

Case Examples With Recommended Certifications and Synoptic Reporting

The case examples presented below illustrate reasons why a sudden pediatric death may remain unexplained. Suggested cause of death certifications and synoptic reporting are provided.

EXAMPLE 1: INVESTIGATION AND AUTOPSY ARE NEGATIVE OR NONCONTRIBUTORY. INFANT DEATH.

Case

A healthy, 3-month-old girl is placed in a safe sleep environment (i.e., supine, alone, in a crib with firm mattress, without soft objects or loose bedding) and is later found dead in the same position, with nothing covering her nose or mouth or near her head. A thorough medicolegal investigation, including doll reenactment, revealed unchanging stories and no concern for foul play. Review of the infant's birth and pediatrician records revealed an uncomplicated term birth and no risk factors for sudden death. A complete autopsy (i.e., macroscopic and microscopic examination of thoracic, abdominal and pelvic organs, brain and spinal cord) demonstrated no specific pathologies. Vitreous electrolytes and screening for metabolic disorders were within normal limits. Toxicology (alcohol, illicit, prescribed, and non-prescribed drugs) was negative. Cultures of blood, lung and cerebrospinal fluid, and nasopharyngeal swab for viruses were noncontributory or negative. Although samples for genetic testing were collected and stored, such testing exceeded the resources of the medical examiner's office.

This unexpected death is unexplained; a cause of death cannot be determined. No intrinsic or extrinsic factors were identified. The death certificate should be completed as cause of death: Unexplained Sudden Death (No intrinsic or extrinsic factors identified); manner of death: Undetermined or Natural. The synoptic report and summary provided in the autopsy report are shown in **Table A6.1**.

Table A6.1: Unexplained Sudden Death in Infancy

Cause of Death	Unexplained Sudden Death (No intrinsic or extrinsic factors identified)
Manner of Death	Natural
Investigation	Medicolegal investigation with scene visit and doll reenactment
Medical History Review	Decedent medical history reviewed, no causative or contributory factors, or risk factors identified
Sleep Environment Concerns	None
Other Environmental Concerns	None
Other Objective Concerns	None

Table A6.1: Continued

Autopsy	Complete autopsy (macroscopic and microscopic examination of thoracic, abdominal and pelvic organs, brain and spinal cord) Subspecialty pathologists (neuropathologist) consulted
Toxicology	Complete toxicology (alcohol, illicit, prescribed, and non-prescribed drugs)
Ancillary Studies	Bacterial cultures done Viral cultures/studies done Vitreous electrolytes done Metabolic screen done
Radiologic Studies	Radiographic skeletal survey (flat plate)
Comment(s)	Genetic testing not performed; samples available

Summary

A thorough investigation and complete autopsy with ancillary testing did not demonstrate an explanation for this sudden infant death. Although no natural disease process (intrinsic factor) or risks in the immediate environment (extrinsic factors) were identified, potentially fatal functional disturbances that have no structural correlate, such as arrhythmia (abnormal heart beats) and seizure, cannot be excluded. Genetic testing of decedent samples (for mutations associated with cardiac conduction disorder, cardiomyopathy, and epilepsy) and clinical consultation for surviving first degree relatives may be warranted; appropriate specimens are available upon request for genetic testing.

Case Discussion

Cases of truly unexplained infant deaths (i.e., those without evidence of significant natural disease, risk factors for asphyxia mechanisms, or other potential causes of death) have an actual need to be stratified from the larger group of unexpected infant deaths that have a combination of intrinsic and extrinsic factors. This small group is most likely to represent the spectrum of diseases, syndromes, or illnesses that we just haven't figured out yet, and that need to be most aggressively studied. It is the comingling of this special (and small) group of infants, with possibly asphyxiated infants and others with intrinsic pathologies, that causes the most practical and philosophical strife, and may hinder identification of causal etiologies. Certification as "Unexplained Sudden Death (No intrinsic or extrinsic factors identified)" will provide epidemiologists and others with higher quality data about unexplained, apparently natural infant deaths.

EXAMPLE 2: INVESTIGATION AND AUTOPSY ARE NEGATIVE OR NONCONTRIBUTORY. CHILD DEATH.

Case

A healthy, 4-year-old boy with a history of febrile seizure as an infant but no current illness, goes to sleep in his bed and is found supine deceased the next morning. A thorough medicolegal investigation, including scene visit and witness interviews revealed unchanging stories, no concern for foul play and absence of circumstances concerning for asphyxia. Contusions of the right knee, left elbow, and abdomen were noted, and the parents could not say when those occurred. Complete autopsy, toxicology, metabolic screening, and microbiology were noncontributory or negative. Postmortem Lodox scan showed no fractures. Examinations of the heart and brain by consultants showed no specific pathologic changes. Genetic testing for cardiac channelopathies demonstrated no known pathologic variants.

This unexpected death is unexplained; a cause of death cannot be determined. Since no intrinsic or extrinsic factors were identified, the death certificate should be completed as cause of death: Unexplained Sudden Death (No intrinsic or extrinsic factors identified); Manner of death: Undetermined or Natural. The synoptic report and summary provided in the autopsy report are shown in **Table A6.2**.

Summary

A thorough investigation and complete autopsy with ancillary testing, including genetic testing for cardiac channelopathies, did not demonstrate an explanation for this child's sudden death. Since the cause of death could not be determined, the manner of death is also undetermined.

Table A6.2: Unexplained Sudden Death in Childhood

Cause of Death	Unexplained Sudden Death (No intrinsic or extrinsic factors identified)
Manner of Death	Undetermined
Investigation	Medicolegal investigation with scene visit
Medical History Review	Decedent medical history reviewed, potential causative or contributory factors, or risk factors identified (infantile febrile seizure history)
Sleep Environment Concerns	None
Other Environmental Concerns	None
Other Objective Concerns	Nonlethal injuries
Autopsy	Complete autopsy (macroscopic and microscopic examination of thoracic, abdominal and pelvic organs, brain and spinal cord) Subspecialty pathologists (cardiac, and neuropathologists) consulted
Toxicology	Complete toxicology (alcohol, illicit, prescribed, and non-prescribed drugs)
Ancillary Studies	Bacterial cultures done Viral cultures/studies done Vitreous electrolytes done Genetic testing done
Radiologic Studies	Full body scanning (i.e., Lodox technology)

EXAMPLE 3: INVESTIGATION AND/OR AUTOPSY REVEAL FINDINGS THAT ARE CONCERNING BUT NOT DIAGNOSTIC FOR A CAUSE OF DEATH.

Case

A previously healthy, term born, 3-month-old boy was placed to sleep on his side and found prone, while sleeping alone on an adult bed. His head was turned to his left side; numerous pillows and blankets were around him. His mother (who discovered him) denied that his mouth was obstructed in any way, or that his head was covered. A thorough medicolegal investigation revealed unchanging stories and no concern for foul play. Doll reenactment confirmed the placed and found positions as described but failed to demonstrate definitive external obstruction of the airway. Only the 2-month well baby visit records were available, but these indicated recent or chronic health problems. A complete autopsy (macroscopic and microscopic examination of thoracic, abdominal and pelvic organs, brain and spinal cord) was performed. Although the boy was at the 15th percentile for height, weight and head circumference, his heart was greater than the 90th percentile for age (without evidence of congenital malformation or myocyte disarray on microscopic examination). Toxicology (alcohol, illicit, prescribed, and non-prescribed drugs), vitreous electrolytes and screening for metabolic disorders were noncontributory. Cultures of lung and cerebrospinal fluid had no growth and nasopharyngeal swab was negative for viruses. Postmortem radiographic skeletal survey showed no fractures or abnormalities. Genetic testing for cardiac channelopathies and cardiomyopathies demonstrated no known pathologic variants.

This unexpected death is unexplained; a cause of death cannot be determined. Since both intrinsic and extrinsic factors were identified, the death certificate should be completed as cause of death: Unexplained Sudden Death (Intrinsic and extrinsic factors identified); Manner of death: Undetermined. The synoptic report and summary provided in the autopsy report are shown in **Table A6.3**.

Cause of Death	Unexplained Sudden Death (Intrinsic and extrinsic factors identified)
Manner of Death	Undetermined
Investigation	Medicolegal investigation with scene visit and doll reenactment
Medical History Review	Incomplete medical record review (birth/neonatal records not available)
Sleep Environment Concerns	Prone sleeping on unsafe surface
Other Environmental Concerns	None
Other Objective Concerns	Pathologic finding of unknown significance
Autopsy	Complete autopsy (macroscopic and microscopic examination of thoracic, abdominal and pelvic organs, brain and spinal cord) Subspecialty pathologists (neuropathology) consulted
Toxicology	Complete toxicology (alcohol, illicit, prescribed, and non-prescribed drugs)
Ancillary Studies	Bacterial cultures done Viral cultures/studies done Vitreous electrolytes done Genetic testing done
Radiologic Studies	Radiographic skeletal survey (flat plate)

Summary

A thorough investigation and complete autopsy with ancillary testing, including genetic testing for cardiac channelopathies and cardiomyopathies, did not demonstrate a definitive explanation for this infant's sudden death. However, two findings are of concern. The unsafe sleep environment (prone on adult bed with soft objects/bedding) is an extrinsic factor that may have caused asphyxia by obstructing the nose and/or mouth. Enlargement of the heart is an intrinsic factor of unclear significance for cause of death that may have increased risk for arrhythmia (abnormal heart beats). Since the cause of death could not be determined, and both intrinsic and extrinsic factors are present, the manner of death is also undetermined.

Case Discussion

In this example, the cause of death is not clear, and the differential diagnosis for cause is unresolvable. This is a typical “gray zone” case that should be separated from the rare unexplained cases that appear natural and other cases that have a definable cause of death. Certification as “Unexplained Sudden Death (Intrinsic and extrinsic factors identified)” enables that distinction without misdirecting coding by inclusion of risk factors on the death certificate.

EXAMPLE 4: INVESTIGATION AND/OR AUTOPSY REVEAL COMPETING CAUSES OF DEATH.

Case

A 4-month-old infant is placed to sleep, supine, on soft bedding and covered with a baby blanket, between two adults in a queen bed. Hours later, the infant is found dead, supine on the bed. A scene visit, with doll reenactment, confirms that the infant was indeed sharing the bed, but both adults deny that an overlay occurred. The blanket was not over the infant's face when found. The home smelled of heavy smoking. Review of the medical history reveals the infant was healthy. Autopsy is negative for trauma. The lividity pattern, seen at autopsy, supports that the infant was found supine. No natural disease process that would explain death are identified grossly or microscopically. Toxicologic and microbiologic studies are negative. Vitreous electrolyte testing and screening for metabolic disorders is within normal limits. A full-body computed tomography scan and radiographic skeletal survey show no fractures, anomalies, or disease processes. Cardiac channelopathy genetic testing demonstrates a mutation that can cause prolonged QT syndrome.

Since intrinsic and extrinsic factors were identified, the death certificate should be completed as cause of death: Unexplained Sudden Death (Intrinsic and Extrinsic Factors Identified); manner of death: Undetermined. The synoptic report and summary provided in the autopsy report are shown in **Table A6.4**.

Table A6.4: Unexplained Sudden Death in Infancy

Cause of Death	Unexplained Sudden Death (Intrinsic and extrinsic factors identified)
Manner of Death	Undetermined
Investigation	Medicolegal investigation with scene visit and doll reenactment
Medical History Review	Decedent medical history reviewed, no causative or contributory factors, or risk factors identified
Sleep Environment Concerns	Sleep surface sharing with more than one adult
Other Environmental Concerns	Cigarette smoking in or outside home
Other Objective Concerns	Genetic mutation associated with Long QT Syndrome
Autopsy	Complete autopsy (macroscopic and microscopic examination of thoracic, abdominal and pelvic organs, brain and spinal cord) Subspecialty pathologists (neuropathology) consulted
Toxicology	Complete toxicology (alcohol, illicit, prescribed, and non-prescribed drugs)
Ancillary Studies	Bacterial cultures done Viral cultures/studies done Vitreous electrolytes done Genetic testing done
Radiologic Studies	Radiographic skeletal survey (flat plate) computed tomography scanning done

Summary

A thorough investigation and complete autopsy with ancillary testing, demonstrated two possible explanations for this sudden infant death. The unsafe sleep environment (bed-sharing between adults and bedding) is an extrinsic factor that may have caused asphyxia by obstructing the nose and/or mouth or compressing the neck/chest. There are no tests or anatomic findings that can confirm or exclude this possibility. Genetic testing revealed a mutation (intrinsic factor) associated with an abnormal heart rhythm (Long QT Syndrome) that confers an increased risk of sudden death. However, arrhythmia as the mechanism of death cannot be confirmed or excluded. Surviving family members are encouraged to seek genetic counseling and clinical evaluation due to the potential heritable nature of Long QT Syndrome. Since the cause of death could not be determined, and both intrinsic and extrinsic factors are present, the manner of death is also undetermined.

Case Discussion

Sudden, unexpected infant deaths in unsafe sleep environments, in which asphyxia is possible, but not definitely proven, comprise most cases of infant deaths that remain unexplained. Some of these cases are difficult to certify due to competing causes of death (two or more potentially lethal conditions). In this case, there were competing causes: 1) the infant may have been asphyxiated by bedding that moved again before the parents awoke, 2) one of the adults could have accidentally and unknowingly overlaid the infant, causing death, and then rolled off the infant, awaking later to find the infant deceased; or 3) the infant may have died from a cardiac dysrhythmia due to channelopathy and the unsafe sleep environment made no contribution to death. Of these competing causes of death, none can be confirmed or excluded with certainty. There are no autopsy findings or laboratory tests that can confirm or exclude

that a death is due to asphyxia. Cardiac monitoring at the time of death is necessary to prove or disprove cardiac dysrhythmia. We are left with an unexplained death with both intrinsic (mutation that can cause a prolonged QT interval) and extrinsic factors (possible asphyxia via bedding or overlay). The manner of death is certified as undetermined because this death was either natural or accident depending on the true cause.

EXAMPLE 5: ABSENCE OR INCOMPLETE SCENE INVESTIGATION.

Case

A 2-month-old baby boy was found unresponsive in his crib by his mother. Law enforcement and the medicolegal death investigator interview the family in the emergency department, but descriptions are vague, and investigators do not return with the family to the home. As such, there is no scene investigation and the circumstances remain unconfirmed. Review of the medical history reveals the infant was healthy. Complete autopsy reveals no evidence of trauma or a natural disease process capable of causing death. Toxicology, metabolic screening, and microbiologic studies are negative or noncontributory. Vitreous volume was insufficient for testing. Radiographic skeletal survey shows no fractures or abnormalities.

The pathologist has inadequate scene information to evaluate potential extrinsic factors. This death is unexplained. The death certificate should be completed as: cause of death: Undetermined (Insufficient Data); manner of death: Undetermined. The synoptic report and summary provided in the autopsy report are shown in **Table A6.5**.

Cause of Death	Undetermined (Insufficient Data)
Manner of Death	Undetermined
Investigation	Medicolegal investigation without scene visit
Medical History Review	Decedent medical history reviewed, no causative or contributory factors, or risk factors identified
Sleep Environment Concerns	Unconfirmed sleep environment
Other Environmental Concerns	Unknown
Other Objective Concerns	Genetic mutation associated with Long QT Syndrome
Autopsy	Complete autopsy (macroscopic and microscopic examination of thoracic, abdominal and pelvic organs, brain and spinal cord)
Toxicology	Complete toxicology (alcohol, illicit, prescribed, and non-prescribed drugs)
Ancillary Studies	Bacterial cultures done Viral cultures/studies done Vitreous electrolytes: volume insufficient Metabolic screen done
Radiologic Studies	Radiographic skeletal survey (flat plate)
Comment(s)	Genetic testing not performed; samples available

Summary

Although a complete autopsy with ancillary studies did not demonstrate a cause of death, this death is certified as undetermined cause because details of the circumstances of death and sleep environment were not sufficient to exclude an extrinsic/external cause of death.

EXAMPLE 6: NO CAUSE OF DEATH IDENTIFIED, BUT SUSPICIOUS INJURIES PRESENT

Case

A previously healthy, pre-term born, 8-month-old boy was placed to sleep supine and found unresponsive on his back on a firm mattress in a crib. He was pronounced dead in the emergency department. A thorough investigation, including scene (home) visit and doll reenactment, were performed. Nothing was covering his mouth, or near his head. The parents both smoked in the home and were compliant with medication assisted treatment for substance abuse. There were no illicit drugs in the home. Birth and pediatrician records were reviewed, being notable only for neonatal abstinence syndrome treated prior to discharge home well. The biological father had twice been reported to Child Protection Services because of unsubstantiated allegations of neglect and physical abuse of two older children. A complete autopsy and ancillary tests did not determine an anatomic cause of death. However, healing, crescentic abraded contusions with an appearance suggesting a bite mark were on the right buttocks of the boy; chondro-osseous calluses of the bilateral third and fourth ribs in a paravertebral distribution were identified by radiographic skeletal survey. The synoptic report and summary provided in the autopsy report are shown in **Table A6.6**.

Table A6.6: Unexplained Sudden Death in Infancy

Cause of Death	Undetermined (Not further specified)
Manner of Death	Undetermined
Investigation	Medicolegal investigation with scene visit and doll reenactment
Medical History Review	Decedent medical history reviewed, potential causative or contributory factors, or risk factors identified (pre-term birth; neonatal abstinence syndrome)
Sleep Environment Concerns	None
Other Environmental Concerns	Caregiver cigarette smoking in or outside home
Other Objective Concerns	Nonlethal injuries
Autopsy	Complete autopsy (macroscopic and microscopic examination of thoracic, abdominal and pelvic organs, brain and spinal cord) Subspecialty pathologists (neuropathology) consulted
Toxicology	Complete toxicology (alcohol, illicit, prescribed, and non-prescribed drugs)
Ancillary Studies	Bacterial cultures done Viral cultures/studies done Vitreous electrolytes done Metabolic screen done
Radiologic Studies	Radiographic skeletal survey (flat plate)

Case Discussion

Although the circumstances are concerning for physical abuse, there is no evidence to confirm that the death was the result of injury or neglect. The sudden death is unexplained and the injuries are alarming. The cause and manner of death are best left undetermined. It would be inappropriate to use a certification that resulted in the death being coded as R95, given the intent assigned to that classification system.