Sudden Unexpected Infant Death (SUID) and Sudden Death in the Young (SDY) Case Registry

Orientation to Advanced Review

Improving investigation, diagnosis, reporting, services, and prevention

Last Update: March 4, 2019

Contents

Table of Contents

Audience *4*

Introduction *4*

Purpose and Activities of Child Death Review *4*

Purpose and Activities of Advanced Review *4*

Collaboration Between the Two Review Processes *5*

Child Death Review and Advanced Review **5**

Table 1: Types of Records for Advanced Review 5

Table 2: Types of Advanced Review Team Members for Review 6

Child Death Review Process **6**

Advanced Review Process **6**

Before the Advanced Review Meeting 6

At the Advanced Review Meeting 7

Review Factors Surrounding the Death Event 7

Discuss and Understand the Child's Health Prior to Death, as well as their Family History 7

Identify Risk Factors Present in the Death 7

Targets for Advanced Review Prevention Recommendations 8

Sources for Additional Information on Disease Specific Resources/Family Support 9

General Definitions *10*

Terminal Illness **10**

Cardiac **10**

Epilepsy/Seizure Disorder **10**

Convulsions/Seizures **10**

Terms and Diagnoses to Help Identify SDY Cases *11*

Cardiac–Related Terms That Can Cause Sudden Death **11**

Neurologic/Epilepsy/Seizure Disorder–Related Terms That Can Cause Sudden Death **11**

Explained Other **12**

Sudden Unexplained Infant Death (SUID) **12**

Examples and Definitions for SDY Categories *13*

Explained Cardiac **13**

Explained Neurological **15**

Epilepsy/Seizure Disorder Related **16**

Explained Other **16**
Explained Infant Suffocation (under age 1) **18**
Unexplained, Possible Cardiac **18**
Unexplained, Sudden Unexpected Death in Epilepsy (SUDEP) **19**
Unexplained Infant Death/SUID **19**
Unexplained Child Death **19**
SUID Specific Categories ***19***
Unexplained: No Unsafe Sleep Factors **19**
Unexplained: Unsafe Sleep Factors **19**
Unexplained: Possible Suffocation with Unsafe Sleep Factors **20**
Checklists for Improving Your Data at SDY Advanced Review ***20***
Directions **20**
Important Information for Every Case **20**
Important Information for Specific Case Types **21**
Asthma 21
Cardiac 22
Drowning 22
Epilepsy/SUDEP (H1p–v) 22
Motor Vehicle Crashes 23
Pneumonia 24
Other Infection Beyond Those That Affect the Heart and Brain* 24
Sickle Cell Disease 24

Audience
Advanced Review Team, SDY Coordinator and Data Entry Staff

Introduction
This manual provides an overview of the purpose, team composition, and necessary materials for conducting Advanced Review.

Purpose and Activities of Child Death Review
Child Death Review (CDR) is the process that brings together a multidisciplinary team of people to understand the death of a child through sharing and discussing comprehensive information about the death of a child. The purpose is to understand the circumstances of the death; identify risk factors that led to the death; identify systems or other issues that may have impacted the death; and make recommendations to prevent future similar deaths. CDR Teams participating in the SUID and SDY Case Registry will also determine whether infant and child deaths in their jurisdictions should continue to Advanced Review. More detailed information about CDR Teams can be found here: https://www.ncfrp.org/wp–content/uploads/NCRPCD–Docs/Tools–Guides.pdf

The expected activities of CDR programs participating in the SUID and SDY Case Registry include:

1. Identify all resident deaths in the funded jurisdiction that are sudden and unexpected
2. Compile all records related to each death
3. Categorize SUID cases using the CDC's classification system (SUID Algorithm)
4. Enter data, findings, and recommendations into the National Fatality Review Case Reporting System (NFR–CRS)

Purpose and Activities of Advanced Review
Advanced Review is a process that brings together a diverse group of pediatric medical experts including a neurologist, forensic pathologist, cardiologist, and geneticist or genetic counselor. The purpose of this team is to conduct an in–depth review of the medical aspects, including personal and family medical history, of each sudden death and to gain a better understanding of the risk factors and causes. The Advanced Review Team is also charged with categorizing the deaths using the SUID and SDY Case Registry Algorithm so that incidence can be calculated for different categories of death.

The expected activities of the Advanced Review Team include:

1. Review the findings and recommendations of the CDR Team
2. In–depth review of all medical records, child and family medical history, and autopsy results
3. Identify any available additional information for entry into the NFR–CRS
4. Categorize the cases for the SUID and SDY Case Registry
5. Develop additional state and local level recommendations for systems improvement and prevention

These activities are described in more detail below.

Collaboration Between the Two Review Processes

Child Death Review and Advanced Review

Open and collaborative communication between the two types of review teams will promote the best and most comprehensive reviews. The SDY Coordinator, who may attend both review team meetings, should take leadership for coordination between the two types of teams. The CDR Team may be local or state. Per SUID and SDY Case Registry benchmarks the CDR Team should meet within 90 days of notification of each death. The team's findings and recommendations should be entered into the NFR–CRS within 30 days of review. Preliminary findings will therefore be available to the Advanced Review Team. The Advanced Review Team should meet and review cases within 90 days of the CDR Team meeting. The Advanced Review Team should enter its findings and recommendations into the NFR–CRS within 30 days of review. Additionally, if a CDR Team revisits an earlier case, it would be best practice for the CDR Team to include the findings of the Advanced Review Team during their second review.

Table 1: Types of Records for Advanced Review

Record	Advanced Review
Vital Statistics records	• Long form birth certificate • Death certificate
Medical records	• Specialty health provider records should include any history of heart or neurological conditions • If child had any cardiac investigations, including EKG, chest X–ray and/or echocardiogram, even if these were not conducted by a cardiologist • If child had epilepsy, records should include history of anti–epileptic drug levels, including frequency of monitoring of levels • Records should include frequency of anti–epileptic drug changes and number of anti–epileptic drugs taken concurrently

Death Investigation Records	• Autopsy report
	• For infants: Sudden Unexplained Infant Death Investigation Reporting Form (SUIDIRF) or jurisdictional equivalent, including doll reenactment photos
	• Include any additional reports from outside experts or additional testing such as:
	  • Cardiac pathology
	  • Neuropathology
	  • Toxicology
	  • Genetic testing
	  • Metabolic testing

Family Information	• Names, ages and genders of other children in home,
	• Comprehensive family medical history minimally include:
	  • Sudden unexpected death < 50 year–old – If yes specify cause of death and relationship to decedent (include siblings, parents, aunts, uncles, first cousins, or grandparents of decedent)
	  • Heart condition/heart attack or stroke before age 50 – If yes, specify type of heart condition and relationship to decedent (include siblings, parents, aunts, uncles, first cousins, or grandparents of decedent)

Table 2: Types of Advanced Review Team Members for Review

Types of agencies that should participate in Advanced Review. Teams are encouraged to invite experts to participate that have an expertise in the types of cases they are seeing.

Specialty Area	Advanced Review
Family Support (Optional)	Cardiac: Parent Heart Watch, Project ADAM, SADS Foundation Epilepsy: CURE, Epilepsy Foundation
Health Care	Specialty physician or other health provider with expertise in the type of death being reviewed, e.g., cardiologist, neurologist or other specialty provider if the child had more than one condition.
	Geneticist or genetic counselor
	State public health SDY experts (e.g. CDR Coordinator)
Pathology	Medical examiner/coroner (including the individual who conducted the autopsy, if possible); specialized pathologists (e.g., cardiac, pediatric)

Child Death Review Process

Information and tips for CDR meetings can be found in *A Program Manual for Child Death Review*, a publication of the National Center for Fatality Review and Prevention available at https://www.ncfrp.org/wp–content/uploads/NCRPCD–Docs/ProgramManual.pdf. Should you have any questions about the manual or CDR, you can contact the National Center for Fatality Review and Prevention (NCFRP) at: info@ncfrp.org or 800–656–2434**.**

Advanced Review Process

CDR findings should be reviewed at the Advanced Review meeting. The Advanced Review Team will provide an expert review of the medical information for each case, will review the prevention recommendations of the CDR Team, and may add any additional recommendations for primary and secondary prevention. Before the meeting, the SDY Coordinator should assure that the members of the Advanced Review Team have or have access to all relevant medical records, and to a summary of the proceedings of the CDR Team, including a list of the CDR Team's prevention recommendations. The Advanced Review Team will do the following:

1. Consult the expert pathologists about the autopsy and ancillary testing and determine whether further evaluation/testing is recommended.
2. Review the cause of death listed on the death certificate.
3. Determine the likelihood that additional family members could be at risk and attempt to determine whether appropriate medical interventions for family members were identified or had been recommended.
4. Confirm that the family has been provided the opportunity to consent to research on a DNA biospecimen, or that an appointment to discuss consent has been scheduled.
5. Re–visit the risk factors identified by the CDR Team to determine whether any additional risk factors were present.
6. Review the prevention recommendations of the CDR Team and determine whether any additional or amended prevention recommendations are warranted.
7. Categorize each case using the SUID and SDY Case Registry Algorithm located on SharePoint.

Before the Advanced Review Meeting

Verify that funded jurisdictions are ensuring that the SDY Autopsy Summary/Guidance is being

followed and that questions on the SDY Field Investigation Guide and Family Interview Tool (https://www.sdyregistry.org/tools–for–providers/) are being asked, and the resulting information is available for the Advanced Review Meeting.

At the Advanced Review Meeting

a. Review and discuss what happened at the death and in the death investigation, including emergency responder information, autopsy, family interviews and, if applicable, witness interviews and other death scene investigation reports.
b. If relevant and available, review interviews with school personnel or with personnel of other organizations whose care the child was in at the time of death.
c. Review other indicated and available interviews and resources as needed.
d. Review the cause of death listed on the death certificate.
e. Verify that the death investigation was performed in accordance with SDY Tools (SDY Autopsy Summary and SDY Field Investigation Guide and Family Interview Tool: https://www.sdyregistry.org/tools–for–providers/) and included a review of the child's health care records, family medical history and circumstances at death.
f. If further investigation is needed, the team may need to adjourn the discussion until the required information is available.

Review Factors Surrounding the Death Event

a. Review the details of what the child was doing at the time of the incident.
b. Describe all significant factors that may have contributed to the death, including health system or community issues, such as access to an automated external defibrillator (AED) in the location where the death occurred.
c. Identify if the school (or other organization in charge of the child at the time of death, such as an athletic organization or child care provider) was fully informed of the risk to participants of sudden cardiac arrest.

Discuss and Understand the Child's Health Prior to Death, as well as their Family History

a. Learn the course of the child's health.
b. Understand the child's life activities, including sports and family life.
c. Identify any barriers the child or family faced to receiving appropriate health care (misdiagnosis, insurance barriers, distance from specialty providers, difficulty taking time off for appointments, financial difficulty getting to specialty appointments, etc.).
d. Identify if authorities or health care providers were aware of barriers and, if so, how the barriers were dealt with.
e. Identify whether the child's medical or other condition (such as cerebral palsy, intellectual disability or other condition) warranted assistance to the family with any type of additional care.
f. Discuss if additional family members could be at higher risk for disease or death by collecting family history; minimally family history of sudden death and family history of heart disease less than age 50. Determine if appropriate medical screening interventions for family members were identified or have been recommended.

Identify Risk Factors Present in the Death

a. Identify whether a previously undiagnosed heart condition or other medical condition was present that could result in sudden death.
b. Identify whether previous symptoms at rest or during exercise associated with sudden death were

known.

c. Identify whether the child had a family history that put him/her at–risk for sudden death.

Identify and Develop Recommendations for Primary and Secondary Prevention of SDY/SUID

The Advanced Review Team may consider many prevention recommendations during its review. The following aspirational objectives and activities are provided so that teams have a sense of the wide range of recommendations that could help reduce SDY. If a team chooses to focus on one or more of the objectives below, it should formulate the objective into a recommendation that identifies an action, identifies the particular agency or institution that is asked to take action, and assigns an agency or individual to take the lead for implementation of the recommendation. The following is an example of a specific recommendation:

By 2020, all schools in [jurisdiction] should have working automated external defibrillators (AEDs) and trained staff who know where they are kept and how and when to use them. This recommendation is directed to [the legislature or other agency], and the health department will take the lead in moving this recommendation forward. The team will discuss progress on this recommendation at its meeting in [date].

Targets for Advanced Review Prevention Recommendations

a. Public and General

- Increase public awareness of SDY risk factors
- Reduce the risk of SDY by exploring existing state mandates or professional recommendations for activities related to survival from sudden cardiac arrest, including activities like CPR and automated external defibrillators (AEDs)

b. Medical Professionals

- Increase provider assessment of SDY risk factors, including family history, through various means including multiple different health system contact points
- Increase resources on education regarding SDY risk factors for medical professionals
- Consider providing information back from case reviews to physicians and other medical professionals involved in SDY cases

c. Emergency Services and Emergency Departments

- Explore appropriateness of response time and initiation of immediate defibrillation for sudden cardiac arrest cases
- Provide feedback to Emergency Medical Technicians (EMTs)
- Investigate availability of AEDs for all responders
- Make formal clinical recommendations regarding appropriate use of medications and techniques in SDY situations to appropriate EMS organizations

d. Medical Examiners

- Encourage use of SDY Death Investigation Tools: SDY Autopsy Summary, SDY Autopsy Guidance and SDY Field Investigation Guide and Family Interview Tool
- Encourage DNA banking for SDY cases
- Identify expense and insurance reimbursement options for DNA banking and genetic testing
- Increase awareness of familial risks among medical examiners and develop a mechanism to ensure autopsy results and recommended follow–up are conveyed to families and primary

providers
- For deceased individuals with pacemakers and/or ICDs, ensure assessment of pacemakers/ICDs' function after SDY
- Provide feedback to medical examiners on how their findings helped other family members

e. Schools and Community Programs

- Require Pediatric Sudden Cardiac Death Risk Assessment and Pre–participation exams for sports be used by schools and athletic programs
- Identify and disseminate clinical guidelines for evaluation and management of students known or possible risk for SDY
- Identify and/or disseminate recommendations to coaches about symptoms and/or conditions that may place athletes at higher risk for SDY
- Reduce the risk of SDY through warning sign recognition, emergency response plans and AED availability and education

f. Patients and/or Families with Diagnoses and/or Family History of SDY

- Educate parents and youth about Sudden Cardiac Arrest and the importance of the following:
    - Obtain a thorough physical examination
    - Ask questions about your child's heart health
    - Know your family health history
    - Ask what you can do to reduce risk
    - Identify methods for reducing risk of SUDEP for families with a child with seizures

g. Bereavement Services and Other Support Services for Families

- Determine the likelihood that additional family members could be at risk and attempt to determine whether appropriate medical interventions for family members were identified or had been recommended
- Refer family members to local support (psychologist, community grief resources)
- Refer to appropriate support groups:
- Parent Heart Watch
- SADS Foundation
- Local Epilepsy Foundation (locate chapter through www.epilepsyfoundation.org)
- See additional recommendations under resources

Sources for Additional Information on Disease Specific Resources/Family Support

a. Cardiac

- Sudden Arrhythmia Death Syndrome (SADS) Foundation www.sads.org
- American Heart Association www.americanheart.org
- Children's Cardiomyopathy Foundation www.childrenscardiomyopathy.org
- Hypertrophic Cardiomyopathy Association www.4hcm.org
- Heart Rhythm Foundation www.heartrhythmfoundation.org
- Heart Rhythm Society www.hrsonline.org
- Mended Hearts, Inc. www.mendedhearts.org/
- Parent Heart Watch www.parentheartwatch.org
- Project S.A.V.E. www.choa.org/projectsave
- Sudden Cardiac Arrest Association www.suddencardiacarrest.org/

- Take Heart America: Sudden Cardiac Arrest Survival Initiative www.takeheartamerica.org/

b. SUDEP

- American Epilepsy Society http://www.aesnet.org/go/search?criteria=SUDEP&x=17&y=6
- Center for Disease Control http://www.cdc.gov/epilepsy/sudep/index.htm
- Chelsea Hutchison Foundation http://www.chelseahutchisonfoundation.org
- Citizens United for Research in Epilepsy (CURE) http://cureepilepsy.org/research/sudep.asp
- Danny Did Foundation http://www.dannydid.org/
- Epilepsy Bereaved http://www.sudep.org
- Finding A Cure for Epilepsy and Seizures (FACES) http://faces.med.nyu.edu/
- Making Sense of SUDEP http://www.makingsenseofsudep.org
- North American SUDEP Registry http://www.sudep–registry.org
- Partners Against Mortality in Epilepsy http://www.aesnet.org/pame/
- SUDEP Aware http://www.sudepaware.org

General Definitions

Terminal Illness

Examples

- Cancer that cannot be cured and death is expected within 6 months
- Lissencephaly – a rare brain disorder where death is expected by age 10

Cardiac

- Medical condition related to the heart including the superior/inferior vena cava, aorta, main pulmonary artery, right and left atrium, right and left ventricle, pulmonary veins, and the cardiac valves (tricuspid, mitral, pulmonary, and aortic).
- Does <u>not</u> refer to the vascular system (of, relating to, affecting, or consisting of a vessel or vessels, especially those that carry blood– except the aorta and main pulmonary artery, the superior/inferior vena cava, and the pulmonary veins).

Epilepsy/Seizure Disorder

- Defined by any of the following conditions:[1]
  - At least two unprovoked (e.g., not febrile) seizures occurring more than 24 hours apart
  - One unprovoked seizure and a probability of further seizures occurring over the next 10 years
  - Diagnosis of an epilepsy syndrome

Convulsions/Seizures

- An episode or history of an episode(s) that could be seizure(s), but without a definitive diagnosis of epilepsy
- Terms used to indicate seizure–like activity: history of seizure, fit, episode, attack or spell, falling out spell, drop attack, staring spell, or out–of–touch

Terms and Diagnoses to Help Identify SDY Cases

- Terms are further defined in examples below. It is of particular importance to note if a child had a previous diagnosis in the SDY section of the case reporting system or if the diagnosis was listed as the official cause of death and/or was not previously known.

[1] Fisher et al. A practical clinical definition of epilepsy. Epilepsia, 2014, 55(4): 475–482.

Cardiac–Related Terms That Can Cause Sudden Death

- Aortic Disease
  - Aortic Aneurysm
  - Aortic Dissection
  - Aortic Rupture
- Arrhythmia Syndrome
  - Brugada Syndrome
  - Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT)
  - Long QT Syndrome
  - Wolff–Parkinson–White Syndrome (WPW)
- Cardiomyopathy
  - Arrhythmogenic Right Ventricular Cardiomyopathy/Dysplasia (ARVC/D)
  - Dilated Cardiomyopathy (DCM)
  - Hypertensive Cardiomyopathy
  - Hypertrophic Cardiomyopathy (HCM)
  - Left Ventricular Non–compaction (LVNC)
  - Restrictive Cardiomyopathy (RCM)
- Commotio Cordis
- Congenital Heart Disease (some forms of CHD are associated with sudden death; others are not)
- Coronary Artery Disease
- Endocarditis
- Kawasaki Disease with coronary artery aneurysms
- Myocarditis
- Pericardial Tamponade

Neurologic/Epilepsy/Seizure Disorder–Related Terms That Can Cause Sudden Death

- Arteriovenous malformation (AVM)
- Brain aneurysm
- Brain hemorrhage
- Brain infection
  - Encephalitis
  - Meningitis
- Brain injury
  - Anoxic

    - Traumatic
- Brain tumor
- Central apnea
- Dravet Syndrome
- Generalized tonic–clonic seizure/ grand mal seizure
- Heterotopia
- Mesial temporal sclerosis
- Neurodegenerative process
- Status epilepticus
- Stroke
    - Brain hemorrhage
    - Ischemic stroke
- Sudden Unexpected Death in Epilepsy (SUDEP)
- Tuberous sclerosis complex

Explained Other

- Blood Disease
    - Acute chest syndrome (complication) of Sickle Cell Disease
- Infectious Disease
    - Croup
    - Epiglottitis
    - Sepsis
- Metabolic
    - Hepatic failure
    - Inborn errors of metabolism
    - Diabetic ketoacidosis (DKA)
- Respiratory
    - Apnea
    - Asthma
    - Airway compression/compromise/malformation
    - Foreign body
    - Pulmonary embolism
    - Pulmonary hemorrhage
    - Pulmonary hypertension
    - Respiratory arrest

Sudden Unexplained Infant Death (SUID)

- Unknown/undetermined/unspecified
- SIDS – sudden infant death syndrome
- SUID – sudden unexpected or unexplained infant death
- Unintentional sleep–related asphyxia /suffocation/strangulation
- Unspecified suffocation, cardiac or respiratory arrest without other well–defined causes
- Other non–specific causes WITH potentially contributing unsafe sleep factors

Examples and Definitions for SDY Categories

Explained Cardiac

- Aortic Disease
  - Aortic aneurysm/dissections/rupture – abnormal dilation of the wall of the aorta, usually 50% greater than its normal diameter/ tear in the intima (inner layer) creating a false lumen. The worst outcome is aortic rupture. At risk young individuals include those with collagen vascular diseases (e.g., Marfan syndrome, Ehlers–Danlos) or bicuspid aortic valve, Turner Syndrome, or hypertension.
- Arrhythmia syndrome
  - Brugada (BRS) – autosomal dominant genetic disorder of ion channels in the heart. Absence of structural cardiac disease. Characteristic abnormal pattern on electrocardiogram (pseudo right bundle branch block and ST segment elevation in leads V1 to V3) and a high risk of ventricular arrhythmias and sudden cardiac death.
  - Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT) –Genetic mutation in cardiac calcium receptors leading to life threatening ventricular tachycardia or fibrillation of various morphologies triggered by emotional or physical stress (including exercise). Fainting is often the first manifestation of the disease. Absence of structural cardiac disease.
  - Long QT Syndrome (LQTS) – Genetic mutations in cardiac ion channels leading to prolonged repolarization (relaxation) and increased risk of life–threatening cardiac arrhythmia (torsades de pointes). This is illustrated by a prolonged QT interval on the electrocardiogram. This can be inherited or acquired (from drug therapy, hypokalemia and hypomagnesemia). Absence of structural cardiac disease.
  - Wolff–Parkinson–White (WPW) – Persistent electrical pathways between the cardiac atria and ventricles that allow electricity to bypass the normal conduction system and can predispose to supraventricular tachyarrhythmias (including atrial fibrillation). Sudden death can result from rapid ventricular response during atrial fibrillation. The electrocardiogram reveals a short PR interval and a delta wave. Most individuals have structurally normal hearts, but WPW can be seen in people with Ebstein's anomaly of the tricuspid valve and hypertrophic cardiomyopathy.
- Cardiomyopathy
  - Arrhythmogenic Right Ventricular Cardiomyopathy/Dysplasia (ARVC/D) – fibro–fatty replacement of myocardium in the right ventricle due to mutations in genes encoding the cardiac desmosomal proteins. There is a high incidence of ventricular arrhythmias and sudden cardiac death.
  - Dilated Cardiomyopathy (DCM) – Left ventricular dilation in the absence of histologic changes consistent with an inflammatory cardiac condition and also in the absence of coronary artery disease. Most non–ischemic cases are idiopathic (no known cause) but may be familial or genetic.
  - Hypertensive Cardiomyopathy –Left ventricular hypertrophy or dilation in the setting of known clinical hypertension.
  - Hypertrophic Cardiomyopathy (HCM) – Genetic heart muscle disease. Many mutations causing this disease are located in the sarcomere genes. Gross pathologic and histologic findings of a non–dilated left ventricle with hypertrophy, in the absence of coexistent

disease that could cause the magnitude of hypertrophy. Histology shows myocyte disarray. It may be associated with genetic syndromes (e.g., Noonan, Pompe, and others). Individuals may have left ventricular outflow tract obstruction, diastolic dysfunction, myocardial ischemia, and arrhythmias.
    - Left Ventricular Non–Compaction (LVNC) – altered myocardial wall with prominent trabeculae and deep intertrabecular recesses resulting in thickened myocardium with two layers (compacted and non–compacted myocardium). Symptoms include heart failure, arrhythmias, and thromboembolic events.
    - Restrictive Cardiomyopathy (RCM) – non–dilated ventricle with normal wall thickness but with rigid walls. Systolic function is normal, but diastolic dysfunction and restrictive filling lead to elevated filling pressures and dilated atria.

- Commotio Cordis – an impact to the chest wall leading to ventricular fibrillation and sudden cardiac death. Absence of structural cardiac disease.
- Congenital Heart Disease – structural heart disease present at birth. There are many varieties. Some forms of congenital heart disease have been associated with sudden cardiac death (e.g., tetralogy of Fallot, double outlet right ventricle, transposition of the great arteries, and single ventricle lesions such as double inlet left ventricle, hypoplastic left heart syndrome, and tricuspid atresia). Most forms of congenital heart disease are not associated with sudden death.
    - Anomalous coronary artery origins– i) Considered causative when specific anomalies known to be associated with sudden death were noted on autopsy, or a coronary anomaly was the only finding (e.g., anomalous left main coronary with take–off from the right coronary cusp and an intramural course between the pulmonary artery and aorta, anomalous right coronary artery with oblique take–off, and regional acute or chronic corresponding regional perfusion defect, single coronary artery, and anomalous left coronary artery from the pulmonary artery (ALCAPA). Separate coronary ostia, cloacal left main coronary artery and anomalous circumflex off the right coronary cusp are not commonly considered to be causative of sudden death.
    - Anatomic (non–surgical) shunts –patent ductus arteriosus, aortopulmonary window
    - Anomalous venous connections (systemic or pulmonary)
        - Anomalous systemic veins
        - Anomalous pulmonary veins
    - Complex: tetralogy of Fallot, transposition of the great vessels, tricuspid atresia, pulmonary atresia, truncus arteriosus, total anomalous pulmonary venous connection, hypoplastic left heart syndrome, single ventricle, truncus arteriosus, pulmonary atresia/intact ventricular septum
    - Septal defects: atrial septal defect, ventricular septal defect, atrioventricular canal defect
    - Valve disease: aortic stenosis, bicuspid aortic valve, mitral stenosis, mitral valve prolapse, Ebstein's anomaly, coarctation of the aorta, aortic stenosis, pulmonary stenosis
- Palliated congenital heart disease – Some cardiac surgeries for congenital heart disease involve placement of surgical shunts or conduits to provide sources of systemic or pulmonary blood flow. Thrombosis/clots of such surgical shunts or conduits can lead to sudden death.
- Coronary artery disease – Gross pathologic and/or histopathologic findings of an acute myocardial infarction or occlusive atherosclerotic coronary artery disease.
- Endocarditis – bacterial infection of the heart valves with findings of vegetations that may

result in septic emboli (to the brain, lungs, eyes, skin, digits).

- Kawasaki Disease with coronary aneurysms – acute self–limited vasculitis characterized by fever, nonexudative conjunctivitis, erythema of the lips and oral mucosa, extremity changes, rash, and cervical lymphadenopathy. Coronary artery aneurysms (abnormal dilation of the walls of the coronary arteries) develop in approximately 15–25% of untreated children and may lead to ischemic heart disease or sudden death.
- Myocarditis – Histopathologic diagnosis of inflammatory infiltrates of the heart muscle with necrosis and/or degeneration of adjacent myocytes not typical of ischemic damage associated with coronary artery disease, leading to heart failure, arrhythmias, and sudden death.
- Pericardial tamponade – accumulation of pericardial fluid under pressure leading to impaired cardiac filling and subsequent decreased cardiac output and shock.

Explained Neurological

- Arteriovenous malformation – (AVM) is an abnormal connection between arteries and veins, bypassing the capillary system. This vascular anomaly is widely known because of its occurrence in the brain, but can appear in any location. Although many AVMs are asymptomatic, they can cause intense pain or bleeding or lead to other serious medical problems.
- Brain aneurysm – is an abnormal bulge or "ballooning" in the wall of an artery in the brain. Most brain aneurysms produce no symptoms until they become large, begin to leak blood, or burst.
- Brain hemorrhage – a type of stroke. It's caused by a blood vessel in the brain bursting and causing localized bleeding in the surrounding tissues. This bleeding kills brain cells.
- Brain infection
    - Encephalitis – an inflammation of the brain. Usually the cause is a viral infection, but bacteria can also cause it. It can be mild or severe.
    - Meningitis – inflammation of the thin tissue that surrounds the brain and spinal cord, called the meninges. The most common type is viral meningitis, which you get when a virus enters the body through the nose or mouth and travels to the brain. Bacterial meningitis is rare, but can be deadly. It usually starts with bacteria that cause a cold–like infection. It can block blood vessels in the brain and lead to stroke and brain damage. It can also harm other organs.
- Brain injury
    - Anoxic – a total depletion in the level of oxygen; an extreme form of hypoxia or "low oxygen".
    - Traumatic – (TBI) is most often an acute event similar to other injuries. Brain injuries do not heal like other injuries. Recovery is a functional recovery, based on mechanisms that remain uncertain. No two brain injuries are alike and the consequence of two similar injuries may be very different. Symptoms may appear right away or may not be present for days or weeks after the injury.
- Brain tumor – brain tumors may arise primarily from the brain tissues or may result from tumors in other organs (lung, breast, GI tract, skin, etc.) spreading (metastasizing) to the brain.
    - There are two main types of tumors: malignant or cancerous tumors and benign tumors.
- Central apnea – results when the brain temporarily stops sending signals to the muscles that control breathing and typically occurs during sleep. The condition often occurs in people who have certain medical problems.

- Neurodegenerative process – a disease in which the function or structure of the affected brain area will increasingly deteriorate over time.
- Stroke – the loss of brain function due to a disturbance in the blood supply to the brain. This disturbance is due to either ischemia (lack of blood flow) or hemorrhage.
    - Brain hemorrhage – a type of stroke. It's caused when a blood vessel in the brain bursts causing localized bleeding in the surrounding tissues. This bleeding kills brain cells.
    - Ischemic stroke– caused by a blockage within a blood vessel that supplies the brain

Epilepsy/Seizure Disorder Related

- Epilepsy[2] is a disease of the brain defined by any of the following conditions:
    - At least two unprovoked (or reflex) seizures occurring >24 h apart
    - One unprovoked (or reflex) seizure and a probability of further seizures similar to the general recurrence risk (at least 60%) after two unprovoked seizures, occurring over the next 10 years
    - Diagnosis of an epilepsy syndrome
    - Epilepsy is considered to be resolved for individuals who had an age–dependent
    - epilepsy syndrome but are now past the applicable age or those who have remained seizure–free for the last 10 years, with no seizure medicines for the last 5 years.
- Dravet Syndrome – also known as Severe Myoclonic Epilepsy of Infancy (SMEI), is a rare and catastrophic form of intractable epilepsy that begins in infancy.
- Generalized tonic–clonic seizure/ grand mal seizure – features a loss of consciousness and violent muscle contractions. This type of seizure is associated with a high risk of morbidity and mortality, including sudden unexpected death in epilepsy (SUDEP).
- Heterotopia – presence of a particular tissue type at a non–physiological site, but usually co–existing with original tissue in its correct anatomical location. Heterotopia within the brain is often divided into three groups: subependymal heterotopia, focal cortical heterotopia and band heterotopia.
- Mesial temporal sclerosis – Mesial temporal sclerosis is closely related to temporal lobe epilepsy, a type of focal (partial) epilepsy in which the seizure initiation point can be identified within the temporal lobe of the brain. Mesial temporal sclerosis is the loss of neurons and scarring of the temporal lobe associated with certain brain injuries.
- Tuberous sclerosis complex – (TSC) is a genetic disorder that causes non–malignant tumors to form in many different organs, primarily in the brain, eyes, heart, kidney, skin and lungs. Most individuals with TSC have seizures, typically starting at a very young age.

Explained Other

- Blood Disease (Hematologic)
    - Acute chest syndrome (complication) of Sickle Cell Disease - a vaso-occlusive crisis of the pulmonary vasculature. This condition commonly manifests with fever, respiratory symptoms, and a new opacification of the lung(s) on a chest x-ray.
    - Pulmonary embolism – obstruction of the pulmonary artery or one of its branches by thrombus, tumor, air or fat that originated elsewhere in the body. If severe, it may result in acute right ventricular heart failure and death.
- Infectious Disease
    - Note: the following infections are categorized elsewhere: endocarditis (cardiac), myocarditis (cardiac), encephalitis (neuro) and meningitis (neuro)

- Croup - inflammation of the larynx and trachea in children, associated with infection and causing breathing difficulties.
- Epiglottitis – inflammation of a flap of cartilage at the root of the tongue, which is depressed during swallowing to cover the opening of the windpipe.
- Sepsis – a life-threatening illness caused by an overreaction of the body's immune response to an infection.

- Metabolic Causes
  - Hepatic failure - rapid deterioration of liver function that results in coagulopathy, usually with an international normalized ratio (INR) of greater than 1.5, and alteration in the mental status (encephalopathy) of a previously healthy individual.
  - Inborn errors of metabolism - genetic (inherited) disorders in which the body cannot properly turn food into energy. The disorders are usually caused by defects in specific proteins (enzymes) that help break down (metabolize) parts of food.
  - Diabetic ketoacidosis (DKA) - a serious complication of type 1 diabetes and, much less commonly, of type 2 diabetes. DKA happens when the blood sugar is very high and acidic substances called ketones build up to dangerous levels in the body.
- Respiratory
  - Apnea - temporary cessation of breathing, often during sleep.
  - Asthma - a respiratory condition marked by spasms of the muscles and inflammation of the bronchi of the lungs, causing difficulty in breathing. It may be associated seen more commonly in people with allergies or other forms of hypersensitivity.
  - Airway compression/compromise/malformation
    - Tumor
    - Vascular
    - Infectious
      - Tracheitis - inflammation of the trachea, usually secondary to a nose or throat infection
      - Lemierre Syndrome- infectious thrombophlebitis of the internal jugular vein. It most often develops as a complication of a bacterial sore throat infection in young, otherwise healthy adults.
      - Retropharyngeal abscess - a collection of pus in the back of the throat.
  - Foreign Body - an object or piece of extraneous matter that has entered the body by accident
  - Pulmonary hemorrhage - an acute bleeding from the lung from the upper respiratory tract, trachea, and/or the alveoli
  - Pulmonary hypertension – elevated pulmonary artery pressure leading to vasculopathy/muscularization of the small muscular pulmonary arterioles (medial hypertrophy, intimal hyperplasia, and plexiform lesions). May be idiopathic (primary) or secondary to other diseases (e.g., connective tissue diseases or unrepaired/palliated congenital heart disease).
  - Respiratory arrest - is caused by apnea (cessation of breathing) or respiratory dysfunction severe enough that it will not sustain the body (such as agonal breathing).
- Status Epilepticus
  - A seizure that lasts more than five minutes or more than one seizure within a five–minute period without returning to normal consciousness between events. Status epilepticus may be convulsive (i.e. with 'violent muscle contractions') or non–convulsive (i.e. without violent physical convulsions but with persistent altered responsiveness and evidence of seizures on an EEG recording). Status epilepticus has a high rate of mortality, not only because of the potential for brain injury, but often through effects on

other body systems like the heart and lungs.

- The International League Against Epilepsy (ILAE) defines status epilepticus as: Status epilepticus is a condition resulting either from the failure of the mechanisms responsible for seizure termination or from the initiation of mechanisms, which lead to abnormally, prolonged seizures (after time point t_1). It is a condition, which can have long–term consequences (after time point t_2), including neuronal death, neuronal injury, and alteration of neuronal networks, depending on the type and duration of seizures.

Explained Infant Suffocation (under age 1)

- Case investigation is complete
- Scene investigation provides sufficient evidence of suffocation or asphyxiation caused by an external airway obstruction. Examples include witnessed overlay, entrapment or wedging, or face pressed into and airway fully occluded by soft bedding (e.g., pillow, egg crate foam, cushion, sleeping bag, or couch). Suffocation must be probable given the infant's age and likely stage of development.
- Evidence of full, external obstruction of both nose and mouth or external compression of the neck or chest. Event was reliably witnessed, and there were no conflicting accounts of full external obstruction of both nose and mouth or external compression of the neck or chest.
- Potentially fatal findings or concerning medical conditions were not present at postmortem examination.

Unexplained, Possible Cardiac

- Child had *one or more* of the following cardiac factors:
  - Family history (sibling, parent, aunt, uncle, first cousin or grandparent) of:
    - Potentially fatal cardiac conditions (e.g., cardiomyopathy, arrhythmia)
    - Sudden unexpected death from birth to age 50
    - Examples include:
      - Family History of sudden unexpected death before age 50 (SIDS, SUID, Drowning, Relative who was the driver in a fatal unexplained motor vehicle accident)
      - Family History of Heart Disease:
        - Heart condition/heart attack or stroke before age 50
        - Family History of Arrhythmia Syndrome:
          - Brugada
          - Catecholaminergic Polymorphic Ventricular Tachycardia
          - Long QT Syndrome
          - Wolff–Parkinson–White Syndrome
      - Family History of Cardiomyopathy:
        - Arrhythmogenic Right Ventricular Cardiomyopathy Dysplasia (ARVC/ARVD)
        - Dilated
        - Hypertrophic
        - Left Ventricular Non–compaction
        - Restrictive
  - Personal history of a cardiac diagnosis (e.g., intracardiac surgery for congenital heart

disease, or diagnoses including hypertrophic cardiomyopathy, Long QT syndrome or Tetralogy of Fallot) or a history of loss of consciousness **during** exertion
    - Factors present at death suggestive of cardiac death (e.g., death following intense exertion, driver in a single car accident, drowning of a child who knew how to swim, emotional or auditory stimuli at time of event including fear, anger, alarm clock, phone ringing)

Unexplained, Sudden Unexpected Death in Epilepsy (SUDEP)

- History of epilepsy/seizure disorder with or without evidence of a seizure (include febrile, exclude status epilepticus) at the time of death.

Unexplained Infant Death/SUID

- Child under the age of one year (0–364 days old)
- No known cause after complete investigation
- Not categorized as Explained Suffocation by the CDR Team using Step 2 of the Algorithm
- Not categorized as Explained, Incomplete, or Possible Cardiac/SUDEP using Step 3 of the Algorithm

Unexplained Child Death

- Child one year old or older (365 days old or older)
- No known cause after complete investigation

SUID Specific Categories

Note: These cases are assigned a second category using Step 3 of the Algorithm

Unexplained: No Unsafe Sleep Factors

- Death is unexplained after complete case investigation.
- Death may or may not occur during sleep. For those deaths that occur during sleep, the sleeping environment is free of unsafe sleep factors or other suffocation or strangulation hazards.
- Note: case may or may not have other potentially fatal findings, concerning conditions, or competing cause of death, but how these factors contribute to death is uncertain.

Unexplained: Unsafe Sleep Factors

- Death is unexplained after complete case investigation.
- Found in an unsafe sleep environment, but the role of the unsafe sleep environment in causing or contributing to the death is uncertain. Examples of unsafe sleep factors are soft objects or loose bedding (e.g., pillow, blanket), not in a crib, portable crib or bassinette, shared sleep surface, found non–supine.
- No factors that might indicate suffocation were present. No evidence of face pressed into or obstructed by soft bedding (e.g., pillow, egg crate foam, sleeping bag, or couch), witnessed overlay, entrapment, or wedging.
- Note: case may or may not have other potentially fatal findings, concerning conditions, or competing cause of death, but how these factors contribute to death is uncertain.

Unexplained: Possible Suffocation with Unsafe Sleep Factors

- Death is unexplained after complete case investigation.
- Scene investigation provides evidence of suffocation or asphyxiation caused by an external airway obstruction. Examples include overlay, entrapment or wedging, or face pressed into and airway fully occluded by soft bedding (e.g., pillow, egg crate foam, cushion, sleeping bag, or couch).
- Event was not witnessed or there was a conflicting account of full external obstruction of both nose and mouth, or external compression of the neck or chest.
- AND/OR Potentially fatal findings or concerning medical conditions were present at postmortem examination.
- AND/OR although there was strong evidence of suffocation, suffocation does not seem probable given the infant's age and likely stage of development (e.g., otherwise healthy 11–month–old infant found face down on pillow).

Checklists for Improving Your Data at SDY Advanced Review

Directions

Use these checklists to make sure you have all the information the Advanced Review Team needs to categorize each case and document their thought process appropriately.

For each case:

1. Abstract before the Advanced Review Meeting
2. Discuss at the Meeting
3. Document in the Case Reporting System

Important Information for Every Case

1. **Was this death sudden and unexpected?** Occasionally a case reaches Advanced Review that may not meet the inclusion criteria of "sudden" and "unexpected". The Advanced Review Team should use their expertise to determine if the death was truly sudden and unexpected.

   Questions to discuss to decide if a case was truly sudden and unexpected:

   - Was the death **sudden**? **Sudden** – death within 24 hours of the first symptom, or death in the hospital after resuscitation from cardiac arrest.
   - Was the death **unexpected**? **Unexpected** – death of someone who was believed to be in good health, or had a stable chronic condition or acute illness that would not be expected to cause death.
     - Examples of such stable chronic conditions and acute illnesses could include congenital heart disease, epilepsy, asthma and pneumonia.
   - What was the child doing in the days leading up to their death (was the child healthy enough to attend daycare/school)?

   Example: Lissencephaly at age 10 is an example of a case that looked sudden and unexpected during the investigation, but that the Advanced Review Team would not find sudden or unexpected because Lissencephaly is a rare brain disorder with a life expectancy of 10 years.

2. **Findings from Autopsy** – All autopsy findings should be discussed. Be sure that those that support the diagnosis are entered in the autopsy section (F4–9) of the Case Reporting System. Some teams

erroneously only enter such findings into the narrative section.

3. **Single Cause of Death** – If there is not a single cause of death (e.g., the team identifies multiple possible contributing factors), the case should be categorized as unexplained. Do not use "catch all" terms such as: complications of prematurity, complications of sickle cell disease, or complications of cerebral palsy.

4. **Family Medical History Information** – Minimal information to include:
    - Sudden unexpected death < 50 years old – if yes specify cause of death and relationship to decedent (include siblings, parents, aunts, uncles, first cousins, or grandparents of decedent)
    - Heart condition/heart attack or stroke before age 50 – If yes, specify type of heart condition and relationship to decedent (include siblings, parents, aunts, uncles, first cousins, or grandparents of decedent)
5. **Document in Advanced Review notes (N3) why a case was categorized a certain way.**
   Examples:
    - **Explained Other:** *The AR Team discussed the child's known diagnosis and treatment of asthma. The autopsy findings were consistent with an asthma attack. The team agreed on the categorization of explained other: asthma.*
    - **Explained Cardiac**: *The AR Team felt that the hypertrophy found in the heart at autopsy was consistent with a diagnosis of hypertrophic cardiomyopathy and significant enough to cause death.*
    - **Explained Neurological**: *The AR Team discussed the child's symptoms and autopsy findings that were consistent with meningitis. The team agreed on the categorization of explained neurological.*
    - **SUDEP:** *The AR Team discussed the child's known diagnosis and treatment for seizures. The team agreed on the categorization of SUDEP.*
    - **Possible Cardiac**: *The AR Team discussed the child's history of fainting, and the paternal grandfather's sudden and unexpected death at age 40 and felt they were significant enough to categorize the case as possible cardiac.*
    - **Unexplained:** If there is no information support a more specific cause, include a note: *The team determined there were no cardiac, neurological or other findings for an explained cause of death in this case. The team agreed on the categorization of unexplained infant/child death.*
    - **Discuss and make prevention recommendations**: Was this death preventable?

Important Information for Specific Case Types

Asthma

☐ If the child had a diagnosis of asthma by a medical professional (I1e)

☐ Current treatment (I1h–k)

- Was the child compliant with their prescribed medications? If not, describe why and how often.
- Recent medication changes (e.g., extra doses, missed doses, change of medication)

☐ Triggers/circumstances of the asthma attack (e.g. child had a virus, child was exercising, child exposed to allergen or other substance that could have triggered attack)?

☐ Autopsy findings from lungs (including findings that support asthma death) (F9)

Cardiac

☐ If the child had a diagnosis of cardiac disease (e.g., intracardiac surgery for congenital heart disease, or diagnoses including hypertrophic cardiomyopathy, Long QT syndrome or Tetralogy of Fallot, among others.) by a medical professional (I1e).

- If the diagnosis is heart murmur - Specify the type and whether the child had an innocent heart murmur (i.e., no structural heart problem) or some underlying congenital defect or acquired heart disease that could cause a heart murmur on exam.
- If the child was diagnosed with an arrhythmia, specify the type.

☐ Current treatment (I1h–k)

- If the child compliant with their prescribed medications? If not, describe why and how often.
- Recent medication changes (e.g., extra doses, missed doses, change of medication)
- Other substances ingested within 24 hours of death

☐ Family History (specifically in siblings, parents, aunt, uncles, first cousin, or grandparents) of:

- Potentially fatal cardiac conditions (e.g., cardiomyopathy, arrhythmia)
- Sudden unexpected death from birth to age 50 (if yes, specify cause)

☐ Factors present at death suggestive of cardiac death (e.g., death during or following intense exertion, driver in a single car accident, drowning of a child who knew how to swim, emotional or auditory stimuli at time of event including fear, anger, alarm clock, phone ringing)?

☐ Autopsy findings from the heart (including finding that support cardiac death) (F9)

Drowning

☐ Child's age?

☐ Child's swimming ability (H3v)?

☐ Was the drowning witnessed or unwitnessed?

☐ Details of the body of water (i.e., what kind of body of water)?

☐ Any risks in the water (deep water, dark water, rushing water)?

☐ Family history (specifically in siblings, parents, aunt, uncles, first cousin, or grandparents) of:

- Young sudden death < 50 years old?
- Irregular heart rhythms?
- Unexplained fainting?
- Motor vehicle accidents?
- Drowning?

Epilepsy/SUDEP (H1p–v)

☐ Child's age when diagnosed with epilepsy/seizure disorder

☐ Details of the child's epilepsy/seizures, including

- Last less than 30 minutes
- Last more than 30 minutes (status epilepticus)
- Occur in the presence of fever (febrile seizure)
- Occur in the absence of fever
- Occur when exposed to strobe lights, video game, or flickering light (reflex seizure)

☐ The underlying cause(s) of the child's seizures

- Brain injury/trauma

- Brain tumor
- Cerebrovascular
- Central nervous system infection
- Degenerative process
- Developmental brain disorder
- Inborn error of metabolism
- Genetic/chromosomal
- Mesial temporal sclerosis
- Idiopathic or cryptogenic
- Other acute illness or injury other than epilepsy
- Other, specify: _____

☐ Type(s) of seizures had by the child
- Non–convulsive
- Convulsive (grand mal seizure)
- Generalized tonic–clonic seizure
- Occur when exposed to strobe lights, video game, or flickering light (reflex seizure)

☐ Number of seizures in the year preceding the death

☐ Current treatment/medications in use
- Compliance with prescribed medications. If not, describe why and how often.
- Recent medication changes (i.e., extra doses, missed doses, change of medication)
- Other Substances within 24 hours of Death?
- If treatment for seizures included an anti–epileptic drug:
- If yes, how many different types of anti–epilepsy drugs (AED) did the child take
- Were therapeutic levels detected on autopsy

☐ Was night surveillance used?

Motor Vehicle Crashes

☐ Circumstances (road conditions (dry, icy), time of day, speed, passengers)?

☐ Condition of the driver
- Were they distracted?
- Sleep deprived?
- Intoxicated?
- Upset?
- Inexperienced at driving?

☐ How was the driver feeling in the days/hours leading up to the event: Were they feeling “normal” or sick?

☐ Medical history of the driver
- Any history of fainting?
- Seizures?
- Arrhythmia or heart palpitations?

☐ Family history of:
- Young sudden death < 50 years old?
- Irregular heart rhythms?
- Unexplained fainting?
- Motor vehicle accidents?

- Drowning?

Pneumonia

☐ How was the child feeling in the days/hours up until the death?
- Were they feeling sick?
- Febrile?
- Coughing?
- Other symptoms you would expect for someone with pneumonia severe enough to cause death?

☐ Had the child been diagnosed with pneumonia, or recently seen by a health care provider for their symptoms?

☐ Was the child taking any prescription or over–the–counter medications for their symptoms?

☐ Document in Autopsy section abnormal findings from lungs or other findings that support pneumonia death

Other Infection Beyond Those That Affect the Heart and Brain*

☐ How was the child feeling in the days/hours up until the death?
- Were they feeling sick?
- Febrile?
- Were they experiencing symptoms you would expect for someone with an infection severe enough to cause death?

☐ Had the child been diagnosed with an infection, or recently seen by a health care provider for their symptoms?

☐ Was the child taking any prescription or over–the–counter medications for their symptoms?

☐ Document in Autopsy section (F9) findings from lungs or other findings that support infection as the cause of death
- Epiglottis
- Urinary tract infection
- Other

*Myocarditis and endocarditis are categorized as cardiac. Meningitis and encephalitis are categorized as explained neuro.

Sickle Cell Disease

☐ Triggers (high elevations, severe dehydration or intense physical activity)?

☐ Symptoms?

☐ Lab tests?

☐ Document in Autopsy section findings from that support sickle cell as the cause of death (F9)