

Characteristics of Reported Deaths Among Fully Vaccinated Persons with COVID-19 —United States, January–April 2021

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Summary: Deaths among fully vaccinated persons were rare and occurred most commonly among those with risk factors for severe COVID-19, including older age and underlying health conditions. Most deaths were COVID-19-related.

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ABSTRACT

Background: COVID-19 vaccines are highly efficacious, but SARS-CoV-2 infections post-vaccination occur. We characterized COVID-19 cases among fully vaccinated persons with an outcome of death.

Methods: We analyzed COVID-19 cases voluntarily reported to CDC by US health departments during January 1, 2021–April 30, 2021. We included cases among U.S. residents with a positive SARS-CoV-2 test ≥ 14 days after completion of an authorized primary vaccine series and who had a known outcome (alive or death) as of May 31, 2021. When available, specimens were sequenced for viral lineage and death certificates were reviewed for cause(s) of death.

Results: Of 8,084 reported COVID-19 cases among fully vaccinated persons during the surveillance period, 245 (3.0%) died. Compared with patients who remained alive, those who died were older (median age 82 years vs. 57 years, $P < 0.01$), more likely to reside in a long-term care facility (51% vs. 18%, $P < 0.01$), and more likely to have at least one underlying health condition associated with risk for severe disease (64% vs. 24%, $P < 0.01$). Among 245 deaths, 191 (78%) were classified as COVID-19-related. Of 106 deaths with available death certificates, COVID-19 was listed on 81 (77%). There were no differences in the type of vaccine administered or the most common viral lineage (B.1.1.7).

Conclusions: COVID-19 deaths are rare in fully vaccinated persons, occurring most commonly in those with risk factors for severe disease, including older age and underlying health conditions. All eligible persons should be fully vaccinated against COVID-19 and follow other prevention measures to mitigate exposure risk.

Key words: COVID-19, SARS-CoV-2, vaccine, breakthrough, post-vaccination, death

INTRODUCTION

As of December 27, 2021, the United States reported approximately 51 million coronavirus disease 2019 (COVID-19) cases and 809,300 deaths.[1] Approximately 62% of the U.S. population (and 71% of population ≥ 12 years of age) has received the recommended primary series with one of three COVID-19 vaccines (Pfizer-BioNTech [BNT162b2], Moderna [mRNA-1273], and Johnson & Johnson's Janssen [JNJ-78436735]) that are authorized or approved by the U.S. Food and Drug Administration (FDA). Clinical trials involving at least 76,000 participants demonstrated these vaccines to be safe and highly efficacious in preventing symptomatic COVID-19 and subsequent observational studies confirmed these findings.[2-9] Real-world data provided further evidence that these vaccines are highly effective in preventing hospitalizations and deaths from severe COVID-19.[10-15] High vaccine effectiveness against severe COVID-19 is maintained even following infection with the SARS-CoV-2 Delta variant, demonstrating the continued critical role of vaccines in controlling the pandemic.[16-22]

Because no vaccine is 100% effective, SARS-CoV-2 infections among fully vaccinated persons are expected and have been documented.[23-29] However, fully vaccinated people remain at much lower risk for hospitalization or death than unvaccinated or partially vaccinated people with similar risk factors.[1, 17-20, 30, 31] Nevertheless, understanding the characteristics of the small proportion of COVID-19 cases among fully vaccinated persons that result in severe disease is of clinical and public health importance.

Beginning in January 2021, the Centers for Disease Control and Prevention (CDC) implemented a passive surveillance system to collect reports of COVID-19 infection among fully vaccinated persons (also called vaccine breakthrough cases). State and territorial health departments voluntarily reported COVID-19 cases among fully vaccinated persons to CDC until April 30, 2021.[32] After that time, surveillance of post-vaccination SARS-CoV-2 infections focused on cases resulting in hospitalization or death, allowing for more complete information on cases of highest clinical and public health significance. The characteristics of COVID-19 cases among fully

vaccinated persons reported to CDC through April 30, 2021 have been previously reported.[23] We describe in more detail the clinical and epidemiologic characteristics of cases with an outcome of death reported during the same time period.

METHODS

Case definition

For this analysis, a COVID-19 case in a fully vaccinated person was defined as the detection of SARS-CoV-2 RNA or antigen in a respiratory specimen collected from the person ≥ 14 days after receipt of recommended primary series of an FDA-authorized or approved COVID-19 vaccine. Cases meeting this definition that were reported to CDC by April 30, 2021 were included in this analysis if outcomes (i.e., alive or dead from any cause) were known as of May 31, 2021. Cases were excluded if a previous positive SARS-CoV-2 test was documented within 45 days of the first post-vaccination positive test, if information on the vaccine manufacturer or administration dates was missing, or if the schedule was inconsistent with CDC recommendation (i.e., receipt of two doses of vaccines from different manufacturers or spacing of doses shorter than 4-day grace period of manufacturer's recommendations).[33] This activity was conducted consistent with applicable federal law and CDC policy, and was determined to be non-research and exempt from further institutional review board review at CDC¹.

Data collection and analysis

Data were collected from state health departments and managed through a REDCap secure platform and data capture tools hosted at CDC.[34] Reported variables included demographics (age, sex, race/ethnicity), vaccination information (dates and manufacturer), SARS-CoV-2 testing results (including cycle threshold [Ct] values from the first positive test and whole genome sequencing [WGS] results when available), underlying medical conditions associated with risk for severe

¹ 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

disease,[35] clinical course (including symptom status, hospitalization status, intensive care unit admission, and requirement for mechanical ventilation), and outcome (i.e., alive or dead). A subset of available residual respiratory specimens, not sequenced within the state, was sent to CDC for WGS. We defined strains based on CDC classification (as of November 2021) using the pangolin nomenclature as variants of concern if the lineage was Delta (B.1.617.2 and AY lineages), and as a variant being monitored if the lineage was Alpha (B.1.1.7 and Q lineages), Beta (B.1.351 and descendent lineages), Gamma (P.1 and descendent lineages), Epsilon (B.1.427, B.1.429), Eta (B.1.525), Iota (B.1.526), Kappa (B.1.617.1, B.1.617.3), Mu (B.1.621, B.1.621.1), or Zeta (P.2).[36]

For cases with an outcome of death, health departments reported whether the cause was COVID-19-related and how this determination was made (e.g., death certificate, medical records, medical examiner, provider report). We reviewed death certificates (i.e., U.S. Standard Certificate of Death Rev 11/2003) and medical records when available to verify the cause(s) of death and completed missing or unreported information. When the death certificate was available for review, the death was classified as COVID-19-related if COVID-19 was listed as an immediate or underlying cause of death (Part I) or as a significant condition contributing to death (Part II). If COVID-19 was not listed on the death certificate or the death certificate was not available for review, the death was still classified as COVID-19-related if the health department reported it to be COVID-19-related based on their review of the death certificate or medical examiner or provider report. We documented all conditions listed on the death certificate (Part I and Part II) for both COVID-19-related and COVID-19-unrelated deaths.

We used descriptive statistics to assess the demographic characteristics, clinical features and course, and SARS-CoV-2 lineage of fully vaccinated people with COVID-19. We compared cases with an outcome of death versus alive, and cases where cause of death was deemed COVID-19-related versus unrelated. Distributions of categorical variables were compared using chi-square or Fisher exact tests. Distributions of continuous variables were compared using Wilcoxon rank sum tests. A P -value <0.05 was considered significant. All analyses were performed using SAS version 9.4 (SAS Institute, Cary NC).

RESULTS

Among 12,417 cases reported to CDC as of April 30, 2021, 8,084 (65%) were included in our analysis. The remaining 4,333 reported cases were excluded because of an unknown outcome as of May 31, 2021 (n=3,649), no positive SARS-CoV-2 test (no test, no result, or negative result; n=258), insufficient information to determine that an authorized vaccine dosing schedule was followed (n=211), fewer than 14 days or an unknown number of days between completion of primary vaccine series and positive SARS-CoV-2 test (n=146), case record not finalized by the state health department (n=62), or a positive SARS-CoV-2 test within 45 days of the first post-vaccination positive test (n=7). The 8,084 cases included in our analysis were reported to CDC from 44 states, Washington DC, and the US Virgin Islands; however, 10 states, Washington DC, and the US Virgin Islands contributed fewer than 20 cases each. As of May 31, 2021, 245 (3%) of the 8,084 reported COVID-19 cases in fully vaccinated persons had an outcome of death.

Among cases of death, dates of positive SARS-CoV-2 test ranged from January 25–April 26, with a median of 33 days (interquartile range [IQR], 22–47 days) after vaccine series completion. Dates of death ranged from February 3–May 19, and patients died a median of 10 days after the positive SARS-CoV-2 test (IQR 4–17 days). For 22 (9%) patients, the positive COVID-19 test was obtained on the day of death or up to 5 days later, suggesting possible post-mortem diagnosis. Compared with patients who lived, those who died were older (median age 82 vs. 57 years, $P < 0.01$), more commonly male (51% vs. 34%, $P < 0.01$), a resident of a nursing home or long-term care facility (51% vs. 18%, $P < 0.01$), and had ≥ 1 underlying medical condition associated with risk for severe disease (64% vs. 24%, $P < 0.01$) (**Table 1**). The most common underlying conditions were the same in both groups but were more common among those who died: diabetes (44% vs. 18%, $P < 0.01$), chronic renal disease (37% vs. 7%, $P < 0.01$), and immunosuppressing condition (33% vs. 7%, $P < 0.01$) (data not shown). Patients who died compared with those who lived were more likely to have COVID-19-like symptoms (84% vs. 63%, $P < 0.01$), to require hospitalization (79% vs. 12%, $P < 0.01$)

and intensive care (54% vs 18% among those hospitalized, $P < 0.01$), and to experience symptoms associated with severe disease such as fever (40% vs. 22%, $P < 0.01$), shortness of breath (67% vs. 24%, $P < 0.01$), and difficulty breathing (51% vs. 15%, $P < 0.01$). Milder symptoms, including headache (19% vs. 24%, $P < 0.01$), sore throat (6% vs. 32%, $P < 0.01$), runny nose (23% vs. 62%, $P < 0.01$), and loss of smell or taste (9% vs. 29%, $P < 0.01$) were more common among patients who lived (data not shown). There were no significant differences between the two groups in the type of vaccine administered.

SARS-CoV-2 sequence data were available for 54 (22%) of 245 patients who died, and 945 (12%) of 7,839 patients who lived (**Supplemental Table**). The Alpha (B.1.1.7) lineage was the most common among both patients who died and those who lived (43% vs. 41%), and the breakdown of variants being monitored did not differ significantly between groups ($P=0.34$). The median Ct value among those specimens with sequence data was lower (associated with higher levels of viral genetic material) for those who died (median 18.6 [IQR, 14.7–24.6]) compared with those who lived (median 28.0 [IQR, 20.6–33.2], $P < 0.01$). Only 4 infections caused by the Delta variant were observed during this time, all among those who remained alive. The proportion of infections caused by other variants being monitored was the same among patients who died and lived (72% for both; $P=0.98$).

Of the 245 total deaths, 191 (78%) were classified as COVID-19-related, 41 (17%) were classified as not COVID-19-related, and 13 (5%) could not be classified. COVID-19-relatedness was determined by review of death certificates for 106 (46%) patients and reported by state health public health officials for the remainder; the most common sources of information used by health officials were death certificates, medical records, and reports from medical examiners or other healthcare professionals. Patients whose deaths were deemed COVID-19-related had similar distributions of age, sex, and race/ethnicity to those whose deaths were not considered COVID-19-related. However, compared with patients with non-COVID-19-related deaths, patients with COVID-19-related deaths were less likely to be residents of a long-term care facility (46% vs. 76%, $P < 0.01$) and more likely to have at least one underlying medical condition (69% vs. 47%, $P=0.01$) or

symptoms of COVID-19 (90% vs. 57%, $P < 0.01$), to be hospitalized (83% vs. 68%, $P < 0.01$), or to have SARS-CoV-2 sequence data available (26% vs. 7%, $P < 0.01$), although not more likely to be infected with a variant being monitored (**Table 2**).

Of the 106 (43%) death certificates available for review, 72 (68%) listed COVID-19 in the chain of events leading to the immediate cause of death, 9 (8%) listed COVID-19 as a contributing condition, and 25 (24%) did not have COVID-19 listed on the death certificate. Other common causes of death listed on the available death certificates included other respiratory conditions, cardiovascular conditions, diabetes, and sepsis (**Table 3**). Of note, among 25 patients for whom COVID-19 was not listed on the death certificate, 8 (32%) had documentation of either pneumonia or respiratory failure.

Of the 245 patients who died, nearly all had at least one underlying condition, resided in a long-term care facility or nursing home, or had advanced age. Only two deaths occurred in patients who were younger than age 50 and had no reported underlying conditions, and only one was classified as a case of COVID-19-related death, with an immediate cause of death of septic shock reported on the death certificate.

DISCUSSION

In this analysis of COVID-19 cases among fully vaccinated persons voluntarily reported during January–April 2021, we found that COVID-19 deaths occurred more commonly among persons with risk factors for severe disease, including older age (especially among those aged >75 years) and underlying health conditions such as diabetes, chronic renal disease, and immunosuppressing condition. These deaths represented a very small proportion of the reported COVID-19 cases among fully vaccinated persons and occurred among the over 100 million Americans fully vaccinated during the same period.[1] The characteristics and causes of death in fully vaccinated patients resembled those who died of COVID-19 pre-vaccination,[37, 38] highlighting the

importance of multiple exposure mitigation strategies and full vaccination in populations at high risk for severe outcomes of COVID-19.

Previous reports have documented that SARS-CoV-2 infections among fully vaccinated individuals are largely not severe, and infrequent cases of severe COVID-19, including from Delta variant, occurred in medically vulnerable individuals with underlying conditions that predisposed them to severe COVID-19 — findings similar to that of our analysis.^[25, 27, 28, 30, 39-41] The overall characteristics of cases included in our analysis were similar to the population prioritized for vaccination in the first 4 months of 2021, with a predominance of older adults, persons with underlying conditions, and residents of long-term care facilities. Likewise, the distribution of vaccine type represented what was administered nationwide,^[1] and we did not find any significant differences in vaccine type among fully vaccinated persons who died versus who lived. The viral lineage of specimens collected during the analytic period also reflected those that were circulating in the United States at the time,^[1] with no evidence that specific lineages were associated with death, though the number of records with sequence information was limited.

Roughly 4 out of 5 deaths were reported as COVID-19-related by state health departments; a review of a subset of cases with available death certificates found that COVID-19 was listed as a cause or contributor of death in a similar proportion of cases. Among death certificates where COVID-19 was not listed, one third of the cases documented pneumonia or respiratory failure as the cause of death, which is consistent with COVID-19. The remaining two-thirds of non-COVID-19-related deaths appeared to be among persons who were medically fragile with conditions that placed them at high risk of death, and the positive SARS-CoV-2 test result may have been incidental.

Approximately one quarter of patients tested positive within the third week (day 15-21) after vaccine series completion, suggesting possible acquisition of infection before full immunity was reached. Prior studies have shown an inverse relationship between time since vaccination and the likelihood of a positive SARS-CoV-2 test ^[24, 27, 42]. However, it is possible that we observed fewer post-vaccination infections further out from the time of full vaccination because the analytic period

was too early in the national vaccination campaign to capture waning immunity and the follow-up time (i.e., known outcome as of May 31, 2021) was less than 4 months.

This analysis is subject to several limitations. First, our findings may not be generalizable because the passive surveillance system for COVID-19 cases among fully vaccinated persons did not receive case reports from all states, represented a time before the widespread circulation of the Delta variant, and focused on a period before vaccines were approved for use in children under age 16 or were widely available to adults at lower risk of occupational exposure or at lower risk of severe COVID. Second, fully vaccinated individuals with COVID-19 who died after May 31, 2021, could have been misclassified as alive in this analysis; however, given the additional month of follow-up time allowed, we expect these misclassifications to be rare. Third, we did not obtain symptom onset date. This could have led to the inappropriate inclusion of some patients who contracted COVID-19 before becoming fully vaccinated. Furthermore, we were unable to assess the Ct value in relation to illness onset, although the viral load is known to vary according to the timing of testing. Fourth, the methods and timing of testing were not standardized across laboratories. Ct values may differ with the type of test, limiting the usefulness of Ct value as a marker for viral load. Also, more severe cases might have been diagnosed earlier, resulting in lower Ct values. Fifth, missing data were more common among patients who lived, which could have affected comparisons with patients who died. Finally, SARS-CoV-2 lineage (all cases) and death certificates (among patients who died) were only available for a small number of cases. Nevertheless, this analysis adds to our understanding of the most severe cases of COVID-19 in fully vaccinated individuals.

COVID-19 vaccines are safe and effective, but COVID-19 cases among fully vaccinated individuals will continue to occur, particularly while community transmission remains high. Deaths among fully vaccinated persons were most common among older adults (especially those over age 75 years) and those with at least one underlying health condition during the early post-vaccination period before widespread transmission of the Delta variant B.1.617.2 (January–April 2021). Our findings highlight the importance of complete vaccination of all persons eligible for COVID-19

vaccination (including a third or booster dose), especially for those at increased risk for severe disease, and the continued use of recommended prevention measures (e.g., masking and social distancing). High population-level vaccination coverage will help reduce community-level transmission and reduce risk of COVID-19 among fully vaccinated persons.

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NOTES

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DISCLAIMER

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Table 1: Characteristics of COVID-19 cases among fully vaccinated persons by outcome— United States, reported January–April 2021 (n = 8,084)

Characteristic	Dead ¹ N=245		Alive N=7,839		P Value
	n / N	(%)	n / N	(%)	
Age group, years					<0.01
16–49	4 / 244	(2)	3046 / 7793	(39)	
50–64	23 / 244	(9)	1740 / 7793	(22)	
65–74	48 / 244	(20)	1203 / 7793	(15)	
75–84	70 / 244	(29)	1040 / 7793	(13)	
≥85	99 / 244	(41)	764 / 7793	(10)	
Male sex	125 / 245	(51)	2672 / 7805	(34)	<0.01
Race/ethnicity					0.04
White, non-Hispanic	189 / 233	(81)	4780 / 6351	(75)	
Black, non-Hispanic	25 / 233	(11)	526 / 6351	(8)	
Asian, non-Hispanic	2 / 233	(1)	172 / 6351	(3)	
AIAN, non-Hispanic	0 / 233	(0)	12 / 6351	(0)	
Pacific Islander, non-Hispanic	3 / 233	(1)	170 / 6351	(3)	
Multi-race/Other, non-Hispanic	6 / 233	(3)	193 / 6351	(3)	
Hispanic or Latino (any race)	8 / 233	(3)	498 / 6351	(8)	
LTCF or nursing home resident	112 / 220	(51)	1010 / 5657	(18)	<0.01
Symptomatic from SARS-CoV-2 infection	185 / 221	(84)	4211 / 6662	(63)	<0.01
Hospitalization	186 / 235	(79)	870 / 7031	(12)	<0.01
Intensive care	84 / 155	(54)	109 / 620	(18)	<0.01
Mechanical ventilation	34 / 141	(24)	30 / 567	(5)	<0.01
Underlying medical conditions					
≥1 underlying medical conditions ²	146 / 227	(64)	1488 / 6099	(24)	<0.01
≥2 underlying medical conditions ²	82 / 227	(36)	411 / 6099	(7)	<0.01
Vaccine type					0.30
Pfizer-BioNTech	169 / 245	(69)	5017 / 7839	(64)	
Moderna	60 / 245	(24)	2175 / 7839	(28)	
Janssen	16 / 245	(7)	647 / 7839	(8)	
Test type					<0.01
Nucleic acid amplification test	226 / 245	(92)	6681 / 7774	(86)	
Antigen test	19 / 245	(8)	1093 / 7774	(14)	

AIAN = American Indian or Alaskan Native; LTCF = long-term care facility

¹ Death from any cause (COVID-19-related and not COVID-19- related)

² Consisting of pregnancy, diabetes, chronic renal disease, chronic liver disease, autoimmune disease, immunosuppressing condition, or use of immunosuppressing medications

Table 2: Characteristics of COVID-19 deaths among fully vaccinated persons by COVID-19-relatedness — United States, reported January–April 2021 (n = 232)

Characteristic	Death COVID-19-related ¹ n = 191		Death not COVID-19-related n = 41		P Value
	n / N	(%)	n / N	(%)	
Age group, years					0.14
16–49	1 / 191	(<1)	2 / 40	(5)	
50–64	18 / 191	(9)	4 / 40	(10)	
65–74	40 / 191	(21)	7 / 40	(17)	
75–84	57 / 191	(30)	8 / 40	(20)	
≥85	75 / 191	(39)	19 / 40	(48)	
Male sex	101 / 191	(53)	25 / 41	(61)	0.11
Race/ethnicity					0.12
White, non-Hispanic	147 / 183	(80)	32 / 38	(84)	
Black, non-Hispanic	22 / 183	(12)	1 / 38	(3)	
Asian, non-Hispanic	2 / 183	(1)	0 / 38	(0)	
AIAN, non-Hispanic	3 / 183	(2)	0 / 38	(0)	
Pacific Islander, non-Hispanic	0 / 183	(0)	0 / 38	(0)	
Multi-race/Other, non-Hispanic	3 / 183	(2)	3 / 38	(8)	
Hispanic or Latino (any race)	6 / 183	(3)	2 / 38	(5)	
LTCF or nursing home resident	79 / 171	(46)	29 / 38	(76)	<0.01
Hospitalization	152 / 184	(83)	27 / 40	(68)	0.03
Intensive care	72 / 126	(57)	9 / 23	(39)	
Mechanical ventilation	29 / 113	(26)	4 / 22	(18)	
Symptomatic from COVID-19	156 / 174	(90)	21 / 37	(57)	<0.01
Fever	54 / 130	(42)	7 / 20	(35)	
Chills	26 / 113	(23)	3 / 19	(16)	
Rigors	4 / 91	(4)	1 / 19	(5)	
Myalgias	33 / 115	(29)	2 / 19	(11)	
Headache	24 / 117	(21)	2 / 18	(11)	
Sore throat	6 / 114	(5)	1 / 19	(5)	
Nausea/vomiting	20 / 121	(17)	3 / 20	(15)	
Diarrhea	18 / 117	(15)	6 / 20	(30)	
Fatigue	70 / 120	(58)	9 / 19	(47)	
Runny nose	28 / 115	(24)	3 / 20	(15)	
Cough	77 / 130	(59)	7 / 20	(35)	
Shortness of breath	98 / 138	(71)	10 / 20	(50)	
Difficulty breathing	65 / 121	(54)	6 / 18	(33)	
Loss of taste	10 / 109	(9)	1 / 17	(6)	
≥1 underlying medical condition ²	124 / 181	(69)	17 / 36	(47)	0.01
Pregnancy	0 / 169	(0)	0 / 35	(0)	
Diabetes mellitus	73 / 162	(45)	10 / 33	(30)	
Chronic kidney disease	61 / 156	(39)	7 / 33	(21)	
Chronic liver disease	6 / 139	(4)	3 / 32	(9)	
Autoimmune disease	6 / 130	(5)	1 / 30	(3)	
Immunosuppressing condition	49 / 140	(35)	6 / 30	(20)	
Immunosuppressing medications	27 / 131	(21)	3 / 28	(11)	
SARS-CoV-2 lineage identified	50 / 191	(26)	3 / 41	(7)	<0.01
B.1.617.2 (Delta)	0 / 50	(0)	0 / 3	(0)	

Variant being monitored ³	37 / 50 (74)	2 / 3 (66)
Other lineage	13 / 50 (26)	1 / 3 (33)

AIAN = American Indian or Alaskan Native; LTCF = long-term care facility

¹ COVID-19-relatedness was determined by review of death certificates for 106 patients and reports from state health public health officials for the remainder (based on death certificates, medical records, and healthcare professional reports)

² Consisting of pregnancy, diabetes, chronic renal disease, chronic liver disease, autoimmune disease, immunosuppressing condition, or use of immunosuppressing medications

³ Variants being monitored included Alpha (B.1.1.7), Beta (B.1.351 and descendent lineages), Gamma (P.1), and Epsilon (B.1.427, B.1.429)

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Table 3. Causes of death among COVID-19 cases among fully vaccinated persons with available death certificates—United States January–April 2021

Causes of death	Total n = 106		COVID-19 listed n = 81		COVID-19 not listed n = 25	
	No.	(%)	No.	(%)	No.	(%)
COVID-19						
In chain of events ¹	72	(68)	72	(89)	--	
As a contributing condition ²	9	(8)	9	(11)	--	
Other conditions on death certificate						
Respiratory conditions						
ARDS or respiratory failure	36	(34)	3	(38)	5	(20)
COPD	10	(9)	9	(11)	1	(4)
Pneumonia	56	(53)	51	(63)	5	(20)
Pulmonary embolism	2	(2)	1	(1)	1	(4)
Cardiovascular conditions						
Arteriosclerosis ³	15	(14)	13	(16)	2	(8)
Atrial fibrillation	4	(4)	4	(5)	0	(0)
Cardiac arrest	8	(8)	6	(7)	2	(8)
Endocarditis	2	(2)	1	(1)	1	(4)
Heart failure or cardiomyopathy	18	(17)	14	(17)	4	(16)
Hypertension	20	(19)	18	(22)	2	(8)
Stroke	9	(8)	5	(6)	4	(16)
Other cardiovascular conditions ⁴	3	(3)	3	(4)	0	(0)
Sepsis	15	(14)	11	(14)	4	(16)
Other chronic conditions ⁵	49	(46)	42	(52)	7	(28)
Other acute conditions ⁶	23	(22)	16	(20)	7	(28)

ARDS = acute respiratory distress syndrome; COPD = chronic obstructive pulmonary disease

¹ Refers to Part I of the death certificate: “Enter the chain of events--diseases, injuries, or complications--that directly caused the death.”

² Refers to Part II of the death certificate: “Enter other significant conditions contributing to death but not resulting in the underlying cause given in Part I.”

³ Includes myocardial infarction, coronary artery disease, and peripheral vascular disease

⁴ Other cardiovascular conditions: aortic valve replacement (1); arteriosclerosis (1); sick sinus syndrome (1); supraventricular tachycardia (1)

⁵ Other chronic conditions include: diabetes (18), chronic renal disease (13), dementia (12), leukemia or lymphoma (12), liver disease (7), solid tumor cancer (3), alcohol abuse (2), obesity (2), rheumatoid arthritis (2), anemia (1), asthma (1), kidney and liver transplant (1), myotonic muscular dystrophy (1), polymyalgia rheumatica (1), protein calorie malnutrition (1), seizure disorder (1), tobacco abuse (1)

⁶ Other acute conditions include: acute renal failure (7), encephalitis (4), gastrointestinal bleed (3), bowel perforation or peritonitis (2), fall (2), urinary tract infection (2), acute blood loss (1), ankle fracture (1), cervical injuries (1), cholecystitis (1), disseminated intravascular disease (1), gangrene (1), influenza B virus (1), methamphetamine positive (1), sacral decubitus ulcer (1), thermal burns from stove (1)

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