

Key Findings

- 36.9% of all deaths had an unsuitable underlying cause of death code.
- 1.7% of deaths had an unknown or ill-defined cause.
- 12.0% of deaths had an immediate or intermediate cause as the underlying cause of death.
- 23.2% of deaths had a nonspecific underlying cause of death.
- Unsuitable underlying cause of death codes varied by age group and place of death.

Assessing the Quality of Cause of Death Reporting, Montana Occurrences, 2015-2019

Introduction

Cause of death data from death certificates have many important uses from both administrative and public health needs. Information about the decedent and the circumstances of death provides family members closure, aids in the settlement of estates, and provides peace of mind. Medical information from the death certificate is used to monitor public health, develop policy, set public health goals, and direct funding towards medical research.

Physicians and other medical certifiers are primarily responsible for completing the cause of death section on the death certificate. Given the importance of the death certificate in public health, proper documentation, including timeliness, completeness, and accuracy are crucial.

This report evaluates the quality of cause of death statements using a list of unsuitable underlying causes of death (UCOD) and examines these measures by age group and place of death.

Methods

Source

Data used in this report come from the Montana death certificates collected by the Montana Office of Vital Records for deaths occurring in the state from 2015 through 2019. A total of 53,535 death certificates were included in this analysis.

Cause of Death

The cause of death section lies within the medical portion of the death certificate and is divided into two parts (Figure 1). Part I is to record the chain of events leading to death, proceeding backwards from the immediate cause, intermediate cause, to the underlying cause. In this manner, each cause leads to the condition listed on the line above. The World Health Organization (WHO) defines the UCOD “(a) as the disease or injury which initiated the train of morbid events leading directly to death, or (b) the circumstances of the accident or violence which produced the fatal injury”.¹ The UCOD should always be reported on the lowest line used in Part I. Part II contains information on the diseases and conditions which contributed to death but not part of the causal chain of events leading to UCOD.

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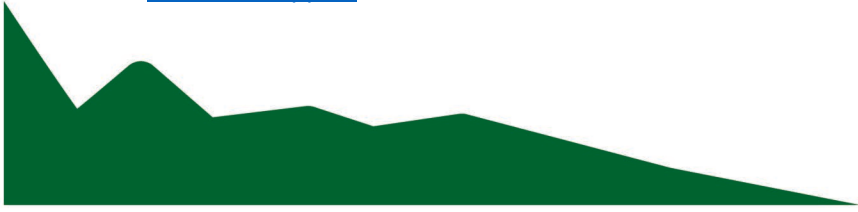




Figure 1. Immediate cause, intermediate cause, and underlying cause of death in Part I of the cause of death section.

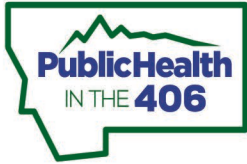
CAUSE OF DEATH (See instructions and examples)			Approximate interval: Onset to death
32. PART I. Enter the <u>chain of events</u> —diseases, injuries, or complications—that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation 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) →	Immediate Cause a. _____ 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	Intermediate Cause b. _____ Due to (or as a consequence of):		
	Underlying Cause c. _____ Due to (or as a consequence of):		
	d. _____		
PART II. Enter other <u>significant conditions contributing to death</u> but not resulting in the underlying cause given in PART I			33. WAS AN AUTOPSY PERFORMED? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
			34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? <input type="checkbox"/> Yes <input type="checkbox"/> No
35. DID TOBACCO USE CONTRIBUTE TO DEATH? <input type="checkbox"/> Yes <input type="checkbox"/> Probably <input checked="" type="checkbox"/> No <input type="checkbox"/> Unknown	36. IF FEMALE: <input checked="" 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"/> Unknown if pregnant within the past year	37. MANNER OF DEATH <input checked="" 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	

Figure 2. An example of a complete cause of death statement in Part I of the cause of death section.

CAUSE OF DEATH (See instructions and examples)			Approximate interval: Onset to death
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) →	Acute renal failure a. _____ 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	Hyperosmolar nonketotic coma b. _____ Due to (or as a consequence of):		
	Type 2 diabetes c. _____ Due to (or as a consequence of):		
	d. _____		
PART II. Enter other <u>significant conditions contributing to death</u> but not resulting in the underlying cause given in PART I			33. WAS AN AUTOPSY PERFORMED? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
			34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? <input type="checkbox"/> Yes <input type="checkbox"/> No
35. DID TOBACCO USE CONTRIBUTE TO DEATH? <input type="checkbox"/> Yes <input type="checkbox"/> Probably <input checked="" type="checkbox"/> No <input type="checkbox"/> Unknown	36. IF FEMALE: <input checked="" 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"/> Unknown if pregnant within the past year	37. MANNER OF DEATH <input checked="" 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	

The immediate cause of death is the disease or condition that directly caused the death and should always be reported on line a. Using Figure 2 as an example, the certifier reported acute renal failure as the immediate cause and hyperosmolar nonketotic coma as the intermediate cause. Intermediate causes are causes in the chain of events which give rise to the UCOD. Neither the immediate or intermediate causes of death fit the WHO definition of an UCOD because, in this example, multiple pathways can lead to both acute renal failure and hyperosmolar nonketotic coma. Conditions or injuries that could arise due to multiple etiologies should not be reported as the UCOD on the lowest line in Part I.

An appropriate UCOD leading to hyperosmolarity and renal failure would be type 2 diabetes because it is a specific condition fitting the WHO definition. In this example the complete cause of death statement would be acute renal failure (immediate cause) due to hyperosmolar nonketotic coma (intermediate cause) due to type 2 diabetes (UCOD).



This statement presents a clear chain of events beginning with the immediate cause working back to the UCOD. If an immediate or intermediate cause of death is reported without an UCOD, it results in either the immediate or intermediate cause of death being coded as the UCOD. A UCOD of acute renal failure or hyperosmolar coma, in this example, would indicate incomplete reporting of the actual UCOD.

The completed death certificate is sent to the National Center for Health Statistics (NCHS) for automated medical coding and any records that the computer cannot code are manually coded by trained NCHS nosologists. It is important to distinguish between what was reported as the UCOD and the coded UCOD. NCHS processes every written condition and contributing factors and the system selects the condition that best describes the initiating disease process or underlying cause of death based on a series of decision tables. Records are examined for contradictions, duplications, or other inconsistencies while an automated process applies corrections which may combine or eliminate certain conditions.^{2,3,4} The coding process is designed to compensate, to some extent, problems in cause of death reporting so that the coded UCOD reflects the actual UCOD. However, these procedures cannot account for all issues in cause of death certification such as failure to report complete and accurate information.

Unsuitable list of UCOD

The list of unsuitable UCOD and their corresponding diseases and conditions is intended to indicate incomplete cause of death reporting. The list used in this report is identical to those reported by Flagg and Anderson and was developed using the ICD-10 coding manuals and medical certification guidelines published by NCHS.^{5,6} Ambiguous conditions, diseases with "post" or "secondary" in title, major nonspecific disorders (e.g. Disorder of the brain, unspecified), and codes considered invalid as an UCOD were refined into three main subtypes of unsuitable UCODs: unknown and ill-defined causes, immediate and intermediate causes, and nonspecific UCODs.⁷

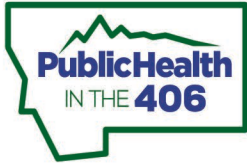
Unknown and ill-defined causes include unknown causes of death, mechanisms of death, and symptoms, signs, and abnormal clinical and laboratory findings not elsewhere classified. Mechanisms of death (e.g. cardiac arrest, respiratory arrest) attest only to the fact of death and provide no information on the cause whereas symptoms, signs, and abnormal clinical and laboratory findings not elsewhere classified can indicate two or more diseases or bodily systems.

Immediate and intermediate causes provide more information than the unknown and ill-defined causes but are missing critical information, namely, the UCOD. Using figure 2, acute renal failure is reported as an immediate cause. While it is acceptable for it to be reported on the higher lines of Part 1, it needs another condition listed below which caused the acute renal failure.

Nonspecific causes are conditions that are not sufficiently specific enough to be useful for public health research. For example, "cancer" is reported on the lowest line in Part 1. Since cancer arises from many different tissues, it requires additional information on the primary site (e.g. lung, stomach) so a more specific code can be assigned as the UCOD.

Analysis

Frequencies and percentages were calculated for all unsuitable UCODs and each subtype for deaths occurring in Montana from 2015 to 2019. Crosstabulations and chi-square tests were conducted comparing unsuitable UCODs and the subtypes by age group and place of death. All tests were statistically significant.



Results

From 2015-2019 in Montana, 36.9% of all deaths had a UCOD code that would be considered unsuitable (Table). Only 1.7% of deaths had an unknown and ill-defined UCOD. Of those deaths, symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (1.1%) were reported most frequently followed by cardiac arrest (0.4%), and respiratory failure, not elsewhere classified (0.3%).

Immediate and intermediate causes were reported in 12.0% of all deaths. Heart failure (3.4%), acute renal failure, chronic kidney disease, and unspecified kidney failure (1.3%), atrial fibrillation and flutter (1.2%), pneumonia, unspecified (1.2%), and sepsis, unspecified (1.0%) occurred most frequently.

Nonspecific UCODs were reported in 23.3% of all deaths. The most frequently reported UCODs were unspecified dementia (5.6%), atherosclerotic cardiovascular disease, so described (5.5%), atherosclerotic heart disease (3.7%), and stroke, not specified as hemorrhage or infarction (2.0%).

Unsuitable UCODs varied by age group with a “V” shaped distribution centered at ages 15 to 24 years (4.7%) while increasing to 25.8% among infants <1 year of age and to 50.1% among adults 85 years and older. Unknown and ill-defined UCODs were proportionately higher among ages <16 years while nonspecific UCODs were highest among those aged 25 years and older (Figure 3).

Unsuitable UCODs also varied by place of death (Figure 4). Nonspecific UCODs were similar among the following places: nursing home or long-term care facility (31.1%), dead on arrival (30.7%), and emergency room or outpatient (28.7%). The proportion of immediate and intermediate UCODs was highest among hospitals and inpatient facilities (18.2%).

Discussion

Over one-third of all deaths certified in Montana between 2015 and 2019 had an unsuitable UCOD code, 1.7% had an unknown and ill-defined UCOD, 12% had immediate and intermediate UCOD, and 23.2% had a nonspecific UCOD. Unsuitable UCOD codes varied by age and place with the highest prevalence among infants <1 year of age (25.8%), adults 85 years and older (50.1%), and in nursing homes or long-term care facilities (47.1%). Older adults tend to have multiple serious conditions which may increase the difficulty in assigning a specific UCOD among some certifiers and those who die in nursing homes or long-term care facilities tend to be older. Unsuitable UCODs among infants were the result of “undetermined” listed as the UCOD on the death certificate—the condition assigned by certifiers when a clear cause could not be determined.

It is important to note that certifiers may not have access to information needed to provide a specific UCOD. While it is unknown how often this happens, an unsuitable UCOD may be the best possible UCOD based on the available information.

This report serves to measure the completeness of cause of death reporting by assessing the UCOD using a list of unsuitable conditions. It can be used to determine if mortality data quality is changing over time or varying by characteristics such as certifiers or facilities and target interventions to improve data reporting. Monitoring the quality of cause of death reporting ensures that the death certificate efficiently performs its important administrative and public health functions.

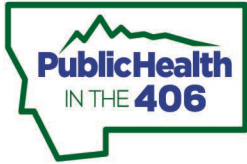


Table. Number and percentage of deaths for selected unsuitable underlying causes of death, Montana Occurrences, 2015-2019

Cause of Death ICD-10 Codes	Deaths	Percent
All causes	50,535	100.0
Unsuitable underlying causes of death	18,665	36.9
Unknown and ill-defined causes	862	1.7
Cardiac arrest (I46)	184	0.4
Respiratory failure, not elsewhere classified (J96)	134	0.3
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00–R94, R96–R99)	543	1.1
Other unknown and ill-defined causes (Residual)	1	0.0
Immediate and intermediate causes	6,082	12.0
Sepsis, unspecified (A41.9)	502	1.0
Secondary malignant neoplasm of other sites (C79)	56	0.1
Anemia, unspecified (D64.9)	52	0.1
Other disorders of fluid, electrolyte and acid-base balance (E87)	73	0.1
Anoxic brain damage, not elsewhere classified (G93.1)	116	0.2
Pulmonary embolism (I26)	159	0.3
Other secondary pulmonary hypertension (I27.2)	172	0.3
Cardiomyopathy, unspecified (I42.9)	208	0.4
Atrial fibrillation and flutter (I48)	590	1.2
Other cardiac arrhythmias (I49)	98	0.2
Heart failure (I50)	1,739	3.4
Phlebitis and thrombophlebitis (I80)	56	0.1
Pneumonia, organism unspecified (J18)	582	1.2
Hepatic failure, not elsewhere classified (K72)	112	0.2
Gastrointestinal hemorrhage, unspecified (K92.2)	205	0.4
Cellulitis (L03)	66	0.1
Acute renal failure, chronic kidney disease, and unspecified kidney failure (N17–N19)	680	1.3
Urinary tract infection, site not specified (N39.0)	208	0.4
Other immediate and intermediate causes (Residual)	408	0.8
Nonspecific underlying causes of death	11,721	23.2
Malignant neoplasm, without specification of site (C80)	652	1.3
Unspecified diabetes mellitus (E14)	913	1.8
Unspecified dementia (F03)	2,831	5.6
Atherosclerotic cardiovascular disease, so described (I25.0)	2,780	5.5
Atherosclerotic heart disease (I25.1)	1,847	3.7
Chronic ischemic heart disease, unspecified (I25.9)	97	0.2
Cardiovascular disease, unspecified (I51.6)	95	0.2
Heart disease, unspecified (I51.9)	72	0.1
Stroke, not specified as hemorrhage or infarction (I64)	1,029	2.0
Sequelae of stroke, not specified as hemorrhage or infarction (I69.4)	247	0.5
Liver disease, unspecified (K76.9)	82	0.2
Unspecified fall (W19)	354	0.7
Exposure to unspecified factor (X59)	163	0.3
Other nonspecific underlying causes of death (Residual)	559	1.1



Figure 3. Percentage of deaths with unsuitable underlying causes of death by age and subtype, Montana Occurrences, 2015-2019

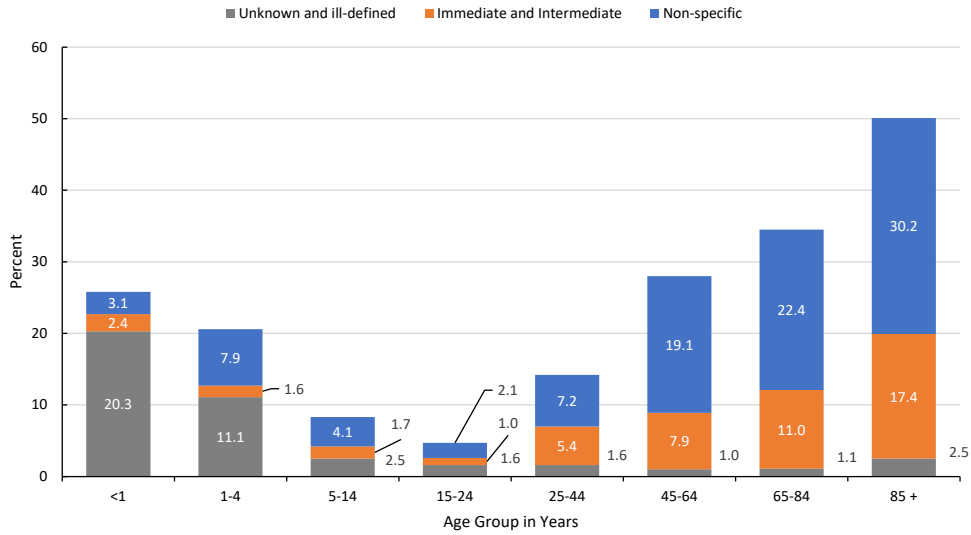
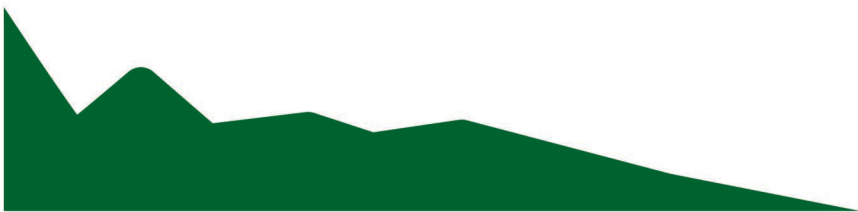
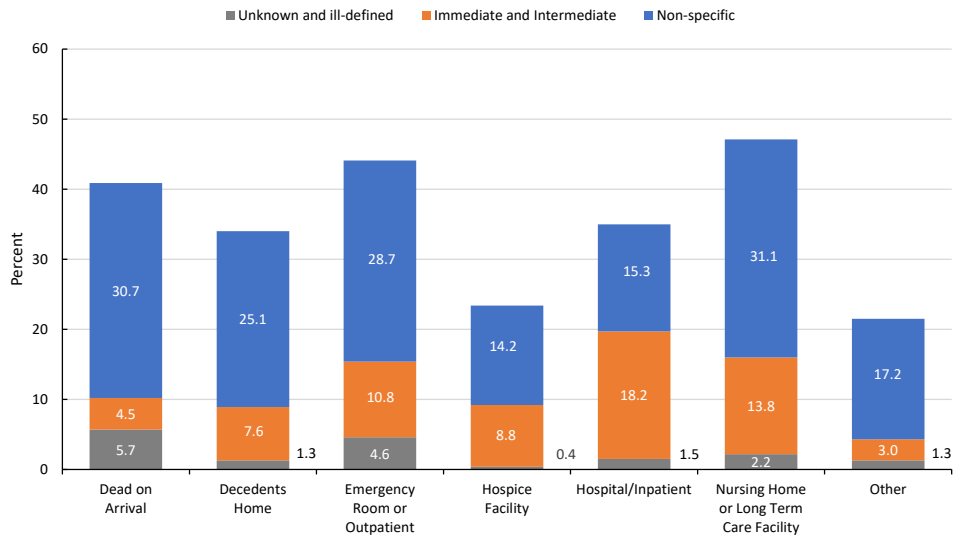


Figure 4. Percentage of deaths with unsuitable underlying causes of death by age and subtype, Montana Occurrences, 2015-2019





¹ World Health Organization. International statistical classification of diseases and related health problems, 10th revision (ICD–10). 5th ed. Volume 2. Geneva, Switzerland. 2016.

² National Center for Health Statistics. Instruction manual, part 2a: Instructions for classifying the underlying cause of death, 2017.

³ National Center for Health Statistics. Instruction manual, part 2b: Instructions for classifying multiple causes of death, 2017.

⁴ National Center for Health Statistics. Instruction manual, part 2c: Vital statistics ICD–10 ACME decision tables for classifying underlying causes of death, 2016.

⁵ Flagg LA, Anderson RN. Unsuitable underlying causes of death for assessing the quality of cause-of-death reporting. National Vital Statistics Reports; vol 69 no 14. Hyattsville, MD: National Center for Health Statistics. 2021.

⁶ National Center for Health Statistics. Physician’s handbook on medical certification of death. 2003.

⁷ World Health Organization. International statistical classification of diseases and related health problems, 10th revision (ICD–10). 5th ed. Volume 1. Geneva, Switzerland. 2016.