring all medicolegal death investigators be certified by 2020.

Variability in cause-of-death determination practices influences how SUID are ultimately reported and classified for surveillance and research purposes. This variability negatively impacts our knowledge of the causes of infant mortality as well as our ability to monitor and prevent future deaths effectively. Findings from this study may inform future strategies promoting standardized practices for medicolegal cause-of-death determination, especially for SUID.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

FUNDING: Supported in part by contract 200-2008-27956 from the Centers for Disease Control and Prevention.

ABBREVIATIONS

CI	confidence interval
ME/C	medical examiner and/or coroner
NAS	National Academy of Sciences
SIDS	sudden infant death syndrome
SUID	sudden unexpected infant death

References

1. Willinger M, James LS, Catz C. Defining the sudden infant death syndrome (SIDS): deliberations of an expert panel convened by the National Institute of Child Health and Human Development. Pediatr Pathol. 1991; 11(5):677–684. [PubMed: 1745639]
2. Corey TS, Hanzlick R, Howard J, Nelson C, Krous H. NAME Ad Hoc Committee on Sudden Unexplained Infant Death. A functional approach to sudden unexplained infant deaths. Am J Forensic Med Pathol. 2007; 28(3):271–277. [PubMed: 17721183]
3. Bajanowski T, Vege A, Byard RW, et al. Sudden infant death syndrome (SIDS)–standardised investigations and classification: recommendations. Forensic Sci Int. 2007; 165(2–3):129–143. [PubMed: 16806765]
4. Centers for Disease Control and Prevention. Guidelines for death scene investigation of sudden, unexplained infant deaths: recommendations of the interagency panel on sudden infant death syndrome. MMWR Morb Mortal Wkly Rep. 1996; 45(RR-10):1–22. [PubMed: 8531914]
5. Centers for Disease Control and Prevention. Sudden, Unexplained Infant Death Investigation Reporting Form. Atlanta, GA: Centers for Disease Control and Prevention; 2007.

6. Camperlengo LT, Shapiro-Mendoza CK, Kim SY. Sudden infant death syndrome: diagnostic practices and investigative policies, 2004. Am J Forensic Med Pathol. 2012; 33(3):197–201. [PubMed: 21030849]
7. Malloy MH, MacDorman M. Changes in the classification of sudden unexpected infant deaths: United States, 1992–2001. Pediatrics. 2005; 115(5):1247–1253. [PubMed: 15867031]
8. Shapiro-Mendoza CK, Tomashek KM, Anderson RN, Wingo J. Recent national trends in sudden, unexpected infant deaths: more evidence supporting a change in classification or reporting. Am J Epidemiol. 2006; 163(8):762–769. [PubMed: 16582034]
9. Byard RW. Changing infant death rates: diagnostic shift, success story, or both? Forensic Sci Med Pathol. 2013; 9(1):1–2. [PubMed: 22664792]
10. Brown LD, Cai TT, DasGupta A. Interval estimation for a binomial proportion. Stat Sci. 2001; 16(2):101–117.
11. Beckwith JB. The sudden infant death syndrome. Curr Probl Pediatr. 1973; 3(8):1–36.
12. Krous HF, Beckwith JB, Byard RW, et al. Sudden infant death syndrome and unclassified sudden infant deaths: a definitional and diagnostic approach. Pediatrics. 2004; 114(1):234–238. [PubMed: 15231934]
13. Byard RW, Marshall D. An audit of the use of definitions of sudden infant death syndrome (SIDS). J Forensic Leg Med. 2007; 14(8):453–455. [PubMed: 17961869]
14. Nashelsky MB, Pinckard JK. The death of SIDS. Acad Forensic Pathol. 2011; 1(1):92–99.
15. National Research Council (US). Strengthening Forensic Science in the United States a Path Forward. Washington, DC: National Academies Press; 2009.
16. Brooks EG, Gill JR. National Association of Medical Examiners NAME Ad Hoc Committee for Bioterrorism and Infectious Disease. Testing for infectious diseases in sudden unexpected infant death: a survey of medical examiner and coroner offices in the United States. J Pediatr. 2015; 167(1):178–182.e1. [PubMed: 25929979]
17. Schraeder PL, Delin K, McClelland RL, So EL. Coroner and medical examiner documentation of sudden unexplained deaths in epilepsy. Epilepsy Res. 2006; 68(2):137–143. [PubMed: 16423504]
18. Hunt CE, Darnall RA, McEntire BL, Hyma BA. Assigning cause for sudden unexpected infant death. Forensic Sci Med Pathol. 2015; 11(2):283–288. [PubMed: 25634430]
19. Moon RY, Byard RW. Need for a working classification system for sudden and unexpected infant deaths. Pediatrics. 2014; 134(1) Available at: www.pediatrics.org/cgi/content/full/134/1/e240.
20. Randall B, Donelan K, Koponen M, Sens MA, Krous HF. Application of a classification system focusing on potential asphyxia for cases of sudden unexpected infant death. Forensic Sci Med Pathol. 2012; 8(1):34–39. [PubMed: 22076787]
21. Shapiro-Mendoza CK, Camperlengo L, Ludvigsen R, et al. Classification system for the sudden unexpected infant death case registry and its application. Pediatrics. 2014; 134(1) Available at: www.pediatrics.org/cgi/content/full/134/1/e210.

WHAT'S KNOWN ON THIS SUBJECT

Medical examiners and coroners who certify infant deaths use nonstandard practices to investigate and classify sudden unexpected infant deaths.

WHAT THIS STUDY ADDS

Given hypothetical scenarios portraying infant deaths with negative autopsy findings and safe or unsafe sleeping environments with potential airway obstruction, medical examiners and coroners disagreed on cause-of-death classifications; only 50% said they use the sudden infant death syndrome classification.

TABLE 1

Characteristics of ME/Cs in the Sample Population

Characteristic	*N*	Unweighted %	Weighted % (95% CI)
Age, y			
20–29	2	0.5	1.8 (0.3–9.5)
30–39	32	8.5	14.8 (7.3–27.8)
40–49	90	23.9	18.4 (12.7–25.9)
50–59	128	34.0	33.9 (23.4–46.3)
60–69	93	24.7	22.9 (16.1–31.4)
70+	23	6.1	6.8 (3.7–12.2)
No response	9	2.4	1.4 (0.6–3.3)
Sex			
Male	273	72.4	70.5 (56.8–81.3)
Female	97	25.7	28.4 (17.6–42.3)
No response	7	1.9	1.1 (0.4–3.0)
Title or position			
Medical examiner	149	39.5	27.0 (19.2–36.5)
Coroner	148	39.3	47.1 (36.3–58.1)
Multiple or no response	80	21.2	26.0 (15.5–40.2)
Medical examiner and highest level of education attained			
High school graduate	0	0	0.0 (0.0–2.4)
Some college	1	0.7	1.0 (0.2–5.7)
2-y college graduate	1	0.7	5.3 (0.9–26.1)
4-y college graduate	3	2.0	1.3 (0.3–5.0)
Postgraduate study	144	96.6	92.4 (74.6–98.1)
Coroner and highest level of education attained			
High school graduate	8	5.4	5.1 (2.1–11.8)
Some college	36	24.3	22.5 (13.9–34.2)
2-y college graduate	25	16.9	29.9 (18.3–44.8)
4-y college graduate	31	21.0	13.7 (8.5–21.3)
Postgraduate study	48	32.4	28.8 (18.9–41.3)
Years of experience as a medical examiner or coroner			
<1	3	0.8	0.5 (0.1–2.2)
1–2	28	7.4	12.6 (5.9–24.7)
3–5	43	11.4	19.1 (9.8–34.0)
6–10	58	15.4	15.4 (9.4–24.3)
11–15	61	16.2	15.2 (10.0–22.4)
16–20	58	15.4	12.3 (7.7–19.0)
>20	120	31.8	23.7 (17.1–32.0)
No response	6	1.6	1.2 (0.5–2.9)
Type of office[a]			
State medical examiner office	34	9.0	10.9 (6.4–18.0)

Characteristic	*N*	Unweighted %	Weighted % (95% CI)
District/regional medical examiner office	41	10.9	7.2 (3.9–12.9)
County medical examiner office	100	26.5	12.7 (7.9–19.7)
City medical examiner office	8	2.1	0.4 (0.1–1.7)
District/regional coroner office	8	2.1	4.3 (1.8–9.9)
County coroner office	185	49.1	59.0 (48.2–69.0)
Private pathology office	1	0.3	0.3 (0.1–1.7)
Other	29	7.7	10.9 (6.2–18.5)
Unknown	2	0.5	0.3 (0.1–1.5)
Size of population the participant's office serves			
250 000 or more	189	50.1	25.1 (18.1–33.7)
25 000–250 000	141	37.4	44.4 (34.0–55.4)
Fewer than 25 000	40	10.6	23.5 (14.8–35.3)
Not sure or no response	7	1.9	6.9 (1.4–27.8)

[a]Indicates a question in which respondents could select all that apply, so *N* may sum to >377 and percent may sum to >100%.

TABLE 2

Case Scenarios by Frequency of Cause-of-Death Determinations by Highest Level of Educational Attainment

	All Educational Levels		Less Than 4-y College Graduate		4-y College Graduate		Postgraduate Study	
	N	Weighted	*N*	Weighted	*N*	Weighted	*N*	Weighted
Cause-of-death determination		**% (95% CI)**		**% (95% CI)**		**% (95% CI)**		**% (95% CI)**
Scenario 1								
Suffocation/asphyxia	303	76.7 (65.9–84.9)	67	76.6 (61.3–87.2)	38	71.3 (42.6–89.2)	195	79.0 (58.5–90.9)
No response	25	8.7 (4.9–15.2)	10	13.0 (5.6–27.2)	10	17.5 (5.7–42.7)	3	2.1 (0.3–13.2)
SUID[a]	21	8.4 (3.1–20.8)	1	0.3 (0.0–4.5)	5	4.9 (1.3–17.4)	15	15.5 (5.1–38.6)
Undetermined/unknown[b]	9	1.1 (0.4–2.7)	3	1.2 (0.2–6.1)	1	0.4 (0.0–7.1)	5	1.2 (0.4–3.7)
Pending/defer to pathologist[c]	7	3 (1.1–8.0)	4	4.6 (1.0–19.2)	1	3.4 (0.5–19.5)	2	1.7 (0.3–8.6)
SIDS versus SUID	5	1.4 (0.5–3.9)	4	3.1 (0.9–10.0)	1	2.3 (0.3–13.8)	0	0.0 (0.0–0.0)
(SIDS or SUID) versus suffocation	4	0.1 (0.0–1.3)	1	0.2 (0.0–4.4)	1	0.3 (0.0–6.8)	2	0.1 (0.0–1.8)
SIDS	3	0.5 (0.1–1.9)	2	1.0 (0.2–5.7)	0	0.0 (0.0–0.0)	1	0.4 (0.1–2.4)
Scenario 2								
Suffocation/asphyxia	272	70.7 (59.8–79.6)	68	72.8 (56.6–84.6)	40	76.7 (49.7–91.6)	162	6.72 (49.5–81.0)
SUID[a]	42	6.8 (3.7–12.2)	3	2.3 (0.6–7.8)	2	0.9 (0.1–7.9)	37	12.3 (6.0–23.5)
No response	19	10 (4.2–22.2)	6	6.9 (2.7–16.5)	7	11.9 (3.1–36.3)	4	11.1 (2.5–38.2)
Undetermined/unknown[b]	15	1.8 (0.9–3.8)	2	1.0 (0.2–5.8)	2	0.9 (0.1–7.8)	10	2.8 (1.1–7.0)
Pending/defer to pathologist[c]	14	5.9 (2.8–11.9)	7	10.3(3.4–27.0)	5	9.2 (2.7–26.6)	2	1.7 (0.3–8.6)
SIDS versus SUID	8	2.8 (1.2–6.4)	4	3.1 (0.9–10.0)	0	0.0 (0.0–0.0)	4	3 (1.2–11.3)
SIDS	4	1.3 (0.3–6.1)	1	3.5 (0.6–18.3)	0	0.0 (0.0–0.0)	3	0.3 (0.0–2.3)
(SIDS or SUID) versus suffocation	3	0.6 (0.1–2.4)	1	0.2 (0.0–4.4)	1	0.5 (0.0–7.2)	1	0.9 (0.1–5.7)
Scenario 3								
Suffocation/asphyxia	245	63.6 (52.8–73.2)	42	50.5 (34.2–66.8)	25	59.0 (28.1–84.2)	177	74.4 (55.4–87.1)
No response	35	13.7 (7.0–25.1)	21	19.2 (10.2–33.2)	8	14.3 (4.2–39.1)	3	9 (1.6–38.4)
Pending/defer to pathologist[c]	29	10.6 (6.3–17.4)	15	16.3 (7.5–32.0)	10	18.8 (6.8–42.1)	4	3.8 (1.0–13.9)
SUID[a]	28	5.1 (2.6–9.6)	4	5.9 (1.7–19.0)	6	3.1 (0.8–11.4)	18	5.2 (2.2–12.0)
Undetermined/unknown[b]	18	1.7 (0.8–3.5)	2	1.4 (0.3–6.9)	3	1.5 (0.2–8.9)	12	1.8 (0.7–4.6)

	All Educational Levels		Less Than 4-y College Graduate		4-y College Graduate		Postgraduate Study	
	N	Weighted	*N*	Weighted	*N*	Weighted	*N*	Weighted
Cause-of-death determination		**% (95% CI)**		**% (95% CI)**		**% (95% CI)**		**% (95% CI)**
Explained (not suffocation)[d]	16	3.5 (1.8–6.8)	7	5.9 (2.1–15.4)	4	2.8 (0.6–11.6)	5	2.2 (0.8–5.9)
SIDS	5	1.8 (0.5–6.2)	1	0.8 (0.1–5.4)	1	0.5 (0.0–7.2)	3	3.1 (0.7–13.1)
SIDS versus SUID	1	0.1 (0.0–1.1)	0	0.0 (0.0–0.0)	0	0.0 (0.0–0.0)	1	0.2 (0.0–2.0)
Scenario 4								
SIDS	135	37.9 (27.0–50.2)	26	38.5 (23.0–56.7)	18	49.4 (18.4–80.9)	91	33.9 (22.3–47.7)
SUID[a]	126	29.6 (20.6–40.4)	32	28.6 (16.5–44.7)	18	18.5 (7.1–40.2)	75	34.0 (20.0–51.4)
Undetermined/unknown[b]	57	14.2 (8.5–22.9)	7	5.5 (2.3–12.5)	7	6.0 (1.8–18.3)	43	23.5 (12.5–39.8)
No response	24	6.1 (3.4–10.8)	10	8.9 (4.0–18.5)	9	15.9 (4.9–40.8)	2	0.1 (0.0–1.9)
Pending/defer to pathologist[c]	17	8.4 (4.3–15.7)	11	14.2 (5.6–31.5)	2	6.1 (1.4–23.5)	4	5.3 (1.7–15.5)
SIDS versus SUID	16	3.3 (1.7–6.2)	6	4.3 (1.7–10.6)	2	2.5 (0.4–13.6)	7	2.8 (1.0–8.1)
Suffocation/asphyxia	2	0.5 (0.1–1.8)	0	0.0 (0.0–0.0)	1	1.5 (0.2–9.7)	1	0.4 (0.1–2.6)

For each scenario, the respondents' free-text answers were categorized to the single best-fit label from those listed here. The survey had a total of 377 respondents.

[a]SUID (includes sudden or unexpected, but not syndrome).

[b]Undetermined/unknown: undetermined, unknown, or uncertain.

[c]Pending/defer to pathologist: pending, needs more info, and defer to pathologist.

[d]Explained (not suffocation): pneumonia, other pulmonary conditions, and other causes.

TABLE 3

Type of Evidence or Factors That Participants Reported Might Cause Them to Make a Cause-of-Death Determination of Suffocation, Overlay, Wedging, and Neck Compression or Hanging

Cause of Death and Evidence Type	Weighted % (95% CI)
Suffocation (obstruction of the mouth and nose)	
Blanched lividity consistent with nose and mouth obstruction	80.8 (69.9–88.4)
Statement that infant's nose and mouth were obstructed	78.1 (66.3–86.6)
Infant laying on pillows or soft bedding	74.3 (63.4–82.8)
Positive signs of asphyxia	68.7 (57.9–77.9)
Doll re-enactment showing that nose and mouth were obstructed	65.1 (53.6–75.0)
Foamy/bloody fluid on object that obstructed nose and mouth	64.0 (53.1–73.6)
No other competing cause of death	25.7 (18.0–35.4)
Other	8.4 (4.5–14.9)
No response	8.7 (3.3–21.1)
Overlay	
Statement from bed-sharer that overlay occurred	81.0 (68.8–89.2)
Lividity pattern consistent with reported circumstances	78.4 (66.8–86.8)
Sharing a sleep surface	76.8 (66.0–85.0)
Positive signs of asphyxia	74.7 (64.2–82.9)
Doll re-enactment that shows overlay position	67.4 (55.9–77.2)
Intoxicated bed-sharer	66.8 (53.7–77.7)
Overweight adult or older child bed-sharer	54.8 (43.1–66.0)
No other competing cause of death	25.3 (17.8–34.5)
Other	9.1 (5.1–15.8)
No response	8.5 (3.1–21.0)
Wedging	
Infant body still in wedged position	87.8 (76.0–94.2)
Lividity pattern consistent with reported circumstances	78.1 (66.4–86.5)
Positive signs of asphyxia	71.4 (60.8–80.1)
Doll re-enactment that indicates probable wedging	69.6 (58.5–78.8)
Inebriation of adults	36.3 (27.0–46.6)
No other competing cause of death	26.4 (18.7–35.9)
Other	9.1 (5.1–15.9)
No response	8.2 (3.0–20.9)
Neck compression/hanging	
Infant body still in compressed/hanged position	88.1 (76.3–94.5)
Ligature or other compression marks on neck	84.5 (73.2–91.6)
Lividity pattern consistent with reported circumstances	75.7 (64.3–84.4)
Positive signs of asphyxia	73.8 (63.2–82.3)
Doll re-enactment that indicates probable neck compression/hanging	64.6 (53.2–74.6)
No other competing cause of death	22.6 (15.6–31.7)

	Weighted
Cause of Death and Evidence Type	**% (95% CI)**
Other	8.8 (4.8–15.6)
No response	8.1 (2.8–20.8)

Respondents could select >1 response, so percentages may sum to a number >100%. The survey had a total of 377 respondents.

TABLE 4

Procedures Used to Make a Cause-of-Death Determination for SUIDs

	Routinely	Case by Case	Never	Not Sure	No Response or Multiple Responses
	Weighted	Weighted	Weighted	Weighted	Weighted
Procedure	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Death scene investigation	93.8 (88.6–96.7)	3.4 (1.6–6.9)	1.7 (0.3–7.7)	0.0 (0.0–1.0)	1.1 (0.4–2.8)
Medical records review	81.7 (73.4–87.9)	11.7 (7.1–18.8)	2.2 (0.6–8.1)	0.0 (0.0–1.0)	4.4 (2.0–9.5)
Complete autopsy	88.0 (80.1–93.0)	7.6 (3.8–14.5)	1.4 (0.3–7.8)	1.9 (0.5–6.9)	1.0 (0.4–2.7)
Partial autopsy	6.9 (2.8–15.7)	21.3 (11.7–35.6)	46.1 (35.6–57.0)	5.5 (2.4–12.1)	20.3 (12.4–31.3)
Toxicology analysis	84.5 (73.2–91.6)	11.3 (5.1–23.1)	1.4 (0.3–7.8)	0.2 (0.0–1.3)	2.7 (1.1–6.1)
Radiology	58.7 (46.5–69.9)	31.3 (20.4–44.8)	2.6 (0.8–8.3)	3.2 (1.3–7.8)	4.1 (2.0–8.3)
Metabolic screen	48.0 (36.9–59.2)	33.3 (23.4–44.9)	5.1 (2.3–10.9)	8.4 (4.6–14.7)	5.3 (2.4–11.2)
Genetic testing	7.4 (4.4–12.1)	41.6 (31.6–52.4)	29.8 (18.9–43.5)	13.0 (8.3–19.7)	8.3 (4.6–14.6)
Microbiology	38.9 (29.7–48.9)	35.2 (24.3–47.9)	2.7 (0.9–8.2)	16.4 (9.1–27.8)	6.8 (3.4–13.1)
Vitreous electrolytes	40.1 (30.4–50.7)	32.7 (22.3–45.3)	3.1 (1.1–8.3)	17.6 (10.1–28.9)	6.5 (3.2–12.7)
Histology	61.8 (50.1–72.3)	18.7 (11.7–28.6)	2.5 (0.7–8.1)	11.1 (5.0–22.8)	6.0 (2.8–12.2)
Bacterial cultures	36.3 (27.5–46.0)	40.4 (29.4–52.4)	4.2 (1.8–9.6)	14.8 (7.9–26.1)	4.3 (2.2–8.3)
Viral cultures	30.3 (22.6–39.2)	42.9 (31.9–54.6)	4.6 (2.0–10.0)	16.8 (9.4–28.0)	5.6 (2.5–11.7)
Genetic testing for cardiac channelopathies	5.9 (3.2–10.6)	35.0 (25.8–45.6)	36.2 (25.2–48.9)	14.8 (9.6–22.0)	8.1 (4.2–14.8)