

Guidance for Identifying and Certifying Death from Environmental Heat Exposure

Think of Heat as an Injury

- External condition that damages bodily tissue or its function
- Damage sustained may result in specific or nonspecific anatomic or functional derangements that cause death
- Injury event (Environmental Heat Exposure)-> Bodily trauma (Heat Stress)-> Fatal derangement (Heat Stroke)

Heat-related illness is a continuum of dysfunction ranging from mild illness (heat edema, heat cramps) to heat exhaustion and heat stroke, which may be fatal. Heat stroke is either exertional or non-exertional. A significant number of non-exertional deaths will occur in persons having pre-existing conditions known to be exacerbated by heat stress. Diagnosing heat-related mortality is challenging due to nonspecific anatomic and physiologic findings, difficulties in capturing accurate core body temperature, unreliable postmortem temperature, and the fact that a diagnosis of hyperthermia is not etiologically specific.

Risk Factors for Heat-Related Mortality

- Intrinsic: age (very young, elderly); high BMI; large muscle mass
- Behaviors: strenuous activity/work; excessive clothing/PPE; poor fluid intake; deconditioned/not acclimated; unhoused; social isolation
- Medical Conditions: cardiovascular disease; autonomic neuropathies; certain mental health disorders; dehydration; endocrine disorders; diffuse skin disease and/or scarring; fever/acute infection
- Medication*/Substances: illicit; antihypertensives (e.g., diuretics, beta blockers, calcium channel blockers, ACEi\ARBs); sympathomimetics; anticholinergics; antihistamines; thyroid replacement medications; tricyclic antidepressants; phenothiazines; MAO inhibitors; lithium; salicylates; ethanol; caffeine. *This list is not comprehensive. Refer to <u>CDC's Heat and Medications – Guidance for Clinicians</u> for more details.
- External: exposure to high heat index; low air circulation

Defining Death as Environmental Heat Exposure for the Death Certificate

Heat-Caused Deaths

→ Record as a primary cause of death when environmental heat is directly involved in the sequence of conditions resulting in heat stroke and death

Examples include: child inside a hot car, roofer working all day in hot & sunny conditions, opioid ingestion during excessive heat warning with subsequent heat stroke and fatal metabolic derangements

Heat-Contributed Deaths

→ Record as a significant contributing factor when pre-existing or co-existing conditions or risk factors that are known to be exacerbated by heat stress are the more important factor in causing death

Examples include: a significant underlying disease is exacerbated by an external event that in many people would be survivable; coronary artery disease exacerbated by stress of no AC during power outage

1. Criteria for Environmental Heat Exposure as Cause of Death

Clinical diagnosis if one or more is true:

- Measured antemortem body temp at time of collapse

 105°F, COD should be certified as heat stroke
 (fatal derangement) due to environmental heat exposure (injury event)
- Lower temperature acceptable if any prior cooling measures were attempted &/or with a clinical history of mental status changes and elevated liver and muscle enzymes

When clinical diagnosis is not available:

- If the investigation provides compelling evidence of continuous exposure to a hot environment and fails to identify another independent COD that would exclude heat as a factor
- A significant number of deaths will occur in persons having pre-existing conditions known to be exacerbated by heat stress
- Deaths may be certified with environmental heat exposure as the primary cause and disease conditions listed as other significant conditions or vice versa

2. Manner of Death

Record the manner of death as accidental when environmental heat exposure hastened death. This is true regardless of whether heat:

- unequivocally precipitated death
- exacerbated an underlying natural pathological condition
- produced a "natural" condition that constitutes the immediate COD
- contributed to the death of a person with natural disease typically survivable with heat exposure

3. Injury Information

- **Place of injury:** general description of where the injury (heat exposure) occurred (e.g., inside of own home, outside another's home, parking lot, construction site, sugarcane farm, public park).
- **Injury at work:** consider if engaged in work activities and situations where the exposure occurred at work, but the person died in a different location.
- Location of injury: provide full address. For unhoused individuals without an available street address, use an approximate location.
- **Describe how injury occurred:** include specific details from the death scene investigation (e.g., presence/use of AC, activities engaged in (working, exercising); location (outside, inside of house, in a vehicle), housing status (unhoused).

Summary

Certify Death from Environmental Heat Exposure when:

- Exposure to a hot environment that either causes or significantly contributes to the death
- There is a history of exposure to environmental conditions and reasonable exclusion of another independent COD that is not aggravated by heat
- Established from circumstances surrounding death, investigative reports on environmental conditions, and/or measured antemortem body temperature at the time of collapse



Examples of Medical Certification

This section contains examples for guidance on certification of environmental heat exposure.

Case 1: A 46-year-old male found unresponsive but alive near an unhoused encampment during a heat wave, with excessive heat warnings in the area the past 3 days. At the hospital, where he later died, his core temperature was recorded as 108°F. He had contact burns on his extremities and laboratory evidence of rhabdomyolysis, severe dehydration, and renal failure. Toxicology testing was positive for alcohol, opiates, and amphetamine.

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Manner of Death: ACCIDENT				
PART I. Enter the chain of events dise DO NOT enter terminal events such as o	CAUSE OF DEATH eases, injuries, or complications th cardiac arrest, respiratory arrest, or y	at directly caused th entricular fibrillation	ne death.	APPROXIMATE INTERVAL: Onset to Death
without showing the etiology. DO NOT	ABBREVIATE. Enter only one cau	se on a line.		
IMMEDIATE CAUSE a (Final disease or condition resulting in death)	HEAT STROKE		I	HOURS
Sequentially list conditions, if any, leading to the cause listed on line a.	NVIRONMENTAL HEAT E	XPOSURE	[DAYS
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events resulting in death) LAST				
PART II. Enter other significant condit	ions contributing to death but not re	sulting in the underl	ying cause	e given in PART I
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DESCRIBE HOW INJURY OCCURRE	D	I		
UNHOUSED. OUTSIDE DUR	ING HEAT WAVE. NO ACO	CESS TO AC O	DR COC	DLER
ENVIRONMENT, CORE TEM	PERATURE 108F			
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Analysis: The patient in this case had a core temperature consistent with heat stroke and environmental heat exposure as a primary COD, so it is recorded in Part I. Therefore, pre- or coexisting conditions and any risk factors that may have contributed to death are included in Part II. Since the manner of death is accidental, injury information is completed, including specific details of how the event occurred.

Case 2: A 60-year-old woman was found in her home. She was last seen by neighbors two days prior, when a midsummer tropical storm passed through. Her house windows were closed, and the AC was not on; it was very humid. The daytime heat index recorded at the local airport during the 5 days preceding her death ranged from 90°F to 105°F. She had a history of hypertension and diabetes.

Manner of De	eath: ACCIDE	NT				
		CAUSE OF DEAT	н			APPROXIMATE
PART I. Ente	r the chain of ev	ents diseases, injuries, or com	plications th	at directly caused	the death.	INTERVAL: Onset to Death
DO NOT ente	er terminal event	ts such as cardiac arrest, respirat	tory arrest, or v	entricular fibrillati	on	
without show	ing the chology.	DO NOT ADDREVIATE. LIIU	a only one cau	se on a nne.		
IMMEDIAT	E CAUSE -	HEAT STROK	E			MINUTES TO
(Final disease o	or condition resulti	ng in death) .				HOURS
Sequentially l leading to the	ist conditions, if cause listed on l	any, b EXPOSURE TO	ENVIRON	MENTAL HE	AT	HOURS TO DAYS
Enter the UN (disease or inj	DERLYING CA	AUSE ^{c.}				
events resulting	ng in death) LAS	ST d.				
PART II. Ente	er other significa	ant conditions contributing to d	leath but not re	sulting in the unde	rlying cau	use given in PART I
	NSION. DIA	BETES				
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INJURY	INJURY			Ν	INJURY, S	SPECIFY:
09/10/2024	06:00pm	INSIDE OF OWN HOME			NOT A	PPLICABLE
LOCATION OF 444 HOLID	F INJURY - (STRI AY DR CU	eet address, city, state, zij T OFF. LA 70112 UNITED	P CODE, COUN STATES	TRY)	PARISH/C :ORLEAN	COUNTY NS:
DESCRIBE H	HOW INJURY C	OCCURRED	VERY HUN		ONS SI	GNIFICANT
UNDERLY	ING DISEA	SE EXACERBATED H	EAT STRES	55		

Analysis: Since found in a hot environment, it should prompt consideration of environmental heat exposure as a COD. No AC and closed windows during the summer in Louisiana provides compelling evidence of continuous exposure to excessive heat. The medical history also reveals at least two diseases that are risk factors for heat-related mortality. A thorough investigation including circumstances preceding death, sequence of events, and your examination did not identify a specific COD that could explain death independent of prolonged heat exposure. This meets criteria for certifying death as environmental heat exposure. Further details may be entered to describe how injury occurred, such as circumstances surrounding death or if underlying disease that may have been exacerbated by heat stress (since it is inseparable with excessive heat exposure). **Case 3: A 65-year-old male was outside all day doing yard work after a tornado in July, with high heat index.** He was found unresponsive sitting next to a tree by his wife that evening. His medical history included diuretic medication for hypertension, antihistamines for allergies, and he was on a tricyclic antidepressant. Autopsy findings revealed atherosclerotic disease.

Manner of De	ath: ACCIDE	NT				
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without show	ing the etiology.	DO NOT ABBREVIATE. Ente	r only one cau	se on a line.	on	
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events resulting	ng in death) LAS	T _{d.}				
PART II. Ente	r other significat	nt conditions contributing to dea	ath but not resi	ulting in the underly	ying cause	e given in PART I.
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DESCRIBE H	IOW INJURY O	CCURRED	SURE. ME		ISK HE	EAT STROKE

Analysis: There are multiple conditions that increase risk of heat related fatality in this case, including intrinsic (age) external (high heat index), behavior (outdoor strenuous activity, possible low fluid intake), cardiovascular disease and polypharmacy (diuretic, antihistamine, TCA). An intact cardiovascular system is critical to maintain thermal homeostasis, so underlying dysfunction especially in the elderly have deleterious effects, particularly during heat waves. As in the previous case, there may be a fatal combination of disease and injury (heat) that seem inseparable or difficult to establish. You must decide which was most important to record as primary COD; record the other in Part II. Cardiac manifestations of heat stroke include arrhythmias, myocardial injury/ischemia, heart failure, and sudden death. It is acceptable to record either disease, or injury as the primary; importantly, record environmental heat exposure and any other specific details somewhere on the death certificate.

Resources: The Cardiovascular System in Heat Stroke

<u>Life-Threatening Events During Endurance Sports: Is Heat Stroke More Prevalent Than Arrhythmic Death?</u> <u>Exertional Heat Stroke during a Cool Weather Marathon A Case Study</u> **Case 4: A 70-year-old woman was found dead in her bedroom during the warm season.** The temperature in the room was over 110°F (37.8°C). There was an AC unit in her home, but it was blowing hot air. History of significant coronary artery atherosclerosis.

14 65							
Manner of De							
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without show	ing the etiology	y. DO NO	DI ABBREVIALE. Ente	r only one cause	on a line.		
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			d.				
PART II. Ente HEAT STR	er other signific RESS, ENV	cant con IRONI	ditions contributing to d	eath but not resu	ulting in the un	derlying cat NSION, P	ise given in PART I. KIDNEY
DISEASE							
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06/30/2024	05:00 PM	INSID	E OF OWN HOME	E	N	NOT A	PPLICABLE
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Analysis: Classifying manner of death depends on the conditions that result in death and the circumstances leading to those conditions. All deaths from external causes (injury or poisoning) are either unintentional (i.e., *accident*) or intentional (i.e., *homicide* or *suicide*). Deaths solely due to disease are *natural*. Since heat is an external COD (an injury), environmental heat exposure should always be accidental. In this example, evidence supported disease being the more important factor causing death, so heat stress and environmental heat exposure are listed in Part II. The manner of death is accidental because death is not solely due to disease when found in hot conditions with disease that is known to be exacerbated by heat stress (cannot determine it to be independent).

Resource: <u>Heat-Related Illnesses and Deaths</u>—Missouri, 1998, and United States, 1979-1996 <u>Heat-Related Deaths</u> --- United States, 1999--2003 **Case 5:** A 27-year-old woman was brought to the ER by co-workers after she had a seizure at work and fell off the loading dock. She works at a warehouse and had been loading packages in delivery trucks for 7 hours. She had a history of hypertension and was seen in the ER for heat illness a week ago; no history of seizures. This was her second day back on the job. Earlier she was complaining of cramping of extremities. At the ED, core temperature was recorded as 100°F and lab analysis revealed serum sodium of 114 mmol/L, acute liver and kidney injury, and rhabdomyolysis, in addition to the head injury she ultimately succumbed to.

Manner of Death: ACCIDENT CAUSE OF DEATH 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. APPROXIMAL INTERVAL: Onset to Death IMMEDIATE CAUSE - (Condition resulting in death) a SUBDURAL HEMATOMA MINUTES TO HOURS Sequentially list conditions, if any, leading to the cause listed on line a. b BLUNT IMPACT TO THE HEAD HOURS
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Sequentially list conditions, if any, leading to the cause listed on line a. Enter the UNDERLYING CAUSE 5411 EDOM USIONT
events resulting in death) LAST
PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in PAR ENVIRONMENTAL HEAT EXPOSURE, SEIZURE, RECENT HEAT ILLNESS,
HYPERTENSION.
WAS AN AUTOPSY PERFORMED? FINDINGS USED IN DETERMINING CAUSE? NO NOT APPLICABLE
DATE OF TIME OF PLACE OF INJURY INJURY AT IF TRANSPORTATION INJURY INJURY INJURY INJURY SPECIFY:
0//23/2024 01:00 PM INSIDE WAREHOUSE Y
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222 PACKAGE BLVD. COVINGTON. LA 70433 UNITED STATES ST. TAMMANY
DESCRIBE HOW INJURY OCCURRED
WORKING ALL DAY INSIDE WAREHOUSE WITH NO AC. PROBABLE HEAT STROKE

Analysis: A seizure after strenuous activity (loading packages in a delivery truck for 7 hours) should prompt investigating the environmental conditions to determine exposure to a hot environment versus exertion-associated hyponatremia with encephalopathy, amongst other conditions. An investigation finds the outdoor temperature was moderate however conditions in in the warehouse was warm and humid, with no air circulation, and she was wearing her work uniform (excessive clothing). Her medical history also has risk factors for heat fatality. You inquire about any prior cooling and find she had spent 20 minutes in an air-conditioned car on the ride to the hospital. This meets criteria for environmental heat exposure as the underlying event, rather than exertion-associated hyponatremia. This case highlights how at times, events leading to death cannot be determined to be independent of environmental heat exposure when in a hot environment. Therefore, specific details surrounding the death are included in available sections. When more than one trauma results from an event, include them all.

Resource: Life-threatening heat-related illness with severe hyponatremia in an aluminum smelter worker

Case 6: A 31-year-old male was working outside all day providing lawn care in July during high heat index.

He was found unresponsive by a coworker in the bed of his truck. He had a positive COVID test. A toxicology report was positive with multiple illicit substances.

Manner of De		NT				
PART I. Enter DO NOT enter without show	r the chain of ever er terminal event ing the etiology.	CAUSE OF DEAT ents diseases, injuries, or com ts such as cardiac arrest, respirat DO NOT ABBREVIATE. Ente	H plications th ory arrest, or v r only one cau	at directly caused t entricular fibrillati se on a line.	ihe death. on	APPROXIMATE INTERVAL: Onset to Death
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Sequentially 1 leading to the	ist conditions, if cause listed on l	f any, line a.	ENVIRON	MENTAL HEA	AT	HOURS
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DATE OF INJURY	TIME OF INJURY	PLACE OF INJURY	OF INJURY INJURY Y		IF TRAN INJURY,	SPORTATION SPECIFY:
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DESCRIBE H WORKING GRASS A	IOW INJURY O OUTDOOR LL DAY.	OCCURRED RS LAWN CARE, FOUN	ND IN TRU	CK BED AFT	ER CU	TTING

Analysis: It may be tempting to certify COD as polydrug use, cardiovascular disease, or COVID related. However, a young male working outside during the summer months should prompt consideration of environmental heat exposure as the primary cause, with other findings as contributing risk factors. If not for exposure to the hot environment, it is probable these conditions would be survivable. Note also that a positive toxicology screen alone does not inform when illicit substances were used in the events preceding death, so if there is no conclusive evidence of immediate use and conditions are not independent of heat exposure, then it is more probable as a risk factor than primary cause.