

A Reference Guide for Certification of Deaths in the Event of a Natural, Human-induced, or Chemical/Radiological Disaster

Executive Summary

Death certificates are the fundamental and primary source of official mortality statistics in the United States. Disaster-related mortality data collected from death certificates are used to assess the scope of an event, identify common risk factors for these deaths, and develop evidence-based public health interventions. Death certificates help families recover from catastrophic events, and data compiled from death certificates help the nation, states, and cities become better prepared to mobilize resources more efficiently.

Currently, inconsistencies in reporting a death as disaster-related on the death certificate make it difficult to generate reliable and accurate mortality statistics and to identify the most frequent causes of death associated with disaster events (1). With complete and accurate information, statistics at the national, state, and local levels can be generated, and research conducted, to better understand contributors to disaster-related deaths. Emergency personnel, public health and public safety professionals, and others use this information to plan for and implement targeted interventions to mitigate risk during disaster response and recovery.

This Reference Guide provides examples and recommendations for recording the name and type of disaster on the death certificate to ensure greater interjurisdictional consistency. The key to more accurate reporting of disaster-related deaths is to promote a common framework and decision-making process for determining disaster relatedness (2,3). Following this guidance will help ensure that disaster relatedness is reflected appropriately on the death certificate.

National statistics are compiled from information on death certificates using the *International Classification of Diseases*, which categorizes deaths by event type (e.g., cataclysmic event) but does not distinguish whether the event is a disaster. Disaster is an overarching concept, which includes many event types. To identify disaster-related deaths, researchers use a combination of coded causes of death and either manual review of death certificates or text analytics of the unstructured data. If the certifier does not record the event name and type on the death certificate, information on the cause of death may be lost, and the death may not be properly counted.

Federal disaster declarations and other notifications, such as local National Weather Service extreme weather warnings or watches and emergency management alerts, can be used to determine whether a disaster has occurred in a jurisdiction. Once a disaster is recognized, determining whether a death is disaster-related is a necessary step. **Deaths can be directly or indirectly related to the disaster** (2,4–6). For planning and preparedness purposes, recognizing and recording all disaster-related deaths is important, whether the deaths are directly or indirectly related:

- A **directly related death** is defined as a death directly attributable to the forces of the disaster or by the direct consequences of these forces, such as structural collapse, flying debris, or radiation exposure (2).
- An **indirectly related disaster death** occurs when the unsafe or unhealthy conditions present during any phase of the disaster (i.e., pre-event or preparations, during the actual occurrence, or post-event during cleanup after a disaster) contribute to a death (2).

This Reference Guide includes a one-page summary and flowchart for determining disaster relatedness for use in the field (Figure). The full Reference Guide provides definitions and examples of disaster-related deaths, tips for successful tracking of disaster-related deaths, and guidance on filling out the death certificate. In addition, this guide includes scenarios and examples of completed death certificates for a variety of common disaster types and causes of disaster-related deaths.

Introduction

Disasters can be severe weather events, other types of natural disasters, or human-induced incidents. The majority of disaster-related deaths are from major floods, extreme heat and cold, and tornadoes (7). Other natural disaster incidents may be geological, such as earthquakes and volcanic eruptions. Human-induced disasters can be technological, transportation, or humanitarian crises, and may involve chemical or radiological processes. To improve recognition and reporting of disaster-related deaths, the Centers for Disease Control and Prevention (CDC) brought together a group of medical examiners, forensic pathologists, and epidemiologists in the late 1990s to develop a matrix for attributing a death to disasters (2). This matrix logic has been

applied by medical examiners and coroners (ME/Cs) after several large-scale events, including hurricanes (e.g., Katrina, 2004–2005 Florida hurricane season, and Isabel) (4,5,8).

Unfortunately, reviews of death certificates after several recent natural disasters (e.g., tornado outbreak on April 27, 2011, and Hurricane Ike) demonstrated that the number of disaster-related deaths were underreported (1). One reason for this underreporting is the lack of awareness by medical certifiers of what constitutes a disaster-related death and how to document this information on the death certificate. This guide converts the matrix previously developed for attributing deaths during disasters into an operational, in-the-field user guide for a) training before events occur, b) use during an event, and c) conducting retrospective disaster-related mortality studies.

Through improved consistency in death certification practices, more accurate statistical information can be compiled. Better data help public health officials and emergency response and recovery workers plan for future events, determine risk factors, monitor national trends, and save lives.

What is a disaster?

From the perspectives of health services and public health consequences, a disaster may be defined as “the result of a vast ecological breakdown in the relation between humans and their environment, a serious and sudden event (or slow, as in a drought) on such a scale that the stricken community needs extraordinary efforts to cope with it, often with outside help or international aid” (9–12). CDC offers a more concise variation:

A serious disruption of the functioning of society, causing widespread human, material, or environmental losses, that exceeds the local capacity to respond, and calls for external assistance. (Available from: <https://www.cdc.gov/nceh/hsb/disaster/training.htm>.)

Alternative definitions of disasters focus on other aspects of the event (8). The key factor of the public health-focused definition of a disaster is that it causes serious disruption and may overwhelm the local jurisdiction, leading to requests for assistance from other local, state, or federal entities. Regardless of the event’s magnitude, sufficient information about the type of event (e.g., hurricane or flood) needs to be included on the death certificate to characterize the cause appropriately. After the disaster, researchers, responders, and other public health professionals may use this information in post-event analyses to classify deaths as directly or indirectly related to the event.

Why is the death certificate important during a disaster?

Death certificates and death data are used during and after disasters by families, public health officials, and emergency response agencies (Box 1). Death certificates assist families in meeting administrative, legal, and personal needs after a disaster. The information provided on the death certificate, including the cause of death, is collected and used for a variety of purposes. After the event, death certificate information is coded using the *International Classification of Diseases* (ICD). ICD includes codes to classify natural and human-induced disaster events (e.g., X37 Victim of a cataclysmic storm or X38 Victim of flood). These data are used to produce verified and accurate national and state estimates of disaster-related mortality. These statistics support the planning development, policy making, and funding that lead to adoption of evidence-based prevention strategies for future disasters at the national, state, local, tribal

Box 1: Examples of How Death Certificate Information Is Used by Stakeholders

Promotes resiliency of families:

- Assists families in reaching emotional closure about the loss of their relative(s).
- Enables families to settle estates and prevent identity theft.
- Qualifies families for immediate Federal Emergency Management Agency funeral assistance, if the disaster is federally declared.

Provides critical, actionable information for public health agencies:

- Defines the mortality scope and impact of a disaster event.
- Identifies leading causes of disaster-related death and at-risk groups who benefit from targeted interventions, to mitigate ongoing hazards and ultimately save lives.
- Enables public health officials to accurately respond to media and other inquiries during a particular event.
- Establishes multistate mortality statistics and supporting public statements.
- Evaluates the efficacy of mitigation strategies to better prepare public health agencies, emergency response and recovery workers, and communities for disasters.
- Informs individuals and communities about disaster preparedness planning for future events.

Provides verified and accurate data for other disaster response and management organizations to use in their disaster-related activities:

- Research partners, including CDC, use death certificate information to identify deaths during a disaster and to determine risk factors and populations at risk for disaster-related deaths. This information is used to develop and evaluate prevention strategies.
- The U.S. Department of Health and Human Services (HHS) and state agencies support the development and adoption of evidence-based prevention strategies for future disasters at the national, state, and community levels.
- The National Weather Service inputs mortality information into the National Oceanic and Atmospheric Administration Storm Events Database.

and territorial, and community levels. For these reasons, if a death is disaster-related, including a reference to the disaster on the death certificate is crucial. **If the ME/C or other certifier thinks the disaster played any role in the death, the certifier should report this information on the death certificate. If the information is not recorded, it will be lost, the death will not be coded correctly, and the death will not be counted as disaster-related.**

Determining Whether a Death Is Disaster-related

Determining whether a death is disaster-related may be challenging. A wide variety of hazards and exposures may directly or indirectly cause or contribute to deaths before, during, and after disasters. **Box 2** summarizes tips for identifying, tracking, and certifying disaster-related deaths. The following questions and definitions are provided to guide the decision-making process.

How do I know if a disaster has occurred in my area?

ME/Cs should use information obtained from reliable sources, such as National Weather Service (NWS) official warnings or watches, emergency management information, and official alerts (e.g., state of emergency or Federal Emergency Management Agency declaration), to determine whether a disaster has occurred in their jurisdiction (**Appendix I**).

How do I determine whether a death was associated with the disaster?

Once a disaster is recognized, the certifier should gather sufficient information on the circumstances of the death to determine whether the death was related to the disaster. For further information, refer to the guidelines on death scene investigation published by the U.S. Justice Department's National Institute of Justice (13).

Deaths may occur before, during, or immediately after the disaster, or months or years after the event. Deaths may also occur among emergency responders and recovery workers during the course of providing services—documenting these fatal occupation-related injuries and health conditions is equally important.

To assist ME/Cs in determining relatedness, definitions for the types of disaster-related deaths, key questions, examples, and lists of common causes of deaths associated with disasters follow.

Box 2: Tips on Preparing for Identifying, Tracking, and Certifying Disaster-related Deaths

Prepare for disasters:

- Foster partnerships with other medical examiners or coroners (ME/Cs), vital records agency personnel, health department preparedness directors, epidemiologists, mass fatality experts, law enforcement, hospital directors, and other emergency responders. Develop plans to coordinate efforts to identify and report disaster-related fatalities.
- Review your jurisdiction's mass fatality and other response plans (e.g., hurricane and radiologic release) to ensure this Reference Guide is listed as a resource for ME/C offices during all types of disasters.
- Consider providing training from this Reference Guide for staff.
- If you have an electronic death registration system (EDRS), examine with your vital records agency whether your EDRS includes options, such as flags, drop-downs, and "pop-up" dialog boxes, to help track the event. Note that these tracking tools may be local. To ensure the information is part of the official record and is ICD-10-coded, the specifics of the events must be included in the cause-of-death statements.
- Participate in your jurisdiction's mass-fatality planning and exercises.
- Consider partnering with your health department to conduct retrospective reviews of fatality data for recent events from multiple sources (e.g., death certificate, emergency manager, or health department information) to evaluate completeness and accuracy of data reported on the death certificate.

Certification of disaster-related deaths:

- Keep this Reference Guide close at hand during a disaster event.
- Use the flowchart, "Determination of Disaster-related Deaths" (**Figure**), to assist your decision-making in determining disaster relatedness.
- Consider both directly and indirectly related disaster deaths.
- For emergency response and recovery workers who die while providing services related to disasters, document on the death certificate that the injury occurred at work.
- Remember to record the disaster type and name of the event on the certificate.

Initiate tracking of disaster-related deaths:

- Consider starting a line list to track cases of disaster-related deaths to answer immediate questions during the disaster.
- Share line list information with public health, emergency management, and other response partners according to your standard operating procedures.

What are the types of disaster-related deaths?

Deaths can be directly or indirectly related to the disaster (2,5).

- A **directly related disaster death** is defined as a death directly attributable to the forces of the disaster or by the direct consequences of these forces, such as structural collapse, flying debris, or radiation or chemical exposure (2).

A key question for ME/C or other certifier to ask is:

- *Was the death caused by the actual environmental forces of the disaster such as wind, rain, flood, earthquake, or*

blast wave, or by the direct consequences of these forces such as structural collapse, chemical spill, or flying debris? If so, this is a directly related death that was caused by natural or human-induced forces.

Drowning deaths in flooded areas during a thunderstorm, or blunt force trauma caused by flying debris during a chemical plant explosion, are examples of direct deaths (Box 3).

Box 3: Common Causes of Direct Disaster-related Death

- Burns
- Crushing
- Drowning
- Electrocutation
- Falls
- Fire or smoke inhalation
- Hyperthermia (heat)
- Hypothermia (cold)
- Radiation or chemical poisoning
- Suffocation
- Traumatic injury
- Blunt-force trauma
- Penetrating injury

- An **indirectly related disaster death** occurs when unsafe or unhealthy conditions are present during any phase of a disaster (i.e., pre-event or preparing for the disaster, during the disaster event, or post-event during cleanup after a disaster) and contributed to a death (2).

Key questions for ME/C or other certifier to ask are:

- *Did unsafe or unhealthy conditions from the environmental forces of the disaster contribute to the death?* These conditions could be loss or disruption of usual services (e.g., utilities, transportation, or health care). If so, this is an indirectly related death.
- *Did the forces, whether natural or human-induced disaster, lead to temporary or permanent displacement, property damage, or other personal loss or stress that contributed to the death?* These indirect circumstances involve personal loss or lifestyle disruption. If so, this is also an indirectly related death.

An example of an indirectly related disaster death is a death resulting from carbon monoxide poisoning due to use of a generator to power a home for multiple days after a storm because of a prolonged power outage. Another example is a hazardous material release from hurricane-damaged storage tanks during repairs (Box 4).

Natural deaths may be indirectly related to natural disasters, severe weather, or human-induced events. In some instances,

Box 4: Common Circumstances Leading to Indirect Disaster-related Death

- Acute exacerbation of chronic condition(s) (e.g., asthma, cardiovascular)
- Cleanup after disaster (e.g., chain-saw injury, electrocution)
- Escaping or fleeing the disaster (e.g., saw the tornado and fell while rushing down storm shelter stairs [Note: This could be directly related if the tornado's winds led to the fall])
- Evacuation (e.g., motor vehicle crash while evacuating before the storm)
- Exposure to industrial or chemical hazards (e.g., chemical release from hurricane-damaged refineries [Note: This could be directly related if the exposure was due to a human-induced disaster])
- Loss/disruption of public utilities (e.g., fall in home without power)
- Loss/disruption of transportation-related services (e.g., lack of medical transport to dialysis)
- Loss/disruption of usual access to medical or mental health care (e.g., oxygen)
- Preparation for disaster (e.g., falling while putting up storm windows)
- Psychosocial stress or anxiety
- Social disruption, including riots or anarchy
- Return to unsafe, unhealthy structures or environment (e.g., electrocution)
- Use of temporary sheltering or provisions; displacement

chronic conditions may be exacerbated by an acute event. For example, asthma-related deaths have been associated with wildfires, and cardiovascular events with hurricanes (2,4,5,14). In these cases, if the medical certifier's opinion is that the event contributed to the death, the certifier should indicate the contribution of the disaster event on the death certificate.

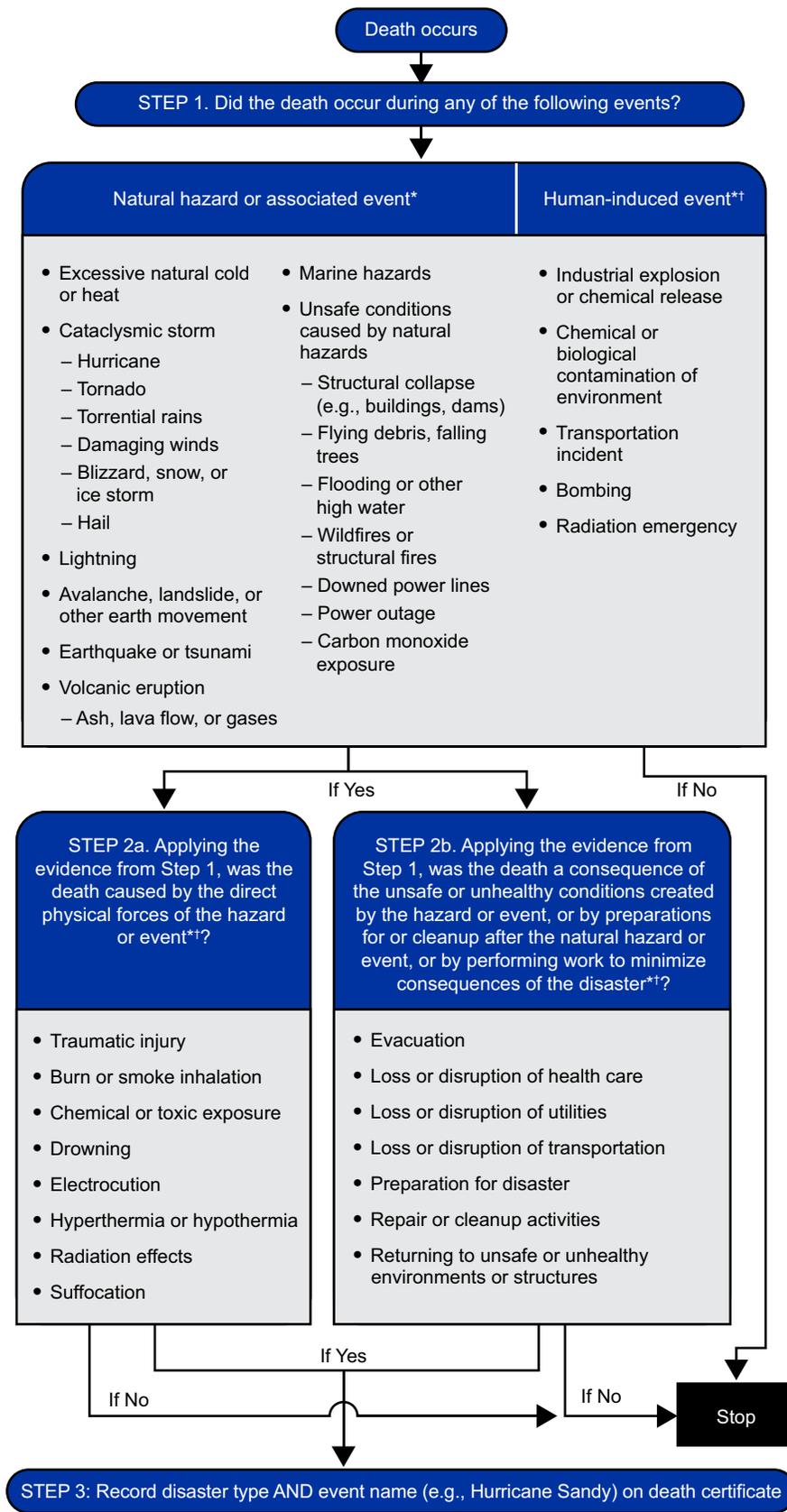
For public health and planning and preparedness purposes, recording sufficient information about the disaster-related circumstances on the death certificate is key, whether deaths are directly or indirectly related (2).

Completing the Death Certificate for Disaster-related Deaths

Once the death has been determined to be disaster-related, it is essential for the ME/C to include a brief description of the circumstances and the disaster type and name (e.g., Hurricane Sandy) on the death certificate (Figure). If this information is not reported on the death certificate, the statistics aggregated from death certificates may not reflect the true number of disaster-related deaths.

The instructions for completing death certificates in this Reference Guide are specific to disaster-related deaths. For

Figure. Determination of Disaster-related Deaths



Quick Reference: Completing Death Certificate for Disaster-related Death

Medical examiners or coroners are responsible for certifying deaths associated with both natural (e.g., hurricane) and human-induced (e.g., Boston marathon bombing) disasters.

What are some key points to remember when certifying disaster-related deaths?

- Consider indirect causes of deaths that can be related to the disaster.
- Record the disaster name and type on the death certificate.
- Identify all disaster-related deaths, even those occurring weeks or months after the event.

How to Use the Flowchart, “Determination of Disaster-related Deaths”

To determine if the death should be considered disaster-related:

STEP 1: Consider whether the death occurred during a disaster.

Use sources such as local National Weather Service or emergency management official warnings or watches, and official alerts (e.g., state of emergency, FEMA declaration), when considering whether a death occurred in a disaster zone (see disaster types on flowchart).

STEPS 2a and 2b: If yes to Step 1, use the questions to explore whether the death was directly or indirectly related to the disaster. Apply the evidence, including the death scene investigation, autopsy, and laboratory findings.

Consider using the “but for” principle: “But for the disaster (hostile environment), would the person have died when he/she did?” Use the evidence to formulate a decision on whether a death is disaster-related.

STEP 3: If yes to 2a or 2b, record the disaster type and name (e.g., Joplin Tornado, Hurricane Sandy) on the death certificate (this can be done in Part I, Part II, or in the Describe How Injury Occurred field).

Example of Completed Death Certificate for a Simulated Disaster-related Death

A 59-year-old female died 3 days after Hurricane Sandy. The storm caused a regional blackout. She was found in her house. A generator was running on the first floor of the home. According to emergency management officials, the carbon monoxide fumes inside the home were three times the danger level. She had a history of emphysema and long-term tobacco use.

CAUSE OF DEATH (See instructions and examples)

IMMEDIATE CAUSE (Final cause or condition resulting in death) Carbon monoxide poisoning

Underlying cause (Primary, leading to the cause listed in I, or the underlying cause)

Describe How Injury Occurred

Emphysema and long-term tobacco use

Carbon monoxide source was a generator located in the home due to power outage after Hurricane Sandy

* Not an exhaustive list.
† Includes unintentional and intentional events.

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general instructions on death certification, see the *Medical Examiners' and Coroners' Handbook on Death Registration and Fetal Death Reporting* (available from: https://www.cdc.gov/nchs/data/misc/hb_me.pdf).

For injuries caused by disasters, the “Describe how injury occurred” field can be used to record the disaster type and name. For natural deaths, the disaster type and name can be included in Parts I and II.

Who fills out the death certificate?

Most disaster-related deaths should be referred to the medical examiner or coroner in the jurisdiction where the death occurred. Depending on the statutes in the jurisdiction, the medicolegal office may take ownership of the case and complete the death certificate. In a few jurisdictions, the medicolegal death investigation entity may not be involved in investigating natural deaths that are ultimately determined to be indirectly related to the disaster.

Filling out Part I

As with any death, the cause-of-death conditions should be reported as precisely as possible in Part I of the death certificate, with the most recent condition listed on line a and the initiating condition on the lowest used line. Certifiers should report a single event on each line, even when the events occurred simultaneously. Avoid using abbreviations or acronyms. The disaster type and name can be included in Part I.

Filling out Part II

All other important events or conditions that were present at the time of death and that may have contributed to the death, but were not part of the causal sequence reported in Part I, should be recorded in Part II. The disaster type and name can be included in Part II as well.

Filling out “Describe how injury occurred” box

For injury deaths, a clear, brief statement indicating the circumstances surrounding the injury or external cause of death should be reported in the “Describe how injury occurred” field. The details provided in this field will depend on the type of injury and disaster involved (e.g., drowning in a flooded residence during Hurricane Ike storm surge).

If the injury occurred at work—including injuries among emergency response and recovery personnel—select “Yes” in the “Injury at work?” field.

Disaster-related Death Scenarios

This section contains two examples of how to fill out the death certificate. The scenarios and certificates were developed for instructional purposes. See [Appendix II](#) for additional instructional scenarios with completed death certificates and detailed explanations.

Scenario A. Natural disaster event

A 28-year-old male died when a tree fell on him during Hurricane Sandy. He suffered multiple trauma, including a fractured skull causing cerebral contusion. Emergency medical service and police reports indicated he thought the hurricane had passed and was walking his dogs.

Comment: This example links the head injury to a tree limb dislodged during the hurricane. Unless the injury is the result of a fall, consider using terms other than “fall” to describe falling debris, to avoid confusion.

Scenario A

CAUSE OF DEATH (See instructions and examples)	
32. PART I: Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Cerebral contusion Due to (or as a consequence of):
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. Fractured skull, facial and clavicle fractures Due to (or as a consequence of):
	c. Blunt impact to head Due to (or as a consequence of):
	d.
PART II: Enter other conditions (diseases, injuries, or complications) that did not result in the underlying cause given in PART I.	
33. WAS AN AUTOPSY PERFORMED? a. Yes <input type="checkbox"/> b. No <input type="checkbox"/>	
34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? (Enter Yes, No, or U) Yes <input type="checkbox"/> No <input type="checkbox"/> U <input type="checkbox"/>	
35. ICD-10 Cause of Death: a. <input type="text"/> b. <input type="text"/> c. <input type="text"/> d. <input type="text"/>	
36. ICD-10 External Cause of Injury: a. <input type="text"/> b. <input type="text"/> c. <input type="text"/> d. <input type="text"/>	
37. ICD-10 External Cause of Injury: a. <input type="text"/> b. <input type="text"/> c. <input type="text"/> d. <input type="text"/>	
38. ICD-10 External Cause of Injury: a. <input type="text"/> b. <input type="text"/> c. <input type="text"/> d. <input type="text"/>	
39. ICD-10 External Cause of Injury: a. <input type="text"/> b. <input type="text"/> c. <input type="text"/> d. <input type="text"/>	
40. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area) Outside on sidewalk	
41. ICD-10 External Cause of Injury: a. <input type="text"/> b. <input type="text"/> c. <input type="text"/> d. <input type="text"/>	
42. ICD-10 External Cause of Injury: a. <input type="text"/> b. <input type="text"/> c. <input type="text"/> d. <input type="text"/>	
43. DESCRIBE HOW INJURY OCCURRED: Walking dogs during Hurricane Sandy. Tree limb broke, striking decedent on head	

Scenario B. Human-induced event

A 39-year-old male was within 4 miles of an improvised nuclear device that was detonated in a major metropolitan area. The event was confirmed by the local emergency manager and FBI as an act of terrorism. The decedent was exposed to a radiation dose of 8 grays (800 rem) as a result of prompt radiation and radioactive fallout. He also had minor traumatic injuries and thermal burns on 15% of his total body surface area. He self-evacuated to a hospital 50 miles away. He developed acute radiation syndrome, starting with intractable vomiting approximately 1 hour after the explosion, followed by bone marrow depletion of granulocyte progenitors on day 2 of hospitalization. He survived for 23 days before expiring from gram-negative sepsis, despite receiving granulocyte colony-stimulating factors, broad-spectrum antibiotics, and multiple transfusions.

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Comment: For radiation events, understanding how radiation injuries can occur is important. Energy from the detonation of a nuclear weapon is released as blast (50%), extreme heat (35%), prompt radiation (5%), and delayed radiation in fallout (10%).

- **Initial deaths** would occur at or near ground zero from:
 - *Blast injuries*—Due to direct blast wave peak overpressure and indirect blast wind drag forces.
 - *Heat or thermal injury*—Direct absorption or direct transmission of thermal energy, causing flash burns or flame burns.
 - *Prompt radiation injury*—Initial detonation resulting in acute radiation syndrome.
- **Delayed deaths** may occur from initial blast injuries and acute radiation syndrome.

Government agencies determine if intentional acts are considered terrorism. If a death is related to an incident designated as terrorism by the federal government, the death certificate should reflect that determination (15). If an incident or event is labeled before completing the death certificate, add the description to the certificate. If the incident is designated as terrorism after the death certificate is completed, the certificate can be amended.

Scenario B

CAUSE OF DEATH (See instructions and examples)	
32. PART 1. Enter the <u>date of death</u> , diseases, injuries, or complications that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventilator failure without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Gram-negative sepsis Due to (or as a consequence of)
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. Aplastic anemia Due to (or as a consequence of)
	c. Acute radiation syndrome Due to (or as a consequence of)
	d.
PART 2. Enter other significant conditions contributing to death, but not resulting in the underlying cause given in PART 1	
Thermal burns, cutaneous radiation injury, cutaneous lacerations	
33. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area) Outdoor construction site	
34. DESCRIBE HOW INJURY OCCURRED: Intentional detonation of nuclear device by another person as an act of terrorism	

Summary

Death certificates play an important role in our understanding of mortality from disasters (3,16). Death certificates are needed by families recovering from a disaster; by public health officials to provide critical, actionable information during and after a disaster; and by public health preparedness to develop future prevention strategies to reduce morbidity and mortality from disasters. ME/Cs and other death certifiers play an integral and active role in identifying directly and indirectly related disaster deaths. Including the disaster name and type on the death certificate allows public health officials to identify deaths related to the disaster.

Many disaster-related deaths are preventable, and understanding the burden of these deaths is important to the prevention work done by public health, governing agencies, law enforcement, and emergency service providers. ME/Cs and other medical certifiers are responsible for the accuracy of information provided on death certificates, which affects the quality and usefulness of the statistics compiled from those certificates. For this reason, medical certifiers are in a unique position to provide critical, actionable information during and after a disaster.

This Reference Guide provides the rationale for including disaster relatedness on the death certificate, gives guidance on proper death certification, describes scenarios of disaster-related deaths, and provides examples of correctly completed death certificates. This guidance is intended for all persons concerned with the registration of deaths. If guidelines are followed, the information derived from the death certificates will better characterize disaster-related deaths and lead to more effective mitigation strategies and emergency response (2,17).

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Appendix I. Key Websites

Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response information on active public health responses:

<http://www.phe.gov/emergency/response/Pages/default.aspx>

Centers for Disease Control and Prevention's disaster information and publications:

<https://www.cdc.gov/disasters/index.html>

<https://www.cdc.gov/ncchd/hsb/disaster/epidemiology.htm>

<https://www.cdc.gov/co/surveillance/disaster.htm>

<https://www.cdc.gov/masstrauma/preparedness/primer.pdf>

Radiation emergency resources:

<https://emergency.cdc.gov/radiation/resourcelibrary/massfatalities.asp>

<http://www.remm.nlm.gov/>

<https://emergency.cdc.gov/radiation/index.asp>

<https://emergency.cdc.gov/radiation/pdf/radiation-decedent-guidelines.pdf>

<https://emergency.cdc.gov/radiation/determineddeaths.html>

Chemical emergency resources:

<https://emergency.cdc.gov/chemical/surveillance.asp>

<https://emergency.cdc.gov/chemical/>

Blast and bombing resources:

<https://www.cdc.gov/masstrauma/preparedness/primer.pdf>

<http://www.acep.org/blastinjury/>

<http://www.aapsus.org/wp-content/uploads/ajcmfour.pdf>

National Center for Health Statistics:

Medical Examiners' and Coroners' Handbook on Death Registration and Fetal Death Reporting

https://www.cdc.gov/nchs/data/misc/hb_me.pdf

Writing cause-of-death statements:

https://www.cdc.gov/nchs/nvss/writing_cod_statements.htm

Council of State and Territorial Epidemiologists, Disaster Epidemiology Subcommittee information on public health activities during disasters:

<http://www.cste.org/group/DisasterEpi>

National Weather Service:

Find the Weather Forecast Office in your state by geographical region (e.g., for Georgia, look under Southern Region link), available from:

<http://www.nws.noaa.gov/organization.php>

Appendix II. Additional Disaster-related Death Scenarios and Sample Death Certificates

This appendix contains examples of how to fill out the death certificate. The scenarios and certificates were developed for instructional purposes.

Natural disaster scenarios

Scenario I: Carbon monoxide during natural disaster

A 39-year-old female died during Hurricane Sandy in her home. The storm caused a regional blackout and she had used charcoal in her fireplace for heat. According to emergency medical services (EMS) officials, high carbon monoxide levels were detected in the home.

Scenario I

CAUSE OF DEATH (See instructions and examples)	
32. PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Carbon monoxide poisoning Due to (or as a consequence of):
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. _____ Due to (or as a consequence of):
	c. _____ Due to (or as a consequence of):
	d. _____ Due to (or as a consequence of):
PART II. Enter other <u>significant conditions contributing to death</u> , but not resulting in the underlying cause given in PART I	
Arteriosclerotic heart disease; Alzheimer's disease	
40. PLACE OF INJURY (e.g., Decedent's home; construction site; restaurant; wooded area) Decedent's home	
43. DESCRIBE HOW INJURY OCCURRED: Carbon monoxide source was charcoal use in the fireplace of the home due to power outage after Hurricane Sandy	

Comment: By stating in the “Describe how injury occurred” field that exposure to fumes from charcoal in the fireplace was due to the power outage during Hurricane Sandy, the certifier is providing information that this death was disaster-related. Such information would be challenging to find retrospectively.

When a carbon monoxide-related death is determined, the death certificate should identify:

- SOURCE OF CARBON MONOXIDE—Gas range, generator, charcoal grill, power washer, or other.
- LOCATION OF THE SOURCE—Basement, outside near window, house, garage, automobile, or other.
- CIRCUMSTANCE(S)—Indicate if the carbon monoxide death is disaster-related and the circumstances, such as power outage, using alternative heat source during snowstorm, no smoke detector in home, or other.
- MANNER—Consider that the carbon monoxide poisoning might be intentional.

Scenario II: Extreme winter cold and chronic condition(s)

An 85-year-old male with a history of Alzheimer disease and arteriosclerosis died from hypothermia after he wandered away from his home for an hour during a severe 2012 northeaster snowstorm, reported by local news. One option is:

Scenario II, option a

CAUSE OF DEATH (See instructions and examples)	
32. PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Hypothermia Due to (or as a consequence of):
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. Exposure to cold weather Due to (or as a consequence of):
	c. _____ Due to (or as a consequence of):
	d. _____ Due to (or as a consequence of):
PART II. Enter other <u>significant conditions contributing to death</u> , but not resulting in the underlying cause given in PART I	
Arteriosclerotic heart disease; Alzheimer's disease	
40. PLACE OF INJURY (e.g., Decedent's home; construction site; restaurant; wooded area) Wooded park area	
43. DESCRIBE HOW INJURY OCCURRED: Wandered away from house and was found outside during the nor'easter snowstorm	

Comment: By stating “exposure to cold weather” in Part I, the certifier is indicating that exposure for 1 hour in the snowstorm was the cause of death. Note that environmental hypothermia is an injury, even though Alzheimer disease, which may have led to the wandering, and heart disease were contributing factors.

An alternative approach in this case is to report the cause of death as environmental hypothermia, instead of hypothermia and exposure to cold weather, in Part I:

Scenario II, option b

CAUSE OF DEATH (See instructions and examples)	
32. PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Environmental hypothermia Due to (or as a consequence of):
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. _____ Due to (or as a consequence of):
	c. _____ Due to (or as a consequence of):
	d. _____ Due to (or as a consequence of):
PART II. Enter other <u>significant conditions contributing to death</u> , but not resulting in the underlying cause given in PART I	
Arteriosclerotic heart disease; Alzheimer's disease	
40. PLACE OF INJURY (e.g., Decedent's home; construction site; restaurant; wooded area) Wooded park area	
43. DESCRIBE HOW INJURY OCCURRED: Wandered away from house and was found outside during the nor'easter snowstorm	

Scenario III: Flash flooding

A 22-year-old male drowned when his pickup truck crossed a flooded bridge, and he was swept away by swift floodwaters associated with Hurricane Irene. His body was found 2 miles downriver. Significant rainfall occurred in the area, and a National Weather Service (NWS) flood warning was in place.

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Scenario III, option a

CAUSE OF DEATH (See instructions and examples)		Was an autopsy performed?
32. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.		
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Drowning	<input type="checkbox"/> Yes <input type="checkbox"/> No If YES, specify: _____
Due to (or as a consequence of):	b. _____	
Due to (or as a consequence of):	c. _____	
Due to (or as a consequence of):	d. _____	
PART II. Enter other significant conditions contributing to death, but not resulting in the underlying cause given in PART I.		
33. DID TOBACCO USE CONTRIBUTE TO DEATH?	34. IF FEMALE: Was pregnant within past year?	35. MANNER OF DEATH
<input type="checkbox"/> Yes <input type="checkbox"/> Probably <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Not pregnant within past year <input type="checkbox"/> Pregnant at time of death <input type="checkbox"/> Not pregnant, but pregnant within 42 days of death <input type="checkbox"/> Not pregnant, but pregnant 43 days to 1 year before death	<input type="checkbox"/> Natural <input type="checkbox"/> Homicide <input type="checkbox"/> Accident <input type="checkbox"/> Pending investigation <input type="checkbox"/> Suicide <input type="checkbox"/> Could not be determined
36. DATE OF INJURY (M/d/yy) (Spell Month)	37. TIME OF INJURY (Approximate)	38. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area)
		Flooded river
39. TRANSPORTATION INJURY, SPECIFY:		
<input type="checkbox"/> Driver/Operator <input type="checkbox"/> Passenger <input type="checkbox"/> Pedestrian <input type="checkbox"/> Nontransportation		
43. DESCRIBE HOW INJURY OCCURRED:		
Driver of pickup truck crossed flooded bridge during heavy rain from Hurricane Irene; found drowned in the river		

Comment: When a motor vehicle or other transport-related injury occurs in floodwater, the death certificate should:

- Provide context surrounding the motor vehicle incident (i.e., “crossed flooded bridge” and “heavy rain from Hurricane Irene”).
- Describe how the drowning occurred during the disaster.

When a motor vehicle or other transport-related injury is reported, the death certificate should identify:

- **ROLE OF THE DECEASED**—Driver, operator, pilot, passenger, unspecified occupant, pedestrian, person boarding or alighting from the vehicle, person outside of the vehicle, or other.
- **TYPE OF VEHICLE(S) INVOLVED**—Auto, pickup truck, 18-wheeler, bus, van, motorcycle, airplane, train, bicycle, or other.
- **OTHER OBJECT INVOLVED**—Telephone pole, tree, wall, or other.
- **TYPE OF ACCIDENT**—Collision, noncollision, rollover, pedestrian, or other.
- **TRAFFIC OR NONTRAFFIC**—Traffic means on a public highway or public road. Nontraffic means off a public highway or public road (on driveway, in park, on private road, or other).
- **TYPES OF PROTECTIVE EQUIPMENT OR RISKS**—Protective equipment includes seat belt, child safety seat, airbag deployed, or helmet used. Risks include drug or alcohol use, ejected from automobile, or other. Note: List only those critical items that contributed to the death (e.g., unrestrained).

An alternative approach is shown below. Line a could also include the event, because this was part of the sequence of events:

Scenario III, option b

CAUSE OF DEATH (See instructions and examples)		Was an autopsy performed?
32. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.		
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Drowning in floodwaters	<input type="checkbox"/> Yes <input type="checkbox"/> No If YES, specify: _____
Due to (or as a consequence of):	b. _____	
Due to (or as a consequence of):	c. _____	
Due to (or as a consequence of):	d. _____	
PART II. Enter other significant conditions contributing to death, but not resulting in the underlying cause given in PART I.		
33. DID TOBACCO USE CONTRIBUTE TO DEATH?	34. IF FEMALE: Was pregnant within past year?	35. MANNER OF DEATH
<input type="checkbox"/> Yes <input type="checkbox"/> Probably <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Not pregnant within past year <input type="checkbox"/> Pregnant at time of death <input type="checkbox"/> Not pregnant, but pregnant within 42 days of death <input type="checkbox"/> Not pregnant, but pregnant 43 days to 1 year before death	<input type="checkbox"/> Natural <input type="checkbox"/> Homicide <input type="checkbox"/> Accident <input type="checkbox"/> Pending investigation <input type="checkbox"/> Suicide <input type="checkbox"/> Could not be determined
36. DATE OF INJURY (M/d/yy) (Spell Month)	37. TIME OF INJURY (Approximate)	38. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area)
		Flooded river
39. TRANSPORTATION INJURY, SPECIFY:		
<input type="checkbox"/> Driver/Operator <input type="checkbox"/> Passenger <input type="checkbox"/> Pedestrian <input type="checkbox"/> Nontransportation		
43. DESCRIBE HOW INJURY OCCURRED:		
Driver of pickup truck crossed flooded bridge during heavy rain from Hurricane Irene; found drowned in the river		

Scenario IV: Hazardous hurricane conditions

EMS reported a 13-year-old female fell during the Moore tornado outbreak in Oklahoma. Her family witnessed her running down wooden basement stairs to escape the impending tornado. She fell approximately 15 steps headfirst, resulting in right parietal epidural bleed and skull fracture.

Scenario IV

CAUSE OF DEATH (See instructions and examples)		Was an autopsy performed?
32. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.		
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Right parietal epidural hematoma	<input type="checkbox"/> Yes <input type="checkbox"/> No If YES, specify: _____
Due to (or as a consequence of):	b. Right parietal skull fracture	
Due to (or as a consequence of):	c. Blunt impact to head	
Due to (or as a consequence of):	d. _____	
PART II. Enter other significant conditions contributing to death, but not resulting in the underlying cause given in PART I.		
33. DID TOBACCO USE CONTRIBUTE TO DEATH?	34. IF FEMALE: Was pregnant within past year?	35. MANNER OF DEATH
<input type="checkbox"/> Yes <input type="checkbox"/> Probably <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Not pregnant within past year <input type="checkbox"/> Pregnant at time of death <input type="checkbox"/> Not pregnant, but pregnant within 42 days of death <input type="checkbox"/> Not pregnant, but pregnant 43 days to 1 year before death	<input type="checkbox"/> Natural <input type="checkbox"/> Homicide <input type="checkbox"/> Accident <input type="checkbox"/> Pending investigation <input type="checkbox"/> Suicide <input type="checkbox"/> Could not be determined
36. DATE OF INJURY (M/d/yy) (Spell Month)	37. TIME OF INJURY (Approximate)	38. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area)
		Home
39. TRANSPORTATION INJURY, SPECIFY:		
<input type="checkbox"/> Driver/Operator <input type="checkbox"/> Passenger <input type="checkbox"/> Pedestrian <input type="checkbox"/> Nontransportation		
43. DESCRIBE HOW INJURY OCCURRED:		
Attempt to escape the Moore tornado, fell down 15 wooden stairs in home		

Comment: The certifier is providing critical information about the event (i.e., Moore tornado) so that the death can be identified as disaster-related using either text searches or manual review of the death certificate.

Scenario V: Motor vehicle-related death during hurricane evacuation

A 21-year-old female was critically injured in an automobile crash and diagnosed with a fractured skull causing cerebral contusion and multiple trauma, including a fractured sternum and pneumothorax. She died soon after being brought to the hospital. Police records indicated her car slid off wet roads into

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a ditch as she was evacuating for Hurricane Ike. Toxicological and alcohol screenings were negative.

Scenario V

CAUSE OF DEATH (See instructions and examples)	
32. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	33. Enter the date of death
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Cerebral contusion
Due to (or as a consequence of):	b. Fractured skull
Due to (or as a consequence of):	c. Blunt impact to head
Due to (or as a consequence of):	d.
33. PART II. Enter other significant conditions contributing to death, but not resulting in the underlying cause given in PART I	Fractured sternum, pneumothorax
34. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area)	Highway
35. DESCRIBE HOW INJURY OCCURRED:	Unrestrained driver of a car while evacuating for Hurricane Ike. Car slid off wet road and struck tree.

Comment: When a motor vehicle or other transport-related injury is reported, the death certificate should identify:

- **ROLE OF THE DECEASED**—Driver, operator, pilot, passenger, unspecified occupant, pedestrian, person boarding or alighting from the vehicle, person outside of the vehicle, or other.
- **TYPE OF VEHICLE(S) INVOLVED**—Auto, pickup truck, 18-wheeler, bus, van, motorcycle, airplane, train, bicycle, or other.
- **OTHER OBJECT INVOLVED**—Telephone pole, tree, wall, or other.
- **TYPE OF ACCIDENT**—Collision, noncollision, rollover, pedestrian, or other.
- **TRAFFIC OR NONTRAFFIC**—Traffic means on a public highway or public road. Nontraffic means off the public highway or public road (on driveway, in park, on private road, or other).
- **TYPES OF PROTECTIVE EQUIPMENT OR RISKS**—Protective equipment includes seat belt, child safety seat, airbag deployed, and helmet used. Risks include drug or alcohol use, ejected from automobile, or other. Note: List only those critical items that contributed to the death (e.g., unrestrained).

Scenario VI: Heat-related death during heat wave

An 85-year-old male with a known history of arteriosclerosis and chronic obstructive pulmonary disease was reported unconscious in his home. The temperature in the home was 86 degrees Fahrenheit during the East Coast derecho and heat wave, as reported by local NWS and weather stations in a major metropolitan area. He died 2 days later in the intensive care unit with a discharge diagnosis of multi-organ failure from complications of heat stroke. EMS reported that he lived alone

and had a functioning air conditioner that was not on; his family indicated that he was concerned about his electric bill.

Scenario VI

CAUSE OF DEATH (See instructions and examples)	
32. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	33. Enter the date of death
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Hyperthermia
Due to (or as a consequence of):	b. Exposure to excessive environmental heat
Due to (or as a consequence of):	c.
Due to (or as a consequence of):	d.
33. PART II. Enter other significant conditions contributing to death, but not resulting in the underlying cause given in PART I	Arteriosclerosis and chronic obstructive pulmonary disease
34. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area)	Decedent's home
35. DESCRIBE HOW INJURY OCCURRED:	Functioning air conditioner in home but not on during the East Coast derecho and heat wave

Comment: Enhanced information provides comprehensive picture of the circumstances surrounding this heat-related death. Lack of air conditioning is a contributor for many heat-associated deaths, and medical history can be used to identify vulnerable populations for outreach.

Human-induced events

Scenario VII: Intentional radiation incident from radiological dispersal device

A 65-year-old male in his home was within 1 mile of a radiological dispersal device (RDD) (i.e., dirty bomb) detonated in a major metropolitan area. The incident was confirmed by the local emergency manager and FBI. The decedent's home was completely destroyed, and he died immediately from massive head and multiple traumatic injuries.

Scenario VII

CAUSE OF DEATH (See instructions and examples)	
32. PART I. Enter the chain of events—diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	33. Enter the date of death
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Cerebral injury
Due to (or as a consequence of):	b. Multiple trauma to head, torso, and extremities
Due to (or as a consequence of):	c. Blast injury from explosion
Due to (or as a consequence of):	d.
33. PART II. Enter other significant conditions contributing to death, but not resulting in the underlying cause given in PART I	
34. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area)	Decedent's home
35. DESCRIBE HOW INJURY OCCURRED:	Intentional detonation of a radiological dispersal device by another person

Comment: Inclusion of the RDD makes it easier for officials to flag the record as being related to the disaster.

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Scenario VIII: Chemical exposure death

A 42-year-old man died after a train derailed and a tanker car of chlorine ruptured 500 yards uphill from his house, according to EMS and police records. He suffered asphyxiation after airway compromise and pulmonary edema secondary to chlorine gas inhalation.

Scenario VIII

CAUSE OF DEATH (See instructions and examples) PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Asphyxia <small>Due to (or as a consequence of):</small>
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. Pulmonary edema <small>Due to (or as a consequence of):</small>
	c. Chlorine inhalation <small>Due to (or as a consequence of):</small>
	d.
PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PART I	
40. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area) Decedent's home	
43. DESCRIBE HOW INJURY OCCURRED: Downwind from chlorine spill from Greenville tanker railroad derailment	

Comment: By stating “downwind from chlorine spill” in the “Describe how injury occurred” field, the certifier is indicating that the exposure is associated with the death. Including the disaster name and type (i.e., “Greenville tanker railroad derailment”) ensures that these deaths will be identified as related to the chemical disaster.

Scenario IX: Chemical incident during natural disaster

A 33-year-old asthmatic worker at a water treatment facility developed respiratory distress and died at a hospital after being exposed to chlorine when a pipe leading from a chlorine tank cracked during the Northridge, California, earthquake, according to the medical record. Emergency management reports confirm that the chemical release was secondary to the earthquake.

Scenario IX

CAUSE OF DEATH (See instructions and examples) PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Acute respiratory failure <small>Due to (or as a consequence of):</small>
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. Chlorine inhalation <small>Due to (or as a consequence of):</small>
	c.
	d.
PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PART I	
Asthma	
40. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area) At work in a water treatment facility	
41. INJURY AT WORK? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
43. DESCRIBE HOW INJURY OCCURRED: Pipe connecting to tank of chlorine cracked during Northridge, California, earthquake and released chlorine gas into facility where he was working	

Comment: A person is determined to be potentially exposed if he or she was in the area of the chemical release and his or her illness is clinically compatible with exposure to a particular chemical. Manifestations of chemical poisonings can vary on the basis of individual differences of the exposed persons (e.g., previous medical history, genetic differences, sex, or age), route of exposure, amount and duration of exposure, and length of time since the exposure. Therefore, the clinical description may include multiple possible clinical manifestations.

Scenario X: Bombing or blast deaths

A 41-year-old firefighter responded to 911 call at the starting line of the Hawaii Ironman racing event, where an improvised explosive device went off. After she arrived, a second device was detonated, and the firefighter sustained fatal abdominal trauma. The incident was confirmed by the local emergency manager and local FBI. She died immediately at the scene of abdominal hemorrhage from her wounds.

Scenario X

CAUSE OF DEATH (See instructions and examples) PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.	
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. Abdominal hemorrhage and perforation <small>Due to (or as a consequence of):</small>
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST	b. Penetrating ballistic debris from exploded improvised explosive device <small>Due to (or as a consequence of):</small>
	c.
	d.
PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PART I	
40. PLACE OF INJURY (e.g., Decedent's home, construction site, restaurant, wooded area) Outdoor sporting event	
41. INJURY AT WORK? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
43. DESCRIBE HOW INJURY OCCURRED: Firefighter responding to discovery of improvised explosive device was struck by explosion of secondary device near starting line of the Hawaii Ironman Race	

Comment: When a death from a bombing or blast occurs, considering the unique pathophysiology of injuries associated with the explosion is important. By describing the object as an “improvised explosive device” and including words such as “exploded” in the text, the record can be identified as disaster-related. See the Centers for Disease Control and Prevention's primer for clinicians on “Explosions and Blast Injuries” (18).

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