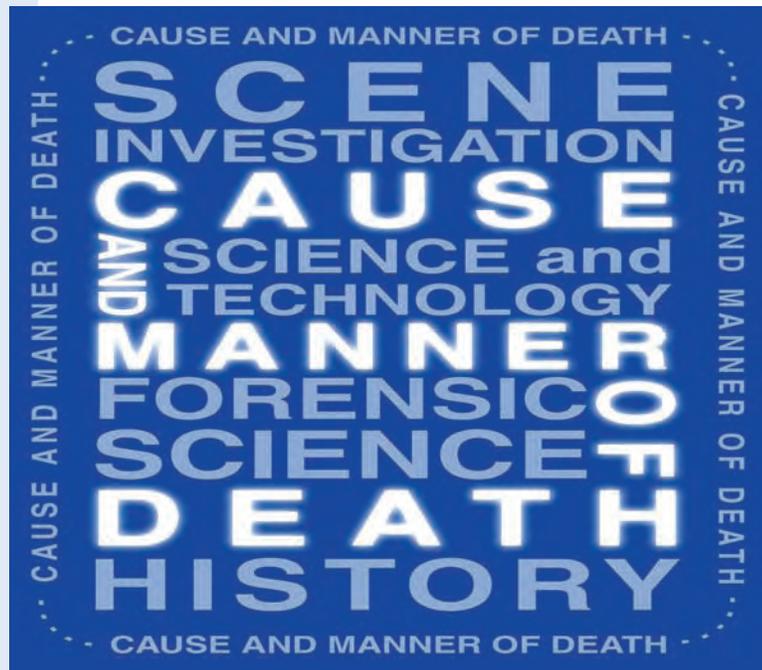


chapter 1



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Sudden, Unexplained Infant Deaths

Introduction

Unit 1: Types of Sudden, Unexplained Infant Death

Unit 2: Data Collection and Reporting Tools



In the world of death investigation, infant death investigation is unique. From scene through certification, these investigations require skill and knowledge drawn from disciplines outside those typically considered a part of medicolegal education. This chapter presents an overview of sudden, unexplained infant death, its typical causes, and the importance of the death scene investigation to accurate cause and manner of death determination.

OVERVIEW

The sudden, unexplained death of an infant is a tragic family event. Families experiencing such grief have the right to receive a thorough investigation, so they can understand the true medical causes of such deaths. In addition, parents and other caregivers deserve an investigation that is sensitive to their grieving state and not one that is accusatory or insensitive to the emotions they are feeling.

Sudden infant death syndrome (SIDS) is just one of several causes of sudden, unexplained death in infancy, but it is the most frequently reported. Since the early 1990s, SIDS rates have declined by more than 50%, in large part due to the national Back-to-Sleep Campaign's efforts to increase the number of infants placed on their backs to sleep. Despite this success, SIDS is still the third leading cause of infant mortality in the United States and remains an important public health priority.

Two recent U.S. studies provide evidence that cause-of-death reporting and classifying of sudden, unexplained infant deaths (SUID) may be unreliable. These studies found that the decline in the SIDS rate since 1999 was offset by an increase in mortality rates for accidental suffocation and strangulation in bed and for unknown/unspecified causes (Shapiro-Mendoza, Tomashek, Anderson, & Wingo, 2006; Malloy & MacDorman, 2005). Some deaths that were previously reported as SIDS are now reported as deaths due to accidental suffocation or unknown cause. This finding suggests that changes in reporting of cause of death might account for part of the recent decrease in rates of SIDS.

To address this change in reporting, we need (1) standardized data collection at infant death scene investigations and (2) consistent translation of DSI findings into cause-of-death on the death certificate. Standardizing and improving data collection at infant death scene investigations is essential to help the medical examiner and coroner accurately report the cause of death. Having accurate and reliable national reporting of SUID, including SIDS, is a priority goal for the Centers for Disease Control and Prevention (CDC). To achieve this goal, CDC collaborated with national organizations to develop comprehensive guidelines and training for death scene investigators.

To prevent these infant deaths, valid and reliable data are needed to support research and prevention efforts. Inaccurate reporting and non-standard practices of classifying infant deaths hinder the ability to (1) monitor trends in SUID, (2) conduct research to identify risk factors, (3) design interventions to prevent these deaths, and (4) evaluate programs aimed at prevention.

This chapter lists each of the leading causes of SUID and describes some scene data collection tools.

SUPPORT MATERIALS

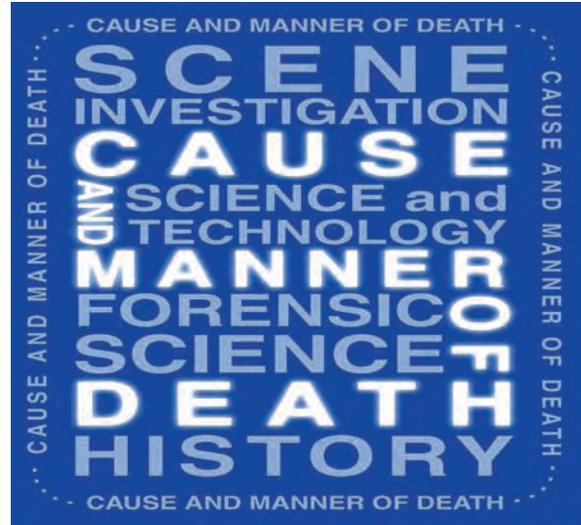
In addition to the SUIDI Reporting Form or jurisdictionally approved equivalent, the following support materials are suggested:

1. *Forensic Autopsy Performance Standards*. Atlanta, Ga: National Association of Medical Examiners. 2005.
2. Clark SC. *Death Investigation: A Guide for the Scene Investigator*. Washington, DC: US Dept of Justice, National Institute of Justice; 1999.
3. Clark SC, Ernst MF, Haglund WD, Jentzen JM. *The Medicolegal Death Investigator: A Systematic Training Program for the Professional Death Investigator*. Big Rapids, Mich: Occupational Research and Assessment; 1996.
4. *Sudden, Unexplained Infant Death Investigation Guidelines*. Atlanta, Ga: Centers for Disease Control and Prevention; 1996.

CHAPTER OBJECTIVES

By the end of this chapter, the students will be able to:

1. Recognize different types of SUID.
2. Identify the tools available for collecting and reporting infant death scene data.



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Types of Sudden, Unexplained Infant Death

INTRODUCTION

Sudden unexplained infant death (SUID) is the sudden and unexpected death of an infant due to natural or unnatural causes. Sudden infant death syndrome (SIDS) is one of several causes of SUID. However, SIDS, unlike the other SUID causes, is a diagnosis of exclusion. Although most conditions or diseases usually are diagnosed by the presence of specific symptoms, SIDS is a diagnosis that should be given only after all other possible causes of sudden, unexplained death have been ruled out through a careful case investigation, which includes a thorough examination of the death scene, a complete autopsy, and a review of the infant's medical history (Willinger, James, & Catz, 1991). Suffocation (asphyxia), drowning, electrocution, hyperthermia, hypothermia, carbon monoxide poisoning, and homicide are examples of other causes of SUID that can be explained after a careful case investigation. A thorough death scene investigation (as described in this text) is often the only way to make a distinction between SIDS and suffocation as a cause of death (Hanzlick, 2001).

Having knowledge about the many causes of SUID, in addition to SIDS, is of utmost importance for the death scene investigator. At the scene, the investigator will gather evidence as well as information from the parents or caregivers who were with the infant and who may be in a great deal of distress. All of this information is crucial for distinguishing between a natural death, an accidental death, or a homicide.

SUDDEN, UNEXPLAINED INFANT DEATH

Below is a description of the most common causes of SUID. Each cause is referred to throughout the text and detailed specifically to the application under discussion.

Sudden Infant Death Syndrome (SIDS)

In the United States, SIDS is the most common cause of death in infants aged one month to one year and the third leading cause of infant mortality, after congenital anomalies and short gestation/low birth weight. SIDS currently accounts for about 2,300 deaths per year. Combining deaths attributed to SIDS with all other explained causes of SUID yields 4,600 deaths per year. This number is similar to the number of deaths per year due to birth defects, the leading cause of infant mortality in the United States. The incidence of SIDS has declined more than 50% since the 1990s. SIDS occurs most commonly in infants two to four months of age and rarely after eight months of age. SIDS also occurs more frequently in African Americans, American Indians, and Alaska Natives than in Caucasians.

Modifiable risk factors for SIDS include

- Stomach and side sleeping positions.
- Overheating.
- Soft sleep surfaces.
- Loose bedding.
- Inappropriate sleep surfaces (such as a sofa or water bed).
- Sharing the same sleep surface (such as a bed) with an individual other than a parent or sharing the same sleep surface with an individual who is overly tired or under the influence of alcohol or drugs.
- Maternal and secondhand smoking.

Interventions aimed at modifying these risk factors are the focus of the Back-to-Sleep Campaign, which was initiated in 1994.

SIDS occurs suddenly without warning, often during periods of sleep. It is not caused by suffocation, aspiration, abuse, or neglect. SIDS occurs during a critical period of rapid growth and development of the brain during the first six months of life. This period accounts for 90% of all SIDS-related deaths. The cause of SIDS is unknown.

Knowledge acquired during the last decade supports the general “triple-risk hypothesis,” which proposes that infants who die from SIDS are born vulnerable (with certain brain stem abnormalities that make them susceptible to sudden death) and, during a critical developmental period, are exposed to an exogenous stressor (such as overheating, secondhand smoke, or entrapment from stuffed animals or pillows) (Guntheroth & Spiers, 2002).

The following is a brief overview of known causes of infant death that are oftentimes overlooked during investigation, resulting in the cause of death being listed as SIDS on the death certificate. Chapter 8 gives a more detailed treatment of each cause and the investigative strategies that may be used to verify and document each.

Asphyxia or Suffocation

Asphyxia or suffocation is caused by the inability to breathe. This condition leads to a lack of oxygen in the body, which can lead to loss of consciousness and death. Asphyxia can be caused by choking, constriction of the chest or abdomen, strangulation, narrowing of airway passages (severe allergic reaction or reactive airway disorders), or the inhalation of toxic gases. Common objects that are involved with asphyxia or suffocation include plastic bags, soft pillows, and soft materials such as bedding or stuffed animals. These objects can occlude the mouth and nostrils, causing suffocation. The most commonly reported cause of asphyxia in infants is accidental suffocation and strangulation in bed.

If the investigator is very observant, knows what to look for, and is particularly careful in talking with the caregiver, he/she may pick up some clues that will help determine the specific cause of asphyxia or suffocation and determine whether the manner of death was accidental or intentionally inflicted. A thorough death scene investigation can help answer questions about environmental factors that may have interfered with breathing (e.g., covering of the nose and mouth) or hazards related to aspiration, choking, electrocution, excessive heat or cold, and other external factors.

There are a number of risk factors associated with asphyxia and suffocation. The following is a list of the typical causes of infant asphyxia and/or suffocation. Again, each is detailed in Chapter 8 of this text and described in the Glossary.

- Overlaying or accidental suffocation on a shared sleep surface.
- Accidental strangulation from unsafe surroundings.
- Wedging or entrapment.
- Immersion in water or drowning.
- Choking.
- Rebreathing.
- Neck compression.

There are a number of risk factors associated with the infant's environment that may be connected with the death. The following is a list of causes typically associated with the environment or death scene. Each is detailed in Chapter 8 of this text and described in the Glossary.

- Poisoning or intoxication.
- Electrocution.
- Hypothermia.
- Hyperthermia.

Metabolic Error

Inborn errors of metabolism are rare genetic disorders that stop or prevent the body from turning food into energy. These disorders are usually caused by defects in the enzymes that help break down foods in the body. When the body cannot process these foods, a buildup of toxic substances or a deficiency of substances needed for normal body function can occur. This buildup can be fatal if not controlled with diet or medication. Some metabolic diseases are inherited. Medium chain acyl-CoA dehydrogenase deficiency is one type of metabolic disorder thought to account for a small percentage of SUID. Other examples of metabolic disorders and conditions are maple syrup urine disease, phenylketonuria, G6PD deficiency, and galactosemia.

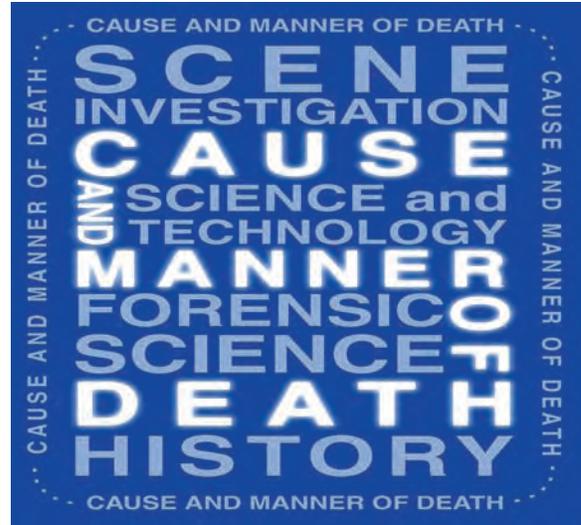
Injury or Trauma

Injuries can be fatal or nonfatal, and they can occur unintentionally or intentionally (because of purposeful acts of harm). It is often difficult to determine whether an infant's injury was a result of an unintentional or intentional act. Examples of unintentional injuries include the infant choking on a small toy or rolling over in bed onto the infant. An adult physically abusing an infant is an example of an intentional injury (Deal, 2000).

Injuries account for approximately 5% of infant deaths or 1,100 deaths yearly in the United States (Tomashek, Hsia & Iyasv, 2003). Shaken baby syndrome (SBS) is one form of abusive head trauma that occurs when an infant or young child is violently shaken or struck against a hard or soft surface. Shaking may cause bleeding over a large portion of the brain. SBS can cause severe brain damage as well as death. In cases where a child receives a head injury from a fall or other impact, there may be external signs of injury, such as bruising or abrasions on the scalp. In SBS, there may be no signs of injury on the infant.

Unknown or Unclassified Causes

“Unknown” or “Unclassified” is assigned as a cause of death if the death scene investigation and/or autopsy were incomplete or not done and the death certifier has insufficient evidence to record a more specific cause of death. The way the cause and manner of death are reported on the death certificate depends on the circumstances of the case. The various methods for reporting cause of death on the death certificate are discussed in Chapter 9.



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Data Collection and Reporting Tools

INTRODUCTION

An infant death scene investigation that follows the guidelines and forms outlined in this text is imperative to help the medical examiner and coroner establish an accurate cause and manner of death. The death scene investigation provides important insight into the infant's sleep environment, clinical and medical history, and family history, including genetic and environmental risk factors. A thorough infant death scene investigation should include interviewing witnesses, examining the death scene, staging a doll reenactment, reviewing medical history, and carefully assessing the infant's exposures prior to death. Because infant deaths are such tragic family events, investigators must learn how to carry out a thorough investigation while remaining sensitive and non-accusatory toward the grieving family and caregivers.

IMPORTANCE OF THE DEATH SCENE INVESTIGATION FOR SUID

Without information from a complete death scene investigation and a review of the clinical history, it is difficult to determine cause and manner of death. Pathologists and those conducting autopsies who receive a corpse without this information are at a great disadvantage compared to those who receive this information. Imagine having your internist or healthcare provider examine you without getting any medical history first. In addition, information from a carefully conducted death scene investigation and clinical history can make the death certificate more accurate, which will ultimately help to prevent infant deaths.

Several studies provide evidence to support the hypothesis that SIDS and other SUID are more accurately diagnosed when information from a death scene investigation is used to make the diagnosis (Bass, Kravath, & Glass, 1986; Byard, Carmichael, & Beal, 1994; Valdes-Dapena, 1992). The goal of the infant death scene investigation is to gather information about the circumstances surrounding the death so that pathologists can use it to interpret autopsy findings, determine the cause of death, and establish the manner of death. Those investigating the scene should gather information concerning all potential causes of SUID, including suffocation (e.g., from wedging, overlying, or obstructed airway), homicide (e.g., from child abuse and neglect), poisoning, and unintentional injury.

THE CENTERS FOR DISEASE CONTROL AND PREVENTION—SUDDEN, UNEXPLAINED INFANT DEATH INVESTIGATION (SUID) REPORTING FORM

In 1996, CDC released the Sudden, Unexplained Infant Death Investigation Guidelines and Reporting Form, a uniform protocol for conducting an infant death scene investigation. Before this time, a uniform protocol for conducting an infant death scene investigation did not exist although a 1989 redefinition of SIDS included the need for a thorough death scene investigation. National evaluations of the effectiveness of the 1996 SUIDI Reporting Form after its release showed that the form was cumbersome, not user friendly, and not widely used. In response to this unfavorable evaluation, CDC began the effort to revise the old form. The Sudden, Unexplained Infant Death Investigation (SUIDI) Reporting Form was released on March 1, 2006 (See Appendix A).

The eight-page SUIDI Reporting Form is designed to guide the investigator in the questioning of witnesses during the infant death scene investigation. The data gathered using the SUIDI Reporting Form is considered critical to the determination of cause of death. If used consistently throughout the United States, the SUIDI Reporting Form will provide standardized collection of data, which will improve the classification of SIDS and other SUID.

The SUIDI Reporting Form was written by a national workgroup made up of medical examiners, coroners, death scene investigators, law enforcement, infant death researchers, and SIDS parent organizations. The new form includes questions deemed necessary to establish cause and manner of death by a 2004 national survey of medical examiners and coroners (S.C. Clark, PhD, unpublished data, 2005), as well as new questions about recently recognized risk factors for SIDS. It is shorter, simpler, and more user friendly compared with the 1996 form. For example, most questions can be answered by placing an X in the corresponding checkbox or filling in the blank provided.

THE SUIDI REPORTING FORM

Because of the hard work of the revision workgroup and the numerous pilot-testing activities, the revised SUIDI Reporting Form has simplified the data collection by presenting

- Only questions deemed critical for establishing cause and manner of death, as well as supporting investigators' findings in court.
- New questions about recently identified risk factors.
- Answers to questions that can be checked off quickly, allowing for easy, consistent data collection.
- Questions in a sequence that works well for infant death investigators.
- Sections to break down the responsibilities of particular members of the death investigation team.
- Supplemental forms for collecting information about contacts and evidence for jurisdictions that do not have their own.

The image shows a screenshot of the SUIDI Reporting Form. The form is titled "Sudden Unexplained Infant Death Investigation SUIDI Reporting Form". It is divided into two main sections: "INVESTIGATION DATA" and "WITNESS INTERVIEW".

INVESTIGATION DATA

Infant's Information: Last _____ First _____ M. _____ Case # _____

Sex: Male Female Date of Birth _____ / _____ / _____ Age _____ Months SS# _____

Race: White Black/African Am. Asian/Pacific Islander Am. Indian/Alaskan Native Hispanic/Latino Other

Infant's Primary Residence Address: Address _____ City _____ County _____ State _____ Zip _____

Incident Address: Address _____ City _____ County _____ State _____ Zip _____

Contact Information for witness:

Relationship to the deceased: Biological Mother Biological Father Grandmother Grandfather
 Adoptive or Foster Parents Physician Health Records Other

Last _____ First _____ M. _____ SS # _____

Home Address _____ City _____ State _____ Zip _____

Place of Work _____ City _____ State _____ Zip _____

Phone (H) _____ Phone (W) _____ DOB _____

WITNESS INTERVIEW

1 Are you the usual caregiver? Yes No

Fig. 1.1: SUIDI Reporting Form helps standardize data collection at the scene.

The basic form addresses the most common information considered necessary to conduct an adequate SUID scene investigation. In addition to the basic form, there are a number of *additional investigative forms* that may be attached, if the specific scene circumstances require that additional information be collected. The additional forms include the following:

- Body diagram.
- EMS interview.
- Hospital interview.
- Immunization record.
- Infant exposure history.
- Informant contact.
- Law enforcement interview.
- Materials collection log.
- Non professional responder interview.

- Parental information.
- Primary residence investigation.
- Scene diagram.

Some investigative agencies may wish to supplement their own scene forms with any or all of the SUIDI Reporting Forms. At a minimum, it is recommended that each investigative agency use the SUIDI forms as a reference to compare the content of their current forms with the content of these newer data collection tools.

STANDARDIZED PRE-AUTOPSY REPORT

Too often, critical scene information fails to reach the forensic pathologist before the autopsy is performed. In an effort to remedy this communication gap and to provide the forensic pathologist with critical scene data before the autopsy, there is now a standardized pre-autopsy report (PAR) that can be generated electronically through the SUIDI Reporting System (mdilog.net). Included in the electronic reporting system is a post-autopsy conclusions (PAC) feedback loop that allows the forensic pathologist to report autopsy findings back to the scene investigator for case updating, review, and printing of the death certificate.

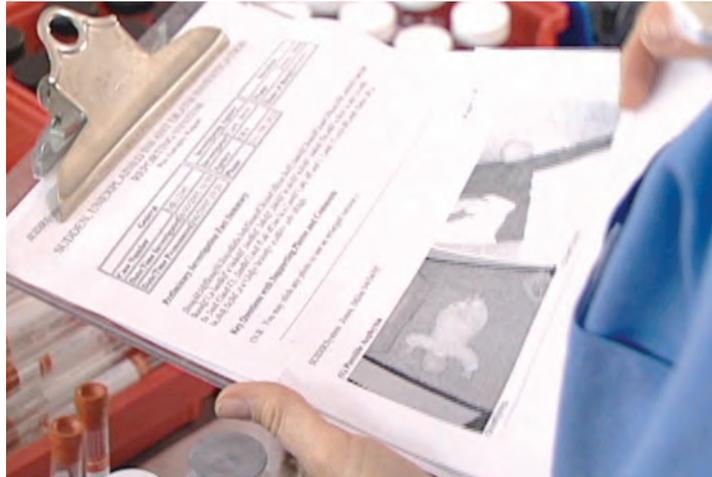


Fig. 1.2: Forensic pathologist reviewing a pre-autopsy report.

Summary

DISCUSSION QUESTIONS

1. Discuss how SIDS is different from other causes of SUID, such as asphyxia, inborn errors of metabolism, and homicide.
2. State reasons why the SUID scene investigation is important for distinguishing between SIDS and other SUID as causes of death and to determine manner of death.
3. Discuss the differences in the types of asphyxia deaths—hanging, strangulation, overlaying, choking—and give examples of each.
4. Distinguish between intentional and unintentional injury.

SAMPLE QUESTIONS

1. What causes of death are difficult to distinguish from one another if only an autopsy, but not a death scene investigation, was completed?
 - A. Overlaying.
 - B. Wedging.
 - C. SIDS.
 - D. All of the above.
2. Which of the following statements would NOT be considered a part of a SIDS description?
 - A. Occurs most often between 12 and 18 months.
 - B. Results in a negative autopsy finding.
 - C. No significant clinical history.
 - D. No unusual scene findings.
3. Which is NOT a type of asphyxia death?
 - A. Poisoning.
 - B. Wedging.
 - C. Obstruction of the nose or mouth by a stuffed animal.
 - D. Overlaying.
4. Which is an example of a wedging death?
 - A. The infant's body is stuck between a crib railing and a crib mattress.
 - B. Accidental drowning when an infant is left unattended in the bathtub.
 - C. The infant's nose or mouth is covered by a stuffed animal.
 - D. Inborn errors of metabolism.
5. Which is NOT a component of the death scene investigation?
 - A. Information about the infant's sleep environment.
 - B. Infant and family clinical and medical history.
 - C. Family history in terms of genetic and environmental risk factors.
 - D. Autopsy.