Public Health
Seattle & King County

Summary Report on Deaths Associated with COVID-19

March 30, 2021

Public Health—Seattle & King County (PHSKC) conducts investigations to help understand the circumstances and burden of deaths attributable to COVID-19. To conduct these analyses, PHSKC linked death certificate data (demographic information, causes of death, and death location), electronic lab reporting data (demographic data for all individuals tested for COVID-19 and their test results), and King County Medical Examiner's Office (KCMEO) data (post-mortem COVID test results and designation of cause of death for decedents with sudden, unexpected, or unnatural deaths). Data were linked based on the decedents name, date of birth, and zip code.

Death counts should be considered preliminary and may change as death certificate or case investigations data are updated. Certification is typically reported within 10 days, but in rare circumstances may take up to one year.

King County COVID-19 Deaths – Key Findings

How does King County define which deaths are related to COVID-19?

PHSKC and Washington State Department of Health classified COVID-19 deaths into four categories:

- **Confirmed**: the deceased person tested positive and had a death certificate noting infection with the virus contributed to death
- **Suspected**: the deceased person tested positive for COVID-19 within 28 days of death, died of a natural disease, and did not have COVID-19 listed on their death certificate
- **Pending**: awaiting death certificates or deaths where cause of death is missing but do have confirmatory testing for COVID-19 within 28 days of death
- **Probable**: COVID-19 was listed on the death certificate, died of a natural cause or illness, but the deceased person did not have a record of confirmatory testing within 28 days of death

Deaths where the decedent died of non-natural causes, such as traffic accidents, overdose, homicide, or suicide, are excluded for COVID-19 death reporting, even if the decedent had a positive confirmatory test. Unless otherwise specified, the deaths due to COVID-19 in this report refer to confirmed and suspected COVID-19 deaths. Based on guidance from the Washington State Department of Health, a confirmatory test must occur within 28 days of death.[1] These definitions may change if national case classifications change.

[1] https://www.doh.wa.gov/Newsroom/Articles/ID/2508/Department-of-Health-improves-how-it-reports-COVID-19-deaths, December 10, 2020.

How many King County residents have died due to COVID-19?

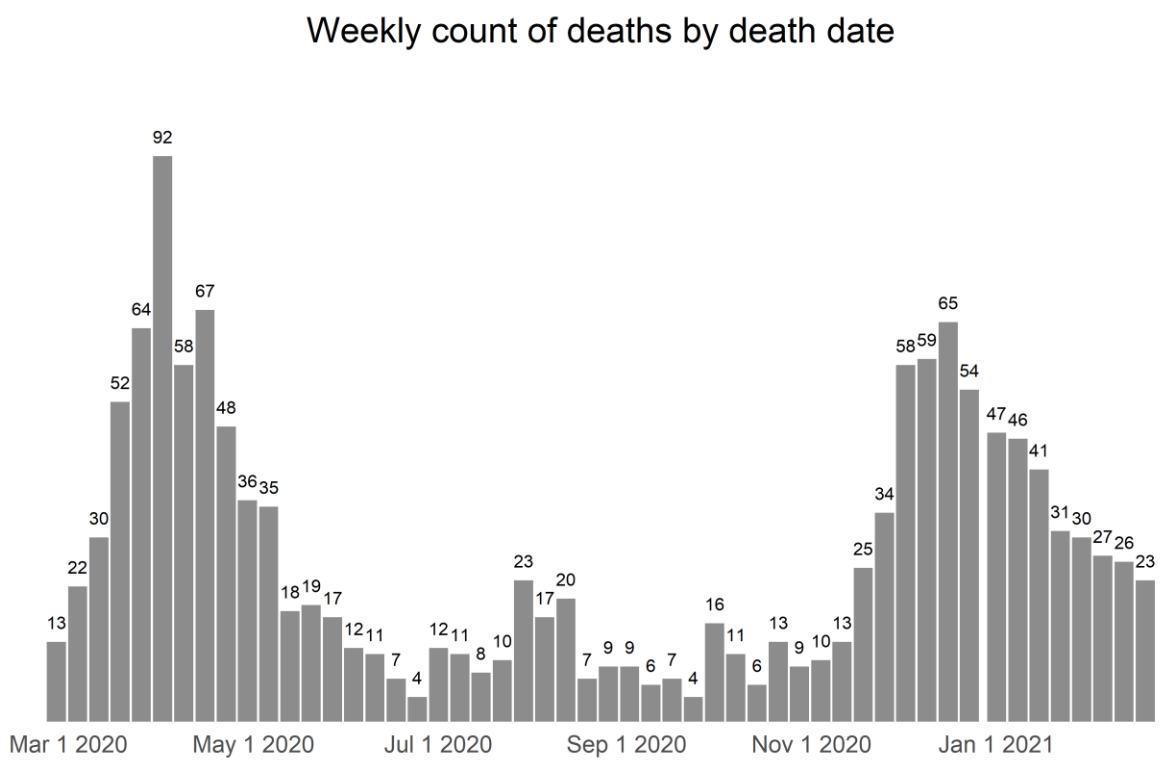
Refer to PHSKC's COVID-19 Outbreak Summary, where the death count and trend is updated daily. As of February 28, 2021, 1424 deaths were associated with COVID-19:

- 91% (1296) are confirmed
- 9% (128) are suspected

An additional 13 deaths are probable.

How have the number of deaths changed over time?

- The first recognized COVID-19 related death occurred in late February 2020.
- COVID-19 deaths peaked in late March and early April 2020, with a weekly high of 92 deaths the week beginning April 1.
- The weekly count of COVID-19 related deaths decreased steadily between mid-April and mid-June 2020, increased between July and August, and returned to a lower level until November. Starting in late November, weekly deaths rose again, reaching similar counts observed in March and April 2020. From the last week of December to the present, weekly deaths have been on a decreasing trend. Refer to PHSKC's COVID-19 Outbreak Summary, where the death count and trend is updated daily.



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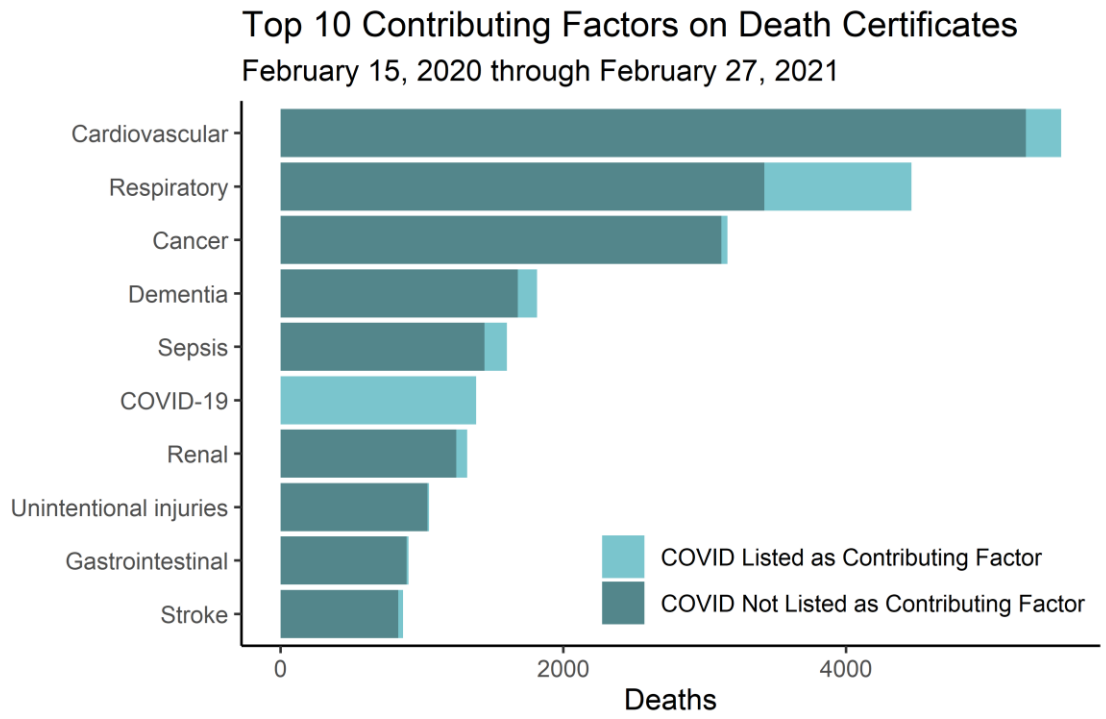
How does COVID-19 compare to other contributing factors on death certificates since the start of the pandemic?

- Death certificates prepared by the Washington State Department of Health list up to four causes as contributing to death. Based on this data, we classified deaths into 34 non-mutually exclusive categories of contributing factors (refer to the Technical Notes at the end of this report for a complete list of categories)[2]
- Between February 15, 2020 and February 27, 2021, COVID-19 ranked 6th among 34 non-mutually exclusive contributing factors.
- The weekly ranking of COVID-19 among contributing causes of death varies over time, ranging from the 3rd most common contributing factor to death (weeks of March 25, April 1, April 15 and December 2, 2020) to the 18th most common contributing cause of death (weeks of September 9, September 23, and October 14, 2020).
- During the last full week covered by this report (the week starting February 19, 2021), COVID-19 was the 6th most common contributing cause of death.



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[2] See **Cause of Death Definitions** in the Technical Notes

What are the leading contributing causes of death among persons with a COVID-19 associated death?

- Through February 27, 2021, respiratory illness was a contributing cause for 75% of COVID-19 related deaths; specifically, pneumonia was a contributing cause in 52% of COVID-19 related deaths and acute respiratory distress syndrome was a contributing cause in 11% of COVID-19 related deaths.
- Cardiovascular disease (CVD) (18%) and sepsis (11%) were also leading contributing causes of death among persons who died of COVID-19.
- Among COVID-19 decedents with available data on symptoms, 94% had a symptomatic illness preceding death; fever, shortness of breath, and cough were the most commonly identified symptoms. 19% of decedents have no available data on symptoms.
- Among COVID-19 decedents with available data on underlying conditions, approximately nine out of ten had underlying medical conditions such as heart disease, diabetes, chronic kidney disease, chronic lung disease, or immunosuppression; 20% of decedents have no available data on underlying conditions.

Which groups experience the highest burden of COVID-19 deaths?

The burden of deaths due to COVID-19 is unevenly distributed across King County residents. This section looks at COVID-19 deaths by age, sex, race/ethnicity, geography, and types of outbreaks. In addition to this report, refer to the **Demographics tab** of PHSKC's Daily Outbreak Summary for up-to-date demographic breakdown of death counts and rates by age group, race, sex at birth, and geography, as well as PHSKC's COVID-19 Race and Ethnicity data dashboard for further detail on deaths by race/ethnicity.

Age

- The majority of COVID-19 deaths were among older adults. As of February 28, nearly 53.4% of those who died from COVID-19 related illness were 80+ years old and more than 90.9% were 60+ years old.
- The median age for COVID-19 related deaths has remained around 81 years old since the beginning of the outbreak.
- Median age of death due to COVID-19 varies by race and ethnicity. For White and Asian decedents, the median age is older than the county median age (84 and 82 years, respectively). For all other race/ethnicities, the median age of death is younger, with the youngest median age of 62 years occurring among Native Hawaiian/Pacific Islander (NHPI) decedents.
- The risk of death from COVID-19 increases with age. Compared to a reference age group of 18-29 year old residents, residents over 85 have a 1830 times higher risk of death due to COVID-19 illness. For comparison, the risk of death due to all causes is 234 times higher in residents over 85 than in 18-29 year old residents.

- Among positive cases of COVID-19, the percentage of cases resulting in death also increases with age, reflecting the higher fatality of COVID-19 for older adults.

Table 1. Risk for COVID-19 Related Death by Age Group

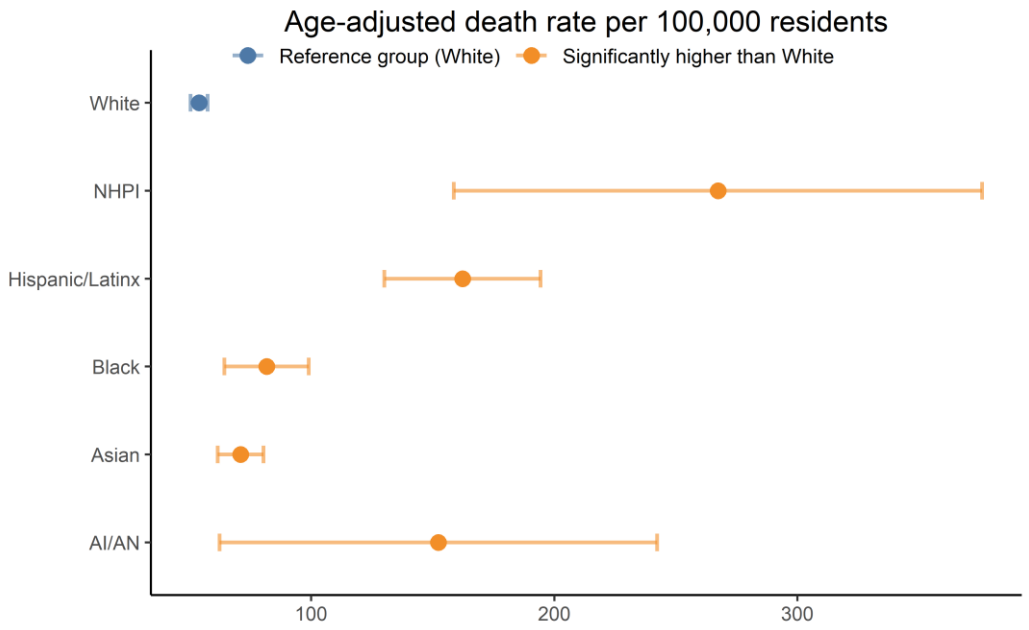
Age (years)	**0-17**	**18-29**	**30-39**	**40-49**	**50-64**	**65-74**	**75-84**	**85+**
Death rate ratio	0.22	*Reference*	2.30	6.11	40.9	150	454	1830
Percent of cases resulting in death	0.01%	0.02%	0.06%	0.15%	1.1%	5.5%	15%	33%

Example interpretation: Compared with 18-29 year olds, the rate of death is 150 times higher in 65-74 year olds.

Race and Ethnicity

- Overall, White residents account for a disproportionate share of COVID-19 deaths. White residents represent 65% of all deaths due to COVID, but make up 59% of the King County population. Among those under 60 years old, Hispanic/Latinx residents account for a disproportionate share of COVID-19 deaths, comprising 36% of deaths relative to less than 12% of the population.
- Although the largest number of COVID-19 deaths are among White residents, the age-adjusted[3] rate of death is higher among all other race/ethnic groups than among White residents. The age-adjusted death rate is highest among NHPI residents (267 per 100,000), followed by Hispanic/Latinx (162 per 100,000 residents), American Indian/Alaska Native (152 per 100,000 residents), Black (82 per 100,000 residents), Asian (71 per 100,000 residents) and White residents (54 per 100,000 residents).
- Racial misclassification, small populations, and missing data may affect the interpretation of these findings, especially regarding AI/AN residents.

[3] See **Age-adjustment** in the Technical Notes



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Geography

- Deaths associated with COVID-19 vary significantly by location within the county. The three health reporting areas with the highest rates are Southeast Seattle (171 deaths per 100,000 residents), Shoreline (145 per 100,000 residents), and South Auburn (138 per 100,000 residents). The three health reporting areas with the lowest death rates are Capitol Hill/Eastlake (12.4 deaths per 100,000 residents), South Bellevue (18.0 per 100,000 residents) and Bear Creek/Carnation/Duvall (18.4 per 100,000 residents). Death rates by location are also highly influenced by locations of long-term care facilities.

Key Populations

- Residents of long-term care facilities (LTCF) have experienced the greatest burden of deaths associated with COVID-19. Eight hundred and six COVID-19 related deaths have occurred in residents of LTCF, making up 56.6% of total COVID-19 deaths in the county. Among LTCF residents who developed COVID-19, 16% died due to COVID-related illness.
- Since so many COVID-19 deaths occur among LTCF residents, the demographic characteristics of LTCF residents heavily influence the demographics of deaths in King County overall. Key demographic characteristics of deaths outside LTCFs may therefore be hard to see when looking at total deaths. To address this, we also looked at death rates excluding LTCF residents to better identify demographic characteristics of deaths in the general population.
- Disparities in death rates by race and ethnicity are wider among the general population than among LTCF residents. The largest difference is among NHPI individuals, who have a death rate 5.0 times higher than White individuals in the total population and 8.8 times

higher than White individuals when LTCF residents are excluded. Similarly, Hispanic/Latinx individuals have a death rate 2.9 times higher than White individuals in the total population and 4.4 times higher than White individuals when LTCF residents are excluded.

- Among all COVID-19 associated deaths, 64% (901 deaths) were linked to an outbreak. Among those deaths, 92% (826) were linked to an outbreak in a LTCF (including LTCF residents and employees), 3.9% (35) in a healthcare facility other than a LTCF, 3.0% (27) in a senior living facility, and 1.2% (11) in a homeless service site.
- Among people experiencing homelessness in King County, there have been 21 COVID-19 related deaths, which represents 1.5% of total COVID-19 deaths. COVID-19 contributed to death among 1.6% of people experiencing homelessness who previously tested positive.

How has COVID-19 impacted death rates for other causes?

To see how death rates for other causes changed after the identification of COVID-19 in the community, we compared age-adjusted death rates for all causes combined, cardiovascular disease, and respiratory disease from February 15, 2020 through February 28, 2021 to the average annual death rate in 2017-2019. This analysis looks at all deaths, regardless of COVID-19 status, within and across each racial/ethnic group.

Overall

- The rate of death for **all causes combined** was 17% higher since February 2020 relative to 2017-2019 (Supplementary Table 2). After excluding deaths where COVID-19 was a contributing cause of death, the death rate for all causes only increased by 6% relative to 2017-2019, suggesting that 65% of the increase was due to COVID-19.
- The overall **respiratory** death rate was 32% higher since February 2020 (Supplementary Table 4). After excluding deaths where COVID-19 was a contributing cause of death, the death rate was not significantly different relative to 2017-2019 (298 per 100,000 people in 2017-2019 and 302 per 100,000 people since February 2020), suggesting the increase in respiratory deaths was primarily due to COVID-19.
- The overall **cardiovascular** death rate was 10% higher since February 2020 (Supplementary Table 6). After excluding deaths where COVID-19 was a contributing cause of death, the death rate was 5% higher relative to 2017-2019 (442 per 100,000 people in 2017-2019 and 463 per 100,000 people since February 2020, suggesting that 50% of the increase was due to COVID-19.

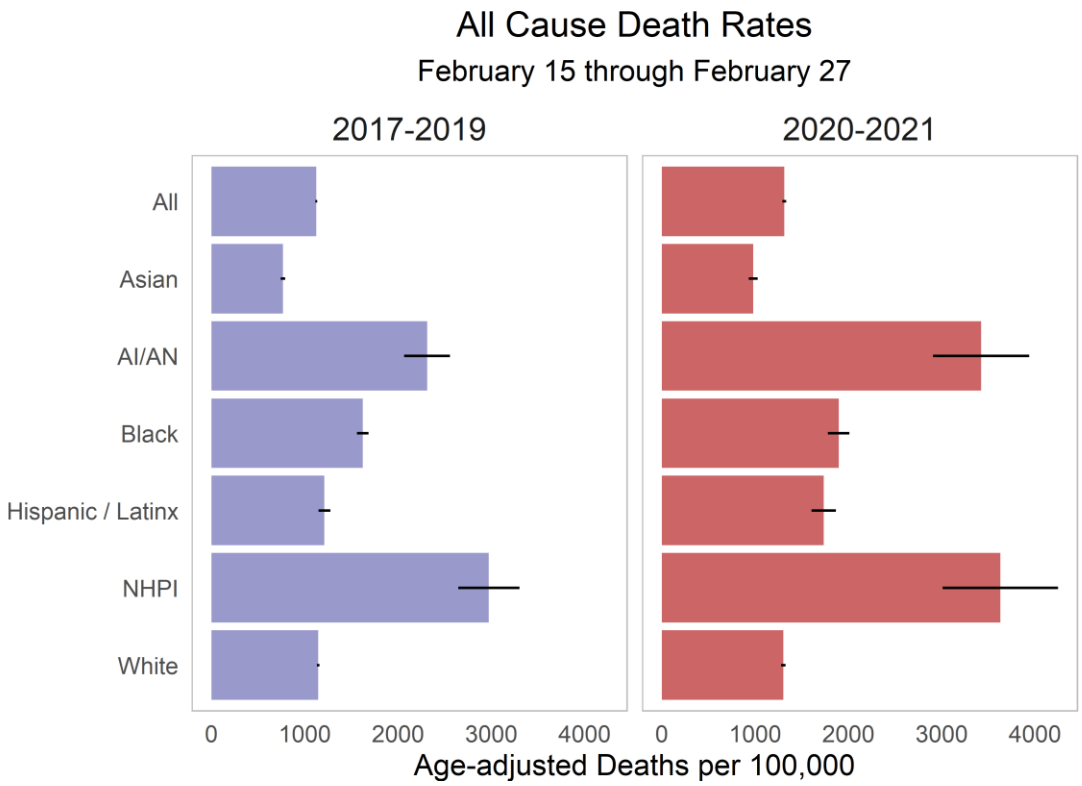
By Race and Ethnicity

All causes combined

- **All cause** death rates increased among all racial/ethnic groups, with the largest increases among non-White residents. Since February 2020, the death rate increased by 48% among AI/AN, 43% among Hispanic/Latinx, 28% among Asian, 22% among NHPI, 17% among Black and 14% among White residents relative to 2017-2019. The limited number of NHPI individuals in the county means small changes in the number of events can cause large variations in rates. Therefore it is

possible the higher death rate among NHPI is within the normal range of the death rate in a typical year.

- Existing disparities in the **all cause** death rate between most racial/ethnic groups widened. Relative to White individuals, death rates among AI/AN, Black, NHPI, and Hispanic/Latinx individuals were higher since February 2020 than they were in 2017-2019.
- Although Asians had lower all-cause death rates than White individuals in both 2017-2019 and in 2020-2021, the difference between the death rate among Asians and White individuals decreased between these time periods. While Asian individuals had a 33% lower death rate than White individuals in 2017-19, this difference decreased to 25% in 2020-2021. This decrease was primarily driven by a disproportionate increase in the death rate among Asian individuals in 2020-2021. Since February 2020, the death rate among Asian individuals increased by 28%, relative to a 14% increase among White individuals.



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Respiratory

- **Respiratory** death rates increased for all racial/ethnic groups, and the increase was larger for non-White residents. Since February 2020, the **respiratory** death rate increased by 106% for Hispanic/Latinx, 75% for NHPI, 63% for Asian, 36% for AI/AN, 29% for Black and 25% for White individuals relative to 2017-2019. The limited number of AI/AN individuals in the county means small changes in the number of events can cause large variations in rates.

Therefore it is possible the higher **respiratory** death rate among AI/AN is within the normal range of the **respiratory** death rate in a typical year.

- As a result of these changes, existing disparities in the **respiratory** death rate between most racial/ethnic groups widened. **Respiratory** death rates among Black and NHPI individuals are higher relative to White individuals since February 2020 than in 2017-2019.
- **Respiratory** death rates among Hispanic/Latinx individuals were comparable to White individuals before the pandemic (321 versus 303 per 100,000), and are now significantly higher (661 versus 380 per 100,000).
- Although Asians had lower **respiratory** death rates than White individuals in both 2017-2019 and in 2020-2021, the difference between the death rate among Asians and White individuals decreased between these time periods. While Asian individuals had a 33% lower death rate than White individuals in 2017-2019, this difference decreased to 12% in 2020-2021. This decrease was primarily driven by a disproportionate increase in the death rate among Asian individuals, which increased by 63%, relative to a 25% increase among White individuals during the same time period.

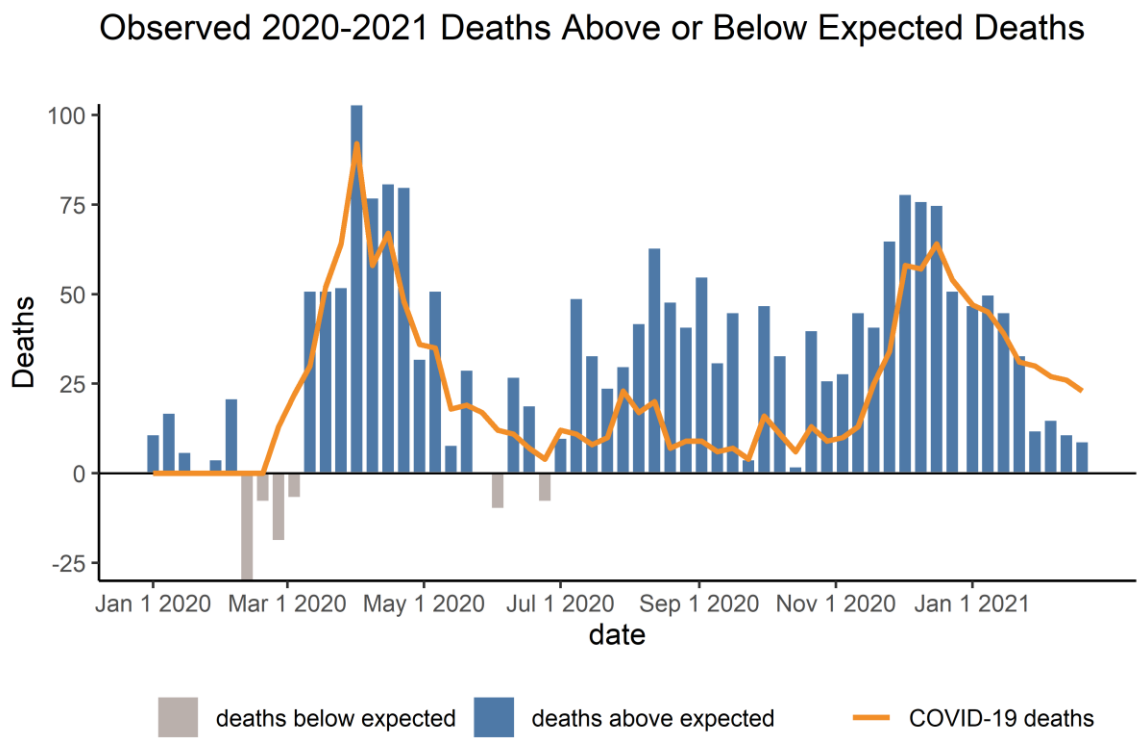
Cardiovascular

- **Cardiovascular** death rates increased for all racial/ethnic groups, and the increase was larger for non-White residents. Since February 2020, **cardiovascular** death rates increased by 73% for AI/AN, 24% for NHPI, 20% for Hispanic/Latinx, 14% for Asian, 9% for Black and 8% for White individuals relative to 2017-2019. The limited number of NHPI individuals and Black individuals in the county means small changes in the number of events can cause large variations in rates. Therefore it is possible the higher death rates among NHPI and Black individuals are within the normal range of the death rates among NHPI and Black individuals in a typical year.
- As a result of these changes, existing disparities in the **cardiovascular** death rate between several racial/ethnic groups widened. **Cardiovascular** death rates among AI/AN, Black and NHPI individuals are higher relative to White individuals since February 2020 than in 2017-2019.
- **Cardiovascular** death rates among Hispanic/Latinx individuals were comparable to White individuals before the pandemic (456 versus 442 per 100,000) and remain comparable since February 2020 (546 versus 478 per 100,000).
- Although Asians had lower **cardiovascular** death rates than White individuals in 2017-2019 and in 2020-2021, the difference between the death rate among Asians and White individuals decreased between these time periods. While Asian individuals had a 30% lower death rate than White individuals in 2017-19, this difference decreased to 25% in 2020-2021. This decrease was primarily driven by a disproportionate increase in the death rate among Asian individuals, which increased by 14%, relative to an 8% increase among White individuals during the same time frame.

How many King County "excess deaths" have there been since the start of 2020?

- Excess deaths[4] are an alternative way to assess change in overall mortality in 2020 and 2021. This method estimates weekly deaths in 2020 and 2021 that are beyond what the county would expect using 2015-2019 as a reference.
- Comparing excess deaths to the number of confirmed and suspected COVID-19 deaths lets us assess whether the increase in deaths since 2020 is attributable to COVID-19. The excess deaths estimate includes deaths regardless of testing for COVID-19 or mentions of COVID-19 in the death certificate.
- From January 1, 2020 to February 25, 2021, PHSKC estimates there have been 2,024 excess deaths (compared to 2015-2019 levels). Excess deaths accounted for 11.7% of total King County deaths (17,281) during this period (Supplemental Table 1). During the same time period, the official PHSKC count includes 1,386 COVID-19 deaths, suggesting 32% of the increase in deaths since 2020 is attributable to COVID-19.
- Because the number of deaths varies from year to year, we also estimated statistically significant excess deaths above and beyond what would be expected due to typical yearly variation in weekly deaths. There were 583 statistically significant excess deaths. This accounts for 3.4% of King County deaths during this period.
- Looking at trends over time, excess deaths correlated closely with COVID-19 deaths early in the pandemic and from late November 2020 through January 2021. However when COVID-19 deaths decreased in the summer and early fall of 2020, excess deaths remained elevated, suggesting increased deaths from other (non-COVID) causes compared to previous years.
- Over the past month of February 2021, there were more total deaths than in previous years, but fewer total deaths than expected given the continued number of COVID-19 deaths. This suggests a recent decrease in other (non-COVID) causes of death. One possible contribution to the decrease is the decline in influenza deaths in the current flu season. There have been zero influenza deaths this season, compared to an average of 32.8 deaths by this time in the season over the past five years.

[4] See **Excess Deaths Methodology** in the Technical Notes



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Are COVID-19 deaths undercounted in King County?

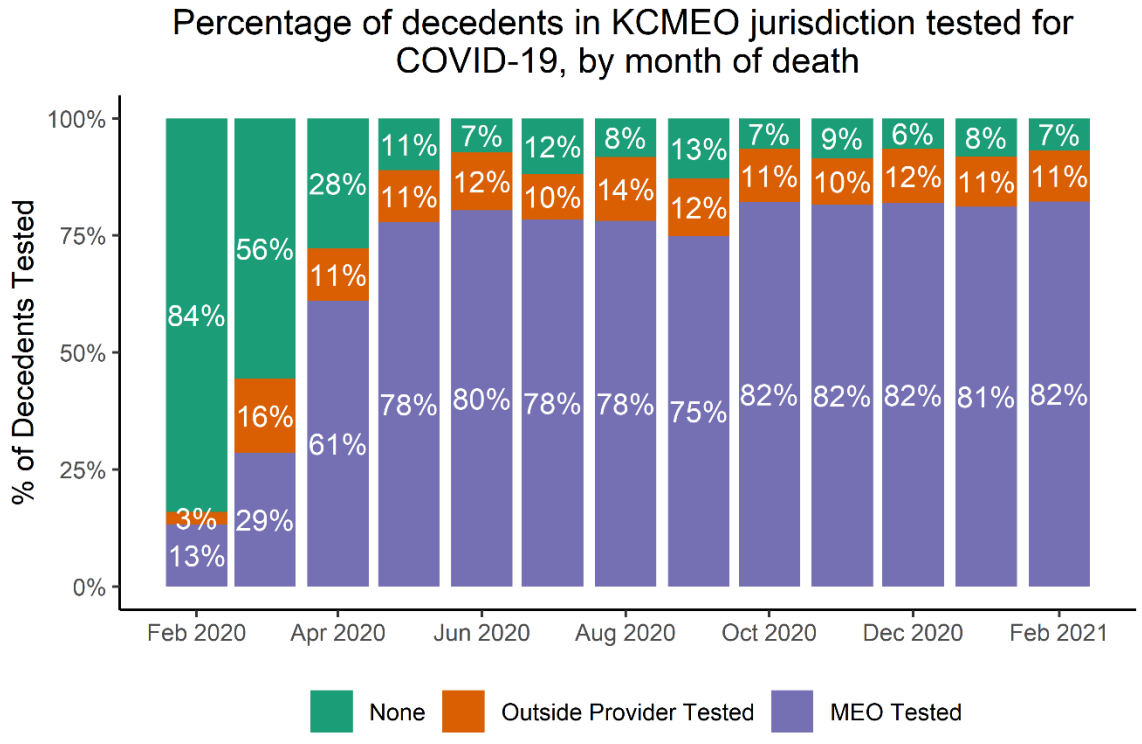
- COVID-19 deaths could have been undercounted when there was insufficient testing, particularly at the start of the pandemic. To assess this possibility for the start of the pandemic in King County, we compared death rates during the three months prior to the outbreak (November 1, 2019 through February 15, 2020) to the same period in 2016-2019. We found no evidence for increased rates of respiratory death, cardiovascular death, or death for all causes combined during this time.
- Although there were some weeks with excess deaths in January and February 2020, there was no increase in deaths due to respiratory or cardiovascular causes in the three weeks leading up to the first identified COVID-19 case in King County in late February. This suggests that there was not an unrecognized increase in deaths due to COVID-19 prior to the first identified death. The excess deaths identified at the start of the year are likely attributable to causes unrelated to COVID-19.
- Looking later in the year to the summer and early fall of 2020, when the number of excess deaths was higher than the number of confirmed and suspected COVID-19 deaths, we assessed whether COVID-19 deaths were undercounted in this period. CVD deaths increased during this time, but it's unlikely that COVID-19 was an unrecognized contributing cause because COVID-19 testing has continually increased in this population.

The percent of CVD decedents tested for COVID-19 increased throughout the year, averaging over 70% tested per week from October through the end of the year.

Is King County attempting to perform COVID-19 tests for those who died without testing?

The King County Medical Examiner's Office (KCMEO) is performing COVID-19 testing for most of the decedents in its jurisdiction. KCMEO assumes jurisdiction over sudden, unexpected, or unnatural deaths and starting in 2020, for deaths with clinical or epidemiologic suspicion of COVID-19.

- From February 15, 2020 through February 28, 2021, KCMEO assumed jurisdiction of 4,214 decedents, tested 72% (3,049) of these decedents, and found 7% (224) of those tested were positive for COVID-19.
- KCMEO has increased its capacity to test decedents post-mortem throughout the outbreak. In recent months, KCMEO has tested approximately 80% of decedents for COVID-19 each month. Approximately 10% of decedents were tested for COVID-19 by outside providers, and the remaining decedents were not tested due to no clinical or epidemiologic indications.
- There were similarities and differences when comparing those who KCMEO found to be COVID positive versus all COVID deaths: they were less likely to be over 60 years old (67% vs. 91%). They were slightly more likely to be males (62% vs. 52%).



Prepared by Public Health Seattle & King County; Data Source: King County Medical Examiner's Office

What is the relationship between location of death and COVID-19 positivity?

Most deaths from all causes occurred in residences and hospitals, but most COVID-19 deaths occurred in hospitals and long-term care facilities.

- Between February 15 through February 27, 2020, 38% (5,987) of King County deaths occurred in residences and 34% (5,298) occurred in hospitals, and 17% (2,715) occurred in LTCF. These proportions are similar to those in recent years (2017-2019).
- During the same time window, 57% (791) of COVID+ deaths occurred in hospitals, 26% (366) of COVID+ deaths occurred in LTCF, 10% (141) of COVID+ deaths occurred in residences, 2% (32) of COVID+ deaths occurred in hospices, and 4% (54) of COVID+ deaths occurred in other locations. These proportions have remained relatively stable over time.
- Among decedents who were tested for COVID-19, deaths occurring in hospitals were more likely to have a positive result (21%) compared to deaths occurring in residences (5%).
- The proportion tested for COVID-19 among hospital deaths and residence deaths without recent medical care did not vary significantly by race/ethnicity.

Appendices

Supplementary Table 1. Summary of Excess Deaths between January 1 and February 25, 2021*

Week beginning	Observed	Expected	Excess	COVID	Percent excess
Jan 1, 2020	289	278	11	0	4%
Jan 8, 2020	296	279	17	0	6.1%
Jan 15, 2020	288	282	6	0	2.2%
Jan 22, 2020	274	274	0	0	-
Jan 29, 2020	283	279	4	0	1.5%
Feb 5, 2020	299	278	21	0	7.6%
Feb 12, 2020	244	274	0	0	-
Feb 19, 2020	265	273	0	0	-
Feb 26, 2020	255	274	0	13	-
Mar 4, 2020	261	268	0	22	-
Mar 11, 2020	317	266	51	30	19.3%
Mar 18, 2020	320	269	51	52	19%
Mar 25, 2020	319	267	52	64	19.4%
Apr 1, 2020	362	259	103	92	39.6%
Apr 8, 2020	333	256	77	58	30.3%
Apr 15, 2020	335	254	81	67	31.8%
Apr 22, 2020	331	251	80	48	31.7%
Apr 29, 2020	282	250	32	36	12.9%
May 6, 2020	296	245	51	35	20.8%
May 13, 2020	253	245	8	18	3.1%
May 20, 2020	272	243	29	19	11.9%
May 27, 2020	243	243	0	17	-
Jun 3, 2020	231	241	0	12	-
Jun 10, 2020	272	245	27	11	11%
Jun 17, 2020	261	242	19	7	8%
Jun 24, 2020	236	244	0	4	-
Jul 1, 2020	251	241	10	12	4%
Jul 8, 2020	289	240	49	11	20.3%
Jul 15, 2020	271	238	33	8	14%
Jul 22, 2020	264	240	24	10	9.8%
Jul 29, 2020	266	236	30	23	12.5%
Aug 5, 2020	273	231	42	17	18.2%
Aug 12, 2020	293	230	63	20	27.4%
Aug 19, 2020	277	229	48	7	21.1%
Aug 26, 2020	266	225	41	9	18.2%
Sep 2, 2020	282	227	55	9	24.2%
Sep 9, 2020	259	228	31	6	13.5%
Sep 16, 2020	280	235	45	7	19%
Sep 23, 2020	242	238	4	4	1.5%
Sep 30, 2020	288	241	47	16	19.3%

Oct 7, 2020	274	241	33	11	13.9%
Oct 14, 2020	251	249	2	6	0.6%
Oct 21, 2020	289	249	40	13	16%
Oct 28, 2020	280	254	26	9	10.4%
Nov 4, 2020	282	254	28	10	10.9%
Nov 11, 2020	300	255	45	13	17.5%
Nov 18, 2020	296	255	41	25	16.3%
Nov 25, 2020	319	254	65	34	25.4%
Dec 2, 2020	335	257	78	58	30.5%
Dec 9, 2020	333	257	76	57	29.7%
Dec 16, 2020	343	268	75	64	28%
Dec 23, 2020	322	271	51	54	18.7%
Jan 1, 2021	325	278	47	47	16.9%
Jan 8, 2021	329	279	50	45	17.9%
Jan 15, 2021	327	282	45	39	16%
Jan 22, 2021	307	274	33	31	12.2%
Jan 29, 2021	291	279	12	30	4.3%
Feb 5, 2021	293	278	15	27	5.5%
Feb 12, 2021	285	274	11	26	4%
Feb 19, 2021	282	273	9	23	3.4%
Total	**17,281**	**15,339**	**2,024**	**1,386**	**11.7%**

**Excess deaths are the Observed minus the Expected. COVID+ deaths are included in the observed number of deaths.*

Supplementary Table 2. Age-adjusted all-cause death rates and ratios between February 15 and February 27, 2021

Strata	Ave Deaths 2017-2019	Deaths 2020-2021	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020-2021	Ratio (95% CI)	Significant
All	13,137	15,582	9,138	1,384	1,124.2 (1,112.8 - 1,135.5)	1,313.8 (1,293.0 - 1,334.6)	1.17 (1.15 - 1.19)	Yes
AI/AN	114	170	95	12	2,312.4 (2,067.1 - 2,557.8)	3,423.1 (2,908.2 - 3,937.9)	1.48 (1.23 - 1.78)	Yes
Asian	1,252	1,700	999	228	766.2 (741.6 - 790.9)	979.9 (933.2 - 1,026.6)	1.28 (1.21 - 1.35)	Yes
Black	853	1,037	605	90	1,622.5 (1,559.3 - 1,685.7)	1,896.7 (1,780.9 - 2,012.4)	1.17 (1.09 - 1.26)	Yes
Hispanic	470	696	400	104	1,211.4 (1,147.1 - 1,275.6)	1,735.8 (1,605.8 - 1,865.8)	1.43 (1.31 - 1.57)	Yes
NHPI	105	133	84	27	2,974.1 (2,645.1 - 3,303.1)	3,629.4 (3,011.7 - 4,247.1)	1.22 (1.00 - 1.49)	No
White	10,140	11,582	6,815	906	1,144.9 (1,131.9 - 1,157.8)	1,303.3 (1,279.5 - 1,327.1)	1.14 (1.11 - 1.16)	Yes
Female	6,438	7,388	4,208	662	952.1 (938.6 - 965.6)	1,079.0 (1,054.4 - 1,103.7)	1.13 (1.10 - 1.16)	Yes
Male	6,699	8,050	4,789	722	1,373.7 (1,354.3 - 1,393.1)	1,622.3 (1,586.5 - 1,658.1)	1.18 (1.15 - 1.21)	Yes

** Significant = "Yes" indicates statistically significant increase in the rate of death in 2020-2021 relative to 2017-2019.*

Supplementary Table 3. Age stratified all-cause death rates and ratios between February 15 and February 27, 2021

Strata	Ave Deaths 2017-2019	Deaths 2020-2021	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020-2021	Ratio (95% CI)	Significant
0-18	157	181	55	1	32.6 (29.7 - 35.6)	37.3 (31.9 - 42.8)	1.14 (0.96 - 1.36)	No
19-50	1,058	1,349	793	36	98.7 (95.2 - 102.1)	123.1 (116.6 - 129.7)	1.25 (1.17 - 1.33)	Yes
51-64	1,857	2,185	1,326	154	510.4 (497.0 - 523.8)	600.6 (575.5 - 625.8)	1.18 (1.12 - 1.24)	Yes
65-84	5,092	6,279	3,833	609	2,108.4 (2,074.9 - 2,141.8)	2,510.3 (2,448.2 - 2,572.4)	1.19 (1.16 - 1.23)	Yes
85+	4,974	5,587	3,131	584	15,173.0 (14,929.5 - 15,416.4)	17,402.0 (16,945.6 - 17,858.3)	1.15 (1.11 - 1.18)	Yes

** Significant = "Yes" indicates statistically significant increase in the rate of death in 2020-2021 relative to 2017-2019.*

Supplementary Table 4. Age-adjusted respiratory death rates and ratios between February 15 and February 27, 2021

Strata	Ave Deaths 2017-2019	Deaths 2020-2021	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020-2021	Ratio (95% CI)	Significant
All	3,325	4,462	3,105	1,041	297.9 (292.0 - 303.9)	394.0 (382.3 - 405.6)	1.32 (1.28 - 1.37)	Yes
AI/AN	31	43	30	8	699.7 (558.1 - 841.3)	952.4 (667.6 - 1,237.2)	1.36 (0.95 - 1.95)	No
Asian	311	540	382	174	204.0 (190.9 - 217.2)	333.1 (304.9 - 361.2)	1.63 (1.47 - 1.81)	Yes
Black	205	276	198	73	424.5 (390.9 - 458.1)	548.6 (483.8 - 613.4)	1.29 (1.12 - 1.49)	Yes
Hispanic	102	218	149	85	320.6 (284.4 - 356.9)	660.9 (572.6 - 749.3)	2.06 (1.73 - 2.45)	Yes
NHPI	24	44	32	24	829.4 (638.7 - 1,020.1)	1,448.1 (1,019.6 - 1,876.6)	1.75 (1.20 - 2.54)	Yes
White	2,604	3,276	2,273	666	303.2 (296.4 - 309.9)	380.0 (367.0 - 393.1)	1.25 (1.20 - 1.31)	Yes
Female	1,663	2,138	1,457	486	253.8 (246.8 - 260.9)	322.3 (308.6 - 336.0)	1.27 (1.21 - 1.34)	Yes
Male	1,662	2,275	1,599	555	362.7 (352.5 - 372.9)	487.8 (467.6 - 508.0)	1.35 (1.28 - 1.41)	Yes

** Significant = "Yes" indicates statistically significant increase in the rate of death in 2020-2021 relative to 2017-2019.*

Supplementary Table 5. Age stratified respiratory death rates and ratios between February 15 and February 27, 2021

Strata	Ave Deaths 2017-2019	Deaths 2020-2021	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020-2021	Ratio (95% CI)	Significant
0-18	35	47	8	0	7.22 (5.83 - 8.61)	9.69 (6.92 - 12.5)	1.34 (0.95 - 1.89)	No
19-50	132	168	119	29	12.3 (11.1 - 13.6)	15.3 (13.0 - 17.6)	1.24 (1.04 - 1.49)	Yes
51-64	387	527	352	117	106.4 (100.3 - 112.5)	144.9 (132.5 - 157.2)	1.36 (1.23 - 1.51)	Yes
65-84	1,435	2,029	1,462	476	594.4 (576.6 - 612.1)	811.2 (775.9 - 846.5)	1.36 (1.29 - 1.44)	Yes
85+	1,336	1,691	1,164	419	4,074.4 (3,948.2 - 4,200.6)	5,267.0 (5,016.0 - 5,518.0)	1.29 (1.22 - 1.37)	Yes

** Significant = "Yes" indicates statistically significant increase in the rate of death in 2020-2021 relative to 2017-2019.*

Supplementary Table 6. Age-adjusted cardiovascular death rates and ratios between February 15 and February 27, 2021

Strata	Ave Deaths 2017-2019	Deaths 2020-2021	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020-2021	Ratio (95% CI)	Significant
All	4,958	5,520	3,100	250	441.9 (434.7 - 449.1)	485.2 (472.3 - 498.0)	1.10 (1.06 - 1.13)	Yes
AI/AN	37	65	34	5	834.9 (680.2 - 989.7)	1,442.7 (1,091.8 - 1,793.6)	1.73 (1.27 - 2.35)	Yes
Asian	476	578	327	48	311.0 (294.8 - 327.2)	355.9 (326.8 - 384.9)	1.14 (1.04 - 1.26)	Yes
Black	364	411	232	24	751.2 (706.5 - 796.0)	816.6 (737.5 - 895.7)	1.09 (0.97 - 1.22)	No
Hispanic	145	179	99	13	456.1 (412.8 - 499.4)	546.0 (465.7 - 626.2)	1.20 (1.01 - 1.42)	Yes
NHPI	43	55	30	5	1,476.2 (1,220.7 - 1,731.7)	1,823.2 (1,340.8 - 2,305.6)	1.24 (0.90 - 1.69)	No
White	3,824	4,145	2,328	153	441.9 (433.8 - 450.1)	477.6 (463.0 - 492.2)	1.08 (1.04 - 1.12)	Yes
Female	2,379	2,568	1,412	113	360.6 (352.2 - 369.0)	384.7 (369.8 - 399.6)	1.07 (1.02 - 1.12)	Yes
Male	2,578	2,902	1,640	137	562.2 (549.5 - 574.9)	622.2 (599.4 - 645.0)	1.11 (1.06 - 1.16)	Yes

** Significant = "Yes" indicates statistically significant increase in the rate of death in 2020-2021 relative to 2017-2019.*

Supplementary Table 7. Age stratified cardiovascular death rates and ratios between February 15 and February 27, 2021

Strata	Ave Deaths 2017-2019	Deaths 2020-2021	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020-2021	Ratio (95% CI)	Significant
0-18	24	40	11	0	5.07 (3.91 - 6.23)	8.25 (5.69 - 10.8)	1.63 (1.11 - 2.39)	Yes
19-50	207	239	146	8	19.4 (17.8 - 20.9)	21.8 (19.1 - 24.6)	1.13 (0.97 - 1.31)	No
51-64	641	738	442	44	176.2 (168.3 - 184.1)	202.9 (188.2 - 217.5)	1.15 (1.06 - 1.25)	Yes
65-84	1,932	2,259	1,332	107	800.1 (779.5 - 820.7)	903.1 (865.9 - 940.4)	1.13 (1.08 - 1.18)	Yes
85+	2,152	2,244	1,169	91	6,565.6 (6,405.4 - 6,725.7)	6,989.4 (6,700.2 - 7,278.6)	1.06 (1.01 - 1.12)	Yes

** Significant = "Yes" indicates statistically significant increase in the rate of death in 2020-2021 relative to 2017-2019.*

Technical Notes

Age-adjustment

Age-adjustment is a statistical technique for standardizing the age distribution across different populations in order to facilitate comparison between groups. For example, almost 90% of Hispanics in King County are under 50 years old, whereas less than 65% of Whites are under 50 years old. Since older persons are at much greater risk of death, calculating age-standardized rates across groups allows us to more accurately assess if one group is at higher risk for death for reasons beyond the differences in age. This technique also allows for more accurate comparisons when age distributions of groups have changed over time.

We modeled death rates using Poisson regression models with the natural log of the population as the offset. Age-adjusted models included age as a natural cubic spline with three degrees of freedom. We then used the R `prediction` package to calculate the average predicted rates across the population distribution of age.

Cause of Death Definitions

Final encoding of death certificate data into ICD-10 codes is a process that can take up to 12 to 18 months. In order to conduct mortality surveillance with minimal delays, 34 causes of death were classified by systematically searching the open text immediate causes of death fields (cause A-D) on the death certificates. The search terms could appear in any of the four cause fields and causes of death were not ascribed a hierarchy and are not mutually exclusive. For example, if a decedent had renal failure, which gave rise to pulmonary edema and cardiac arrest, the individual would be classified as having renal, respiratory, and CVD related death. To avoid introducing temporal biases from using ICD-10 codes with older data and open text for newer data, we applied the search string algorithm to entirety of our dataset.

Below we present the search strings for the top two causes of death. Additional search algorithms are available upon request.

Cardiovascular Disease

- “aneurysm” OR “aorta” OR “aortic” OR “arrhythmi” OR “arteriosclerosis” OR “artery” OR “asystole” OR “atherosclerotic cerebral disease” OR “atrial fiberlation” OR “atrial fibrillation” OR “card” OR “cerebrovascular” OR “chf” OR “congestive heart” OR “coronary” OR “cor pulmonale” OR “deep vein thromb” OR “deep vein thrombosis” OR “deep venous thromb” OR “heart attack” OR “heart block” OR “heart disease” OR “heart failure” OR “hypertension” OR “hypertensive disease” OR “infarct” OR “ischemia” OR “left ventri” OR “mitral regurgitation” OR “peripheral arterial disease” OR “pulmonary embol” OR “pulmonary embolism” OR “pulmonary thromboembol” OR “pulseless electrical activity” OR “recurrent venous thrombosis” OR “resuscitated arrest” OR “stemi” OR “vascular disease” OR “vascular ischemic” OR “venous insufficiency” OR “ventricular fibrillation”
- “atherosclero” NOT “cereb”

- "vascular" NOT ("cereb" OR "dementia" OR "alz" OR "brain" OR "cerbro")
- "heart" AND "failure"

Respiratory

- "asthma" OR "bronchitis" OR "chronic obstructive" OR "chronic pulmonary disease" OR "chronic pulmonary obstructive disease" OR "copd" OR "diffuse alveolar damage" OR "dyspnea" OR "emphysema" OR "hypox" OR "influenza" OR "obstructive bronchitis" OR "pneumoni" OR "pneumonia" OR "pulmonary arrest" OR "pulmonary failure" OR "pulmonary infection" OR "respir" OR "rsv" OR "syncytial vir" OR "tuberculosis"

Data Sources

The following datasets were used to produce this report.

1. Death certificate data provided by the Washington Department of Health including all information that appears on a decedent's death certificate including demographic information, causes of death, and death location. Note that racial and ethnic classifications are subject to misclassification. Since self-identification is not possible, classification is often determined by a funeral director.
2. Electronic lab reporting data from the Washington Department of Health providing demographic information on all individuals tested for COVID-19, positive or negative, to enable us to match with the death certificate dataset.
3. King County Medical Examiner data including all deaths under KCMEO jurisdiction and testing performed and results for all decedents.

These data were combined utilizing Link King software based on name, date of birth, and zip code of decedents in all datasets. Racial and ethnic categorization was based solely on death certificates.

Deaths among Adult Family Home Residents

Decedents were classified as adult family home residents if their residence address or death address matched to an address list of DSHS licensed adult family homes in King County.

Excess Deaths Methodology

Excess death analyses assessed whether COVID-19 may have contributed to higher than expected death rates even when death records make no mention of an infection. In other words, this analysis attempted to identify the undercounting of COVID-19 associated mortality. We followed the methodology used by the CDC to calculate excess deaths associated with COVID-19.[5] We calculated the weekly difference between the 2020 observed number of deaths and the expected number of deaths based on data from the same time period in the previous five years (2015-2019).

[5] https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm, June 10, 2020

Rather than defining the expected number of deaths as the simple average of the historic number of deaths, we used the Farrington algorithm[6] in the R surveillance package[7]. The Farrington algorithm, which was designed for early outbreak detection, uses an overdispersed Poisson generalized linear model with reweighting to account for past outbreaks. Time (week of the year) was modeled as a spline with 6 knots to account for seasonal variation, the window was set so that there were 2 weeks on either side of the current week, and other settings followed those by Salmon et al 2016. We deviated from the CDC methodology by reporting the number of deaths exceeding the point estimate. In contrast, the CDC reports the number of deaths exceeding those of the predicted upper 95% confidence interval, i.e., statistically significant excess deaths.

The calculation of the total "Percent excess possibly attributable to COVID+" prohibits the carrying over of COVID+ deaths to another week. For example, in a week with 14 excess deaths and 20 COVID+ deaths, only 14 COVID+ deaths would be attributed to the excess deaths. The remaining 6 COVID+ deaths would not be attributed to deaths in the following week(s).

Testing/Place of death

Decedents who died in a residence were classified as recently receiving medical care if they were not referred to the Medical Examiner's Office because they had received medical care in the last 36 hours and that provider was willing to certify the death. This is often an indicator of decedents who were on home hospice care.

Revisions Since Last Update

Since the last update, we expanded the section on who is most impacted by COVID-19 related deaths to look at age, geographic location, and outbreak locations. The time range covered by the report has also expanded into 2021 for the first time, so we adjusted the time frames being used for tabulation as appropriate.

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[6] Farrington, C., Andrews, N., Beale, A., & Catchpole, M. (1996). A Statistical Algorithm for the Early Detection of Outbreaks of Infectious Disease. Journal of the Royal Statistical Society. Series A (Statistics in Society), 159(3), 547-563. doi:10.2307/2983331

[7] Salmon M, Schumacher D, Hohle M (2016). "Monitoring Count Time Series in R: Aberration Detection in Public Health Surveillance." Journal of Statistical Software, 70(10), 1-35. doi: 10.18637/jss.v070.i10.