



## Key Findings

- Among 1,279 death certificates listing COVID-19 in 2020, 94.6% of death certificates had a co-occurring diagnosis that was a plausible chain-of-event condition (e.g., pneumonia), a significant contributing condition (e.g., hypertension), or both.
- Fewer than 60 death certificates (4.6%) listed only COVID-19 with no other medical conditions.
- Ten (0.8%) of death certificates which listed COVID-19 had co-occurring diagnosis codes that could not be plausibly categorized as either a chain-of-event or significant contributing condition.

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## Death Certificate—Based ICD-10 Diagnosis Codes for COVID-19 Mortality Surveillance, Montana Occurrences, 2020

### Introduction

Approximately 1,300 deaths during 2020 were attributed to COVID-19 on death certificates filed in Montana. Concerns have been raised that some deaths may be inappropriately attributed to COVID-19.<sup>1</sup> To determine whether COVID-19 deaths have been overestimated, the International of Classification of Diseases, Tenth Revision (ICD-10) diagnosis codes were examined using official Montana death certificates. This report describes ICD-10 codes for COVID-19 by age, sex, race, and place of death reported on the death certificate.

### Methods

Data used in this report come from the Montana death certificates collected by the Montana Office of Vital Records for COVID-19-associated deaths occurring in Montana regardless of residency (Montana and non-Montana residents). Death certificates analyzed included only those processed using standard CDC protocols to convert all written text and diagnoses to ICD-10 codes.<sup>2</sup> COVID-19 deaths were ascertained using the ICD-10 code U07.1 listed in Part I (the section for reporting chain of events leading to directly to death, the immediate cause of death, and the underlying cause of death) or Part II (the section for reporting all other significant conditions that contributed to the death) of the death certificate for deaths occurring during 2020. The following methods were adapted from an analysis of COVID-19 death certificate coding published by the Centers for Disease Control and Prevention (CDC) in March 2021.<sup>3</sup>

First, the location of ICD-10 diagnoses in relation to the COVID-19 diagnosis was used to categorize the co-occurring diagnoses as being in the chain of events that directly caused the death (chain-of-event conditions) or a significant condition contributing to death (significant contributing conditions).



Any co-occurring ICD-10 code that appeared on the same line or above U07.1 in Part I was considered to be a chain-of-event condition. Any ICD-10 code that appeared on a line below U07.1 in Part I or in Part II was considered to be a contributing condition (Figure).

Second, ICD-10 codes were ranked by frequency and conditions that appeared  $\geq 20$  times on death certificates with COVID-19 listed in Part I and at least one diagnosis other than COVID-19 were reviewed for consistency and plausibility with conditions known to be associated with severe outcomes in patients with COVID-19.<sup>4,5,6,7</sup> Conditions consistent with those known to be associated with severe COVID-19 outcomes were coded as chain-of-event or significant contributing conditions regardless of their location on the death certificate. For example, a death certificate with an ICD-10 code for respiratory failure listed below U07.1 would be coded as a chain-of-event condition because respiratory failure caused by COVID-19 led directly to the death.

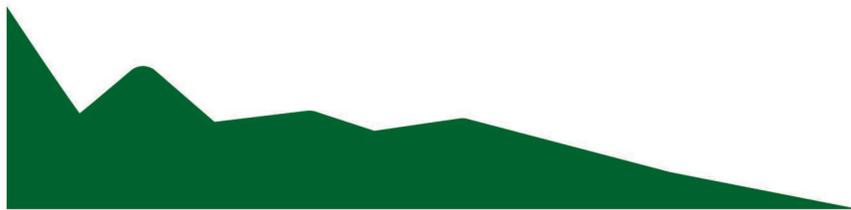
Finally, death certificates were categorized into five mutually exclusive categories according to the ICD-10 codes recorded on the death certificate 1) only the ICD-10 code for COVID-19; 2) at least one other co-occurring ICD-10 code for a chain-of-event condition; 3) at least one other co-occurring ICD-10 code for a significant contributing condition; 4) an ICD-10 code for both a chain-of-event and significant contributing condition; or 5) an ICD-10 code that could not be categorized as a plausible chain-of-event or significant contributing condition based on current knowledge. A total of 1,279 deaths occurring in 2020 were included in this analysis.

## Results

Among 1,279 death certificates listing U07.1, a total of 1,220 (95.4%) had at least one other ICD-10 code; 59 (4.6%) had only U07.1; and 1,113 (87.0%) listed COVID-19 in Part I (Tables 1 and 2). Death certificates with only U07.1 and no other diagnosis were slightly higher among decedents in 40–49 and  $\geq 85$ -year age groups and among women (10.0%, 7.7%, and 5.8%, respectively). Having only COVID-19 listed on the death certificate occurred more often for certificates that listed the decedent's home (12.6%) or nursing home/long-term care facility (8.5%) as the place of death (Table 1).

Overall, 94.6% (1,210 of 1,279 death certificates) were noted to have a co-occurring diagnosis that was a plausible chain-of-event condition (e.g., pneumonia, respiratory failure, adult respiratory distress syndrome, cardiac arrest, or sepsis), significant contributing condition (e.g., hypertension, diabetes, dementia, or chronic obstructive pulmonary disease), or both (Table 1). Among death certificates listing COVID-19 and at least one other diagnosis, 99.2% (1,210 of 1,220 death certificates) listed a co-occurring diagnosis that was a plausible chain-of-event condition, significant contributing condition, or both.

The most frequent chain-of-event ICD-10 diagnosis codes on 1,113 death certificates that listed COVID-19 on Part I of the death certificate were pneumonia (60.0%), acute respiratory failure (33.4%), and respiratory failure, unspecified (20.9%) (Table 2).





The most frequent significant contributing condition ICD-10 codes were essential hypertension (21.4%), chronic obstructive pulmonary disease, unspecified (16.2%), tobacco use (15.9%), and unspecified dementia (12.6%) (Table 1).

Nearly 79% of all death certificates had a chain-of-event condition, alone or in combination with a significant contributing condition. This finding was slightly higher among adults aged 50–64 years, American Indian or Alaska Native (AI/AN) persons, those who died in hospital/inpatient settings, and lower among those who died at home or in nursing home/long-term care facility (Table 1).

Sixteen percent of death certificates had a co-occurring significant contributing condition only. This finding was more frequent for death certificates indicating that the death occurred in the decedent's home (24.3%) or a nursing home/long-term care facility (33.8%) and lower among AI/AN (6.1%) (Table 1).

Only 10 (0.8%) of death certificates had co-occurring diagnosis codes that could not be plausibly categorized as either a chain-of-event or significant contributing condition (e.g., Other lack of expected normal physiological development). In 99.2% of all deaths, the manner of death listed was natural as opposed to an external cause or accident (Table 1).

## Discussion

Among Montana death certificates from 2020 listing COVID-19 and at least one other co-occurring diagnosis, the documentation is consistent with these deaths being attributable to COVID-19. Overall, 99.2% of 1,220 death certificates with at least one other diagnosis were noted to have a co-occurring diagnosis that was a plausible chain-of-event condition, a significant contributing condition, or both. Montana's results are similar to national findings and support the accuracy of COVID-19 mortality surveillance in Montana and the United States using death certificates.<sup>2</sup>

The death certificate is an important document that serves to provide both legal/administrative functions and statistical data for public health surveillance and policy development. Proper documentation of co-occurring diagnoses on the death certificate is essential for a comprehensive and authoritative public record and many resources are available to assist medical certifiers.<sup>8,9</sup> Accurate mortality surveillance is crucial for understanding the impact of COVID-19 and guiding public health action.



**Figure** Example Death Certificate with COVID-19 listed as a diagnosis along with chain-of-event and significant contributing conditions

CAUSE OF DEATH (See instructions and examples)			Approximate Interval: Onset to death
<p>32. <b>PART I.</b> 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.</p>			
IMMEDIATE CAUSE (Final disease or condition resulting in death) →	a. Acute respiratory distress syndrome	} (A)	2 days
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the <b>UNDERLYING CAUSE</b> (disease or injury that initiated the events resulting in death) <b>LAST</b>	b. Pneumonia Due to (or as a consequence of):		10 days
	c. COVID-19 Due to (or as a consequence of):		10 days
	d. _____		
<p><b>PART II.</b> Enter other <u>significant conditions contributing to death</u> but not resulting in the underlying cause given in PART I</p>			<p>33. WAS AN AUTOPSY PERFORMED? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
Hypertension, diabetes mellitus			<p>34. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? <input type="checkbox"/> Yes <input type="checkbox"/> No</p>
<p>35. DID TOBACCO USE CONTRIBUTE TO DEATH?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> Probably</p> <p><input checked="" type="checkbox"/> No <input type="checkbox"/> Unknown</p>	<p>36. IF FEMALE:</p> <p><input checked="" type="checkbox"/> Not pregnant within past year</p> <p><input type="checkbox"/> Pregnant at time of death</p> <p><input type="checkbox"/> Not pregnant, but pregnant within 42 days of death</p> <p><input type="checkbox"/> Not pregnant, but pregnant 43 days to 1 year before death</p> <p><input type="checkbox"/> Unknown if pregnant within the past year</p>	<p>37. MANNER OF DEATH</p> <p><input checked="" type="checkbox"/> Natural <input type="checkbox"/> Homicide</p> <p><input type="checkbox"/> Accident <input type="checkbox"/> Pending Investigation</p> <p><input type="checkbox"/> Suicide <input type="checkbox"/> Could not be determined</p>	

- A. Chain-of-event condition: Any ICD-10 code on the same line as or above the COVID-19 listing in Part I (i.e., leading to the cause of death)
- B. Significant contributing condition: Any ICD-10 code listed in Part II or below the COVID-19 listing in Part I or considered a significant contributing condition (excluding common chain-of-event conditions)



**Table 1.** Distribution of death certificates with COVID-19 diagnosis across five mutually exclusive categories defined by presence and classification of co-occurring diagnoses, by demographic characteristics, place of death, and manner of death characteristics, Montana Occurrences, 2020.

	Death certificates	COVID-19 only		COVID-19 and ≥1 chain-of-event condition only		COVID-19 and ≥1 significant contributing condition only		COVID-19 and ≥1 chain-of-event and ≥1 significant contributing condition		COVID-19 with no plausible chain-of-event or significant contributing condition	
		Number (No.)	No.	%	No.	%	No.	%	No.	%	No.
<b>Total</b>	1,279	59	4.6	245	19.2	205	16.0	760	59.4	10	0.8
<b>Age group (years)</b>											
<18	1	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0
18-29	1	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0
30-39	17	1	5.9	3	17.6	1	5.9	12	70.6	0	0.0
40-49	30	3	10.0	5	16.7	3	10.0	18	60.0	1	3.3
50-64	167	6	3.6	35	21.0	16	9.6	110	65.9	0	0.0
65-74	276	7	2.5	59	21.4	37	13.4	172	62.3	1	0.4
75-84	372	10	2.7	60	16.1	67	18.0	233	62.6	2	0.5
≥85	415	32	7.7	82	19.8	81	19.5	214	51.6	6	1.4
<b>Sex</b>											
Male	713	26	3.6	135	18.9	99	13.9	449	63.0	4	0.6
Female	566	33	5.8	110	19.4	106	18.7	311	54.9	6	1.1
<b>Race</b>											
White	1,002	47	4.7	180	18.0	187	18.7	579	57.8	9	0.9
AI/AN	263	12	4.6	64	24.3	16	6.1	170	64.6	1	0.4
Other	14	0	0.0	1	7.1	2	14.3	11	78.6	0	0.0
<b>Place of death</b>											
Hospital/Inpatient	765	15	2.0	168	22.0	52	6.8	527	68.9	3	0.4
Nursing Home/Long term care facility	355	30	8.5	51	14.4	120	33.8	147	41.4	7	2.0
Decedent's home	103	13	12.6	15	14.6	25	24.3	50	48.5	0	0.0
Outpatient/Emergency department	29	0	0.0	8	27.6	5	17.2	16	55.2	0	0.0
Hospice facility	19	0	0.0	3	15.8	1	5.3	15	78.9	0	0.0
Other	7	1	14.3	0	0.0	1	14.3	5	71.4	0	0.0
Dead on arrival	1	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0
<b>Manner of death</b>											
Natural	1,269	58	4.6	244	19.2	203	16.0	754	59.4	10	0.8
Accident	10	1	10.0	1	10.0	2	20.0	6	60.0	0	0.0



**Table 2.** Highest-frequency International Classification of Diseases, Tenth Revision (ICD-10) codes listed in death certificates with COVID-19 in Part I of death certificate and at least one diagnosis other than COVID-19, Montana Occurrences, 2020.

	Number	Percent
<b>Condition ICD-10 coded Certificates</b>	1,113	100.0
<b>Conditions listed as chain-of-event conditions (ICD-10 code)</b>		
Pneumonia, unspecified (J18.9)	668	60.0
Acute respiratory failure (J96.0)	372	33.4
Respiratory failure, unspecified (J96.9)	233	20.9
Sepsis, unspecified (A41.9)	80	7.2
Adult respiratory distress syndrome (J80)	75	6.7
Asphyxia (R09.0)	63	5.7
Cardiac arrest, unspecified (I46.9)	57	5.1
Respiratory arrest (R09.2)	22	2.0
<b>Conditions listed as significant contributing conditions (ICD-10 code)</b>		
Essential (primary) hypertension (I10)	238	21.4
Chronic obstructive pulmonary disease, unspecified (J44.9)	180	16.2
Tobacco use (F17.9)	177	15.9
Unspecified dementia (F03)	140	12.6
Unspecified diabetes mellitus without complication (E14.9)	118	10.6
Atherosclerotic heart disease (I25.1)	116	10.4
Type 2 Diabetes mellitus without complication (E11.9)	115	10.3
Atrial fibrillation and flutter (I48)	102	9.2
Congestive heart failure (I50.0)	69	6.2
Hyperlipidemia, unspecified (E78.5)	65	5.8
Chronic kidney disease, unspecified (N18.9)	56	5.0
Other specified disorders of the kidney and ureter (N28.8)	45	4.0
Alzheimer disease, unspecified (G30.9)	44	4.0
Obesity, unspecified (E66.9)	43	3.9
Stroke, not specified as hemorrhage or infarction (I64)	37	3.3
Acute renal failure, unspecified (N17.9)	36	3.2
Heart failure, unspecified (I50.9)	26	2.3
Morbid obesity (E66.8)	25	2.2
Chronic kidney disease stage 3 (N18.3)	23	2.1
Chronic kidney disease stage 5 (N18.5)	22	2.0
<b>Conditions listed and not identified as known chain-of-event conditions or significant contributing conditions (ICD-10 code)</b>		
Sleep Apnea (G47.3)	34	3.1
Other specified general symptoms and signs (R68.8)	30	2.7
Hypothyroidism, unspecified (E03.9)	28	2.5
Other lack of expected normal physiological development (R62.8)	23	2.1



- <sup>1</sup> Weinberger DM, Chen J, Cohen T, et al. 2020. Estimation of excess deaths associated with the COVID-19 pandemic in the United States, March to May 2020. *JAMA Intern Med* 180:1336–44.
- <sup>2</sup> National Center for Health Statistics. 2017. Section I: instructions for classifying the underlying cause-of-death, 2017. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics.
- <sup>3</sup> Gundlapalli, AV, et al. 2020. Death Certificate–Based ICD-10 Diagnosis Codes for COVID-19 Mortality Surveillance — United States, January–December 2020. *MMWR* 70;14: 523-527.
- <sup>4</sup> CDC. COVID-19: people with certain medical conditions. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. Accessed April 12, 2021. <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html>
- <sup>5</sup> Kim L, Garg S, O’Halloran A, et al. 2020. Risk factors for intensive care unit admission and in-hospital mortality among hospitalized adults identified through the U.S. coronavirus disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET). *Clin Infect*.
- <sup>6</sup> Ko JY, Danielson ML, Town M, et al. 2020. Risk factors for coronavirus disease 2019 (COVID-19)–associated hospitalization: COVID-19–Associated Hospitalization Surveillance Network and Behavioral Risk Factor Surveillance System. *Clin Infect Dis*.
- <sup>7</sup> Richardson S, Hirsch JS, Narasimhan M, et al. 2020. Northwell COVID-19 Research Consortium. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA* 323:2052–9.
- <sup>8</sup> Centers for Disease Control and Prevention, National Center for Health Statistics. *Physician’s Handbook on Medical Certification of Death* (2003 ed.). 2004. Hyattsville, Maryland: US Department of Health and Human Services.
- <sup>9</sup> CDC. Coronavirus Disease 2019 (COVID-19) FAQs. Accessed April 16, 2021. <https://www.cdc.gov/nchs/covid19/faq.htm>