

## Summary Report on Deaths Associated with COVID-19

January 5, 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 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 cause or illness, 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. Since the previous report published in September 2020, the Washington State Department of Health modified definitions for deaths attributed to COVID. With the current guidelines, a confirmatory test must be within 28 days of death, shorten from the previous 60 days threshold.<sup>1</sup> These definitions may change over time as national classifications are modified.

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<sup>1</sup> <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 December 1, 887 deaths were associated with COVID-19:

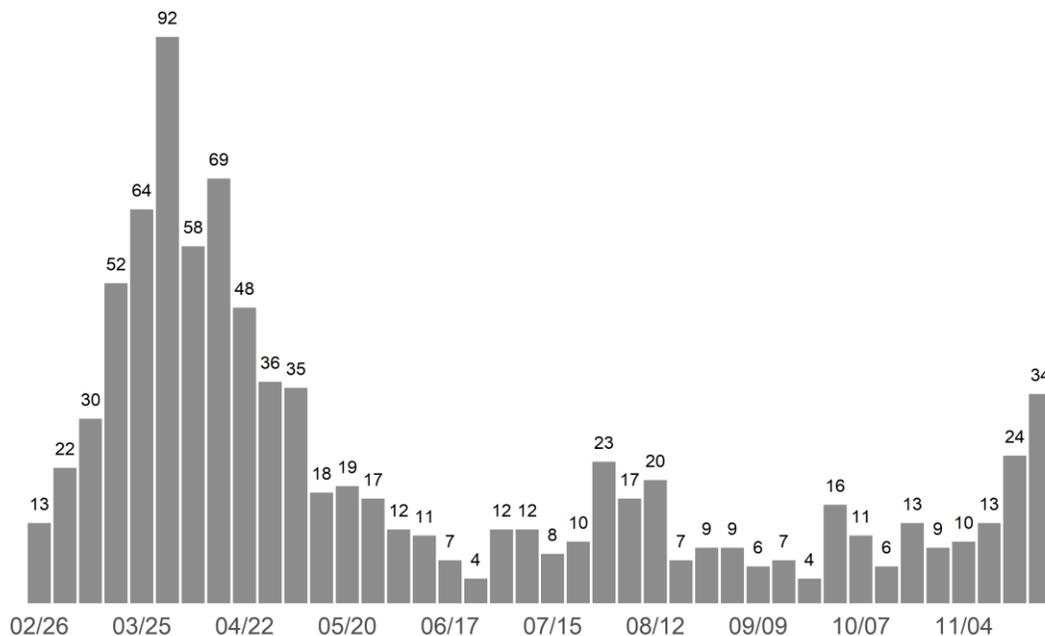
- 94% (835) are confirmed
- 6% (52) are suspected
- 0% (0) are pending

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, 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. In late July, weekly deaths increased again, then returned to a lower level until November. Though deaths are still down substantially from the peaks observed in March and April, the number of deaths has increased throughout November. Refer to PHSKC's [COVID-19 Outbreak Summary](#), where the death count and trend is updated daily.

Weekly count of deaths by death date



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

- The greatest burden of COVID-19 deaths is among those above 60 years old. The early outbreaks of COVID-19 in long-term care facilities led to many deaths among elderly residents, which decreased markedly in April and May in response to effective COVID-19 prevention measures. Through December 1, nearly 53.3% of those who died from COVID-19 related illness were 80+ years old and more than 90.5% were 60+ years old. The median age for COVID-19 related deaths has remained around 81 years old since the beginning of the outbreak.
- Overall, Whites account for a disproportionate share of COVID-19 deaths, representing 66% of all deaths relative to 59% of the King County population. Among those under 60 years old, Hispanics comprise less than 12% of the population but accounted for 43% of COVID-19 related deaths.
- Although most COVID-19 deaths are among Whites, the age-adjusted rate of death is highest among Native Hawaiian/Pacific Islanders (NHPI) and Hispanic/Latinx residents.
- Adjusted for age<sup>2</sup>, the rate of death due to COVID-19 among NHPI (143 per 100,000 residents) and Hispanic/Latinx (105 per 100,000 residents) residents is higher compared to White residents (33 per 100,000 residents). However, residents of skilled nursing and assisted living facilities contributed to a large number of COVID-19 deaths, and the race/ethnicity of residents of these facilities is different than that of the population at large. These disparities in death rates by race/ethnicity widened after excluding residents of skilled nursing and assisted living facilities from the analysis (118 per 100,000 among NHPI; 74 per 100,000 among Hispanic/Latinx, and 14 per 100,000 among Whites).
- The rate of death due to COVID-19 among American Indian / Alaskan Native (AI/AN), Asian and Black county residents did not differ significantly from the rate among Whites. However, racial misclassification, small populations, and missing data may affect the interpretation of these findings, especially regarding AI/AN.
- COVID-19 deaths are more common among males than females (52% vs. 48%, respectively).
- 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, and sex at birth.
- Refer to PHSKC's [COVID-19 Race and Ethnicity data dashboard](#) for additional information about deaths by race/ethnicity.

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<sup>2</sup> See **Age-adjustment** in the Technical Notes

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

- Through December 1, respiratory illness was a contributing cause for 77% of COVID-19 related deaths; 53% of all COVID-19 deaths had pneumonia and 14% had acute respiratory distress syndrome.
- Through December 1, cardiovascular disease (CVD) (15%) and sepsis (11%) were also leading contributing causes of death among persons who died of COVID-19.
- Through December 1, 84% of COVID-19 decedents had a symptomatic illness preceding death; fever, shortness of breath, and cough were the most commonly identified symptoms.
- Through December 1, approximately nine out of ten COVID-19 decedents had underlying medical conditions such as heart disease, diabetes, chronic kidney disease, chronic lung disease, or immunosuppression.

### *How many King County “excess deaths” have there been since the start of 2020?*

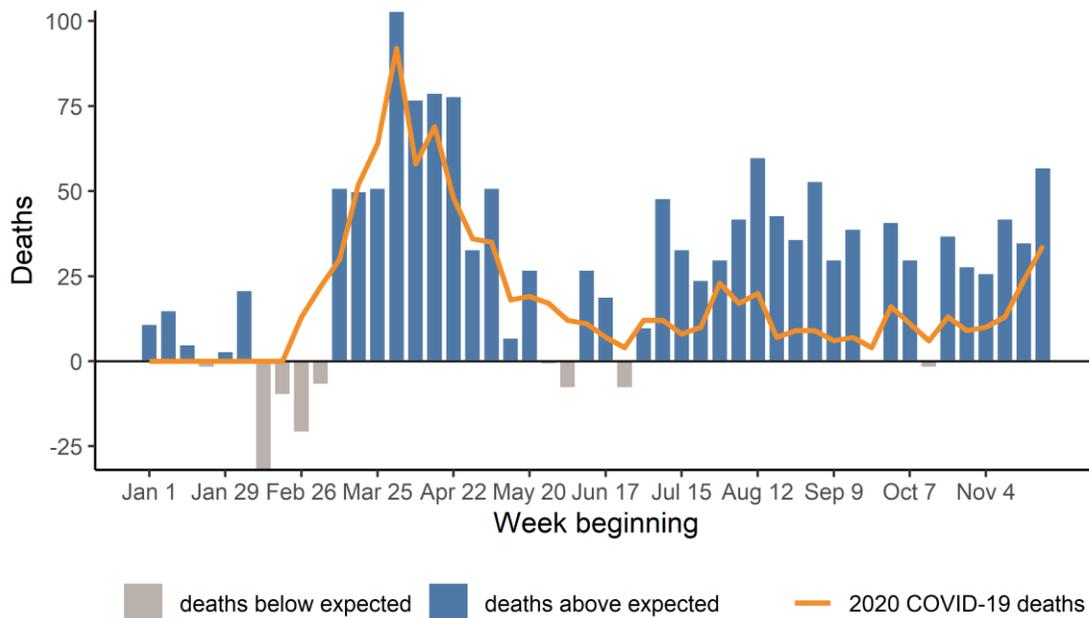
- Excess deaths<sup>3</sup> are an estimate of the pandemic’s toll on overall mortality. This method estimates weekly deaths in 2020 that are beyond what the county would expect using 2015-2019 as a reference.
- Excess deaths are an alternative way of estimating COVID-19’s death burden that we can use in addition to counting deaths among decedents who tested positive for COVID-19. For example, some decedents may not have been tested for COVID-19 early in the outbreak or before it was recognized locally. The excess deaths estimate includes deaths regardless of testing for COVID-19 or mentions of COVID-19 in the death certificate.
- From January 1 to December 1, PHSKC estimates there have been 1,452 excess deaths (compared to 2015-2019 levels). Excess deaths accounted for 10.8% of total King County deaths (13,430) during this period ([Supplemental Table 1](#)).
- During the same time period, the official PHSKC count includes 887 COVID-19 deaths.
- Because the number of excess 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 382 statistically significant excess deaths. This accounts for 3% of King County deaths during this period.
- Trends in excess deaths correlated with COVID-19 deaths early in the pandemic, however, since the summer, there were consistently more excess deaths than COVID-19 deaths.
- This may be due to an increase in other (non-COVID) causes of death, including cardiovascular disease. PHSKC is currently conducting a more in-depth analysis of other causes of death in 2020, expected for release in early 2021.

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<sup>3</sup> See **Excess Deaths Methodology** in the Technical Notes

- These excess deaths do not appear to be the result of unrecognized COVID-19. Death rates for pneumonia and acute respiratory distress syndrome, which contributed to 53% and 14% of COVID-19 deaths, respectively, have shown no significant increase compared to previous years.
- Although CVD deaths, which could be related to COVID-19, increased by 8% in 2020, 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 pandemic, averaging over 70% tested per week in November.

### Observed 2020 Deaths Above or Below Expected Deaths



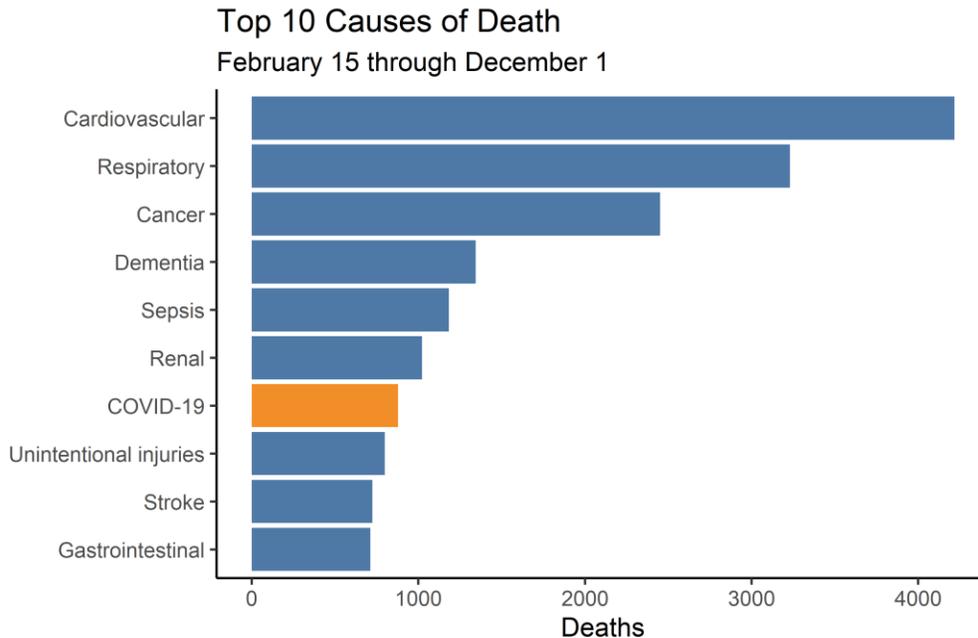
Prepared by Public Health Seattle & King County; Data Source: WA State Department of Health

### *Are COVID-19 associated deaths early in the epidemic undercounted due to lack of testing?*

- 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.

*How does COVID-19 compare to other causes of death since the start of the pandemic?*

- Between February 15 and December 1, COVID-19 ranked 7th among 34 non-mutually exclusive causes of death.<sup>4</sup>
- Weekly COVID-19 related deaths ranked as the 3rd most common cause of death at the peak level in March and early April, but COVID-19 has since dropped to the 5th most common cause of death during the week of November 25 through December 1.



Prepared by Public Health Seattle & King County; Data Source: WA State Department of Health

*Are there notable disparities in 2020 death rates for all causes compared to previous years by race and ethnicity?*

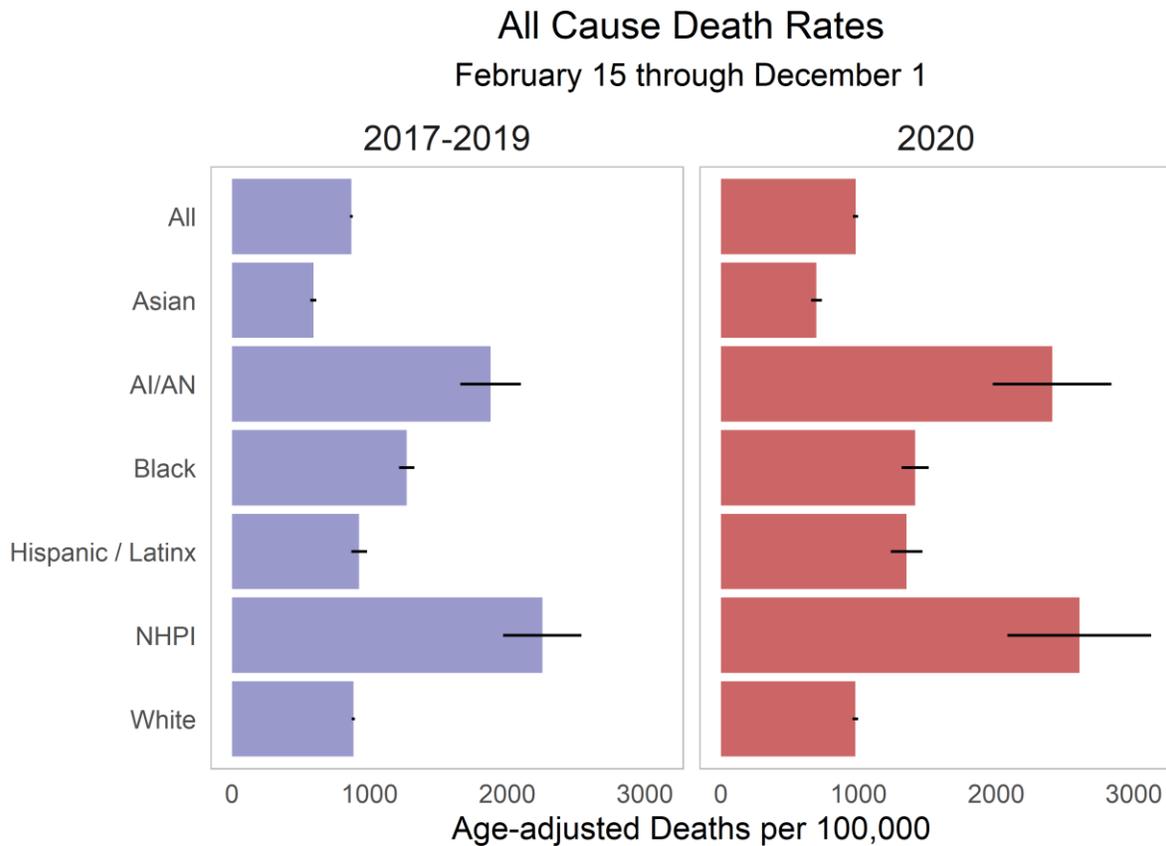
While excess deaths provide a measure of the degree to which the pandemic impacted overall mortality, comparing death rates over time helps us understand severity of disease. In addition, comparing demographic groups helps identify at-risk populations. As a supplement to the excess deaths analysis described above, we compared age-adjusted death rates from February 15 through December 1 in 2020 relative to 2017-2019, within and across each racial/ethnic group. This analysis combined COVID and non-COVID related deaths.

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<sup>4</sup> See **Cause of Death Definitions** in the Technical Notes

Overall, the **rate of death for all causes combined** was 13% higher in 2020 relative to 2017-2019 ([Supplementary Table 2](#)).

- The **death rate for all causes combined** increased in 2020 among Hispanics/Latinx (46%), AI/AN (28%), Asians (17%), Blacks (11%) and Whites (11%) relative to 2017-2019.
- For both time periods, the **death rate for all causes combined** among AI/AN, Blacks, and NHPI was higher relative to Whites, and rates for Asians were lower relative to Whites.
- The **death rate for all causes combined** among Hispanics/Latinx was not significantly different relative to Whites in 2017-2019 but was significantly higher in 2020 relative to Whites.



Prepared by Public Health Seattle & King County; Data Source: WA State Department of Health

The overall **respiratory death rate** was 26% higher in 2020 relative to 2017-2019 ([Supplementary Table 4](#)).

- **Respiratory death rates** increased in 2020 among Hispanics/Latinx (97%), Asians (51%), and Whites (21%) relative to 2017-2019.
- For both time periods, **rates for respiratory deaths** among AI/AN, Blacks and NHPI were higher relative to Whites, and rates for Asians were lower relative to Whites.
- The **respiratory death rate** among Hispanics/Latinx was not significantly different relative to Whites in 2017-2019 but was significantly higher in 2020 relative to Whites.

The overall **cardiovascular death rate** was 8% higher in 2020 relative to 2017-2019 ([Supplementary Table 6](#)).

- **Cardiovascular disease death rates** increased in 2020 among AI/AN (57%), Hispanics/Latinx (33%) and Whites (7%) relative to 2017-2019. For both time periods, **rates for cardiovascular disease deaths** among AI/AN, Blacks, and NHPI were higher relative to Whites, and rates for Asians were lower relative to Whites. The **cardiovascular disease death rate** among Hispanics/Latinx was not significantly different relative to Whites in 2017-2019 but was significantly higher in 2020 relative to Whites.

Together, these findings suggest that COVID-19 widened existing disparities in death rates that were present prior to the pandemic.

### *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.

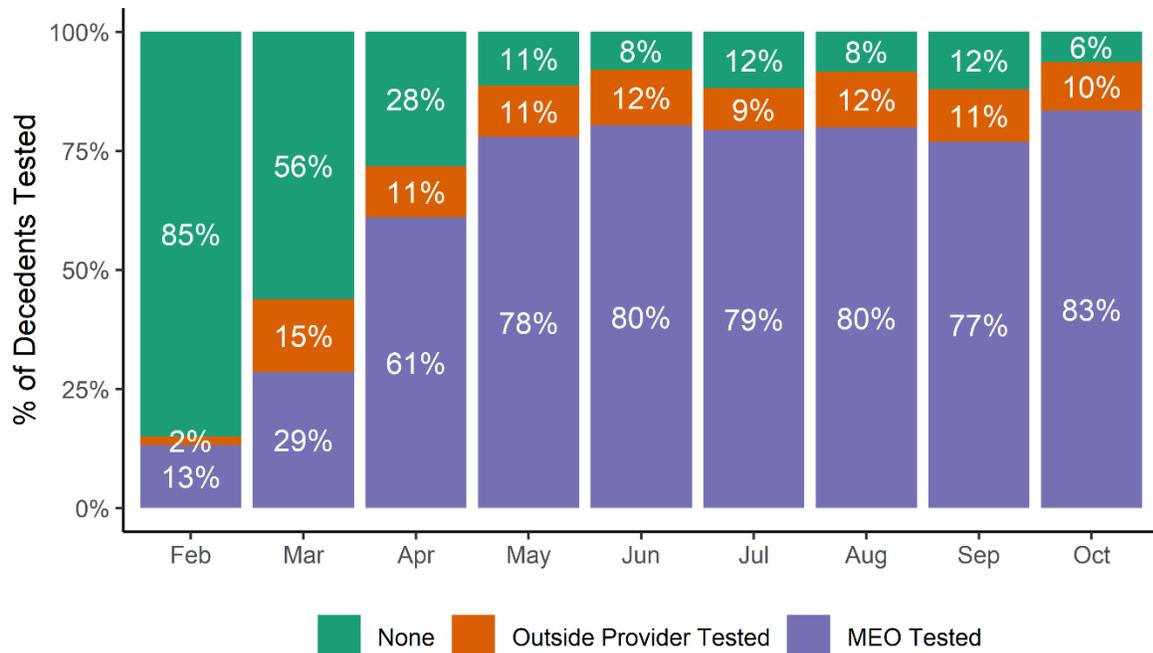
- Between February 15 through December 1, 2020, 39% (4,478) of King County deaths occurred in residences and 34% (3,892) occurred in hospitals, and 17% (2,021) occurred in long-term care facilities. These proportions are similar to those in recent years (2017-2019).
- During the same time window, 54% (551) of COVID+ deaths occurred in hospitals, 27% (274) of COVID+ deaths occurred in long-term care facilities, 11% (111) of COVID+ deaths occurred in residences, 3% (26) of COVID+ deaths occurred in hospices, and 5% (52) of COVID+ deaths occurred in other locations. These proportions have remained relatively stable throughout 2020.
- Among decedents who were tested for COVID-19, deaths occurring in hospitals were more likely to have a positive result (22%) compared to deaths occurring in residences (6%).
- The proportion tested for COVID-19 among hospital deaths and residence deaths without recent medical care did not vary significantly by race/ethnicity.

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

The King County Medical Examiner’s Office is performing COVID-19 testing for most of the decedents in its jurisdiction.

- From February 15 through December 1, the King County Medical Examiner’s Office (KCMEO) assumed jurisdiction of 2,866 decedents, tested 69% (1,969) of these decedents, and found 25% (493) of those tested were positive for COVID-19.
- 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 White (61% vs. 67%) and less likely to be over 60 years old (74% vs. 90%). They were slightly more likely to be males (54% vs. 52%).
- KCMEO has increased its capacity to test decedents post-mortem throughout the outbreak and is now testing approximately 80% of decedents for COVID-19.
- Less than half (45%) of decedents under KCMEO's jurisdiction receive only a death certificate review and do not come to the office for a post-mortem exam. Of these decedents, 56% were tested for COVID through field investigation teams due to clinical indications or congregate settings of concern. An additional 21% of these decedents were tested by an outside provider, and the remaining 23% were not tested due to no clinical or epidemiologic indications.

Percentage of decedents in KCMEO jurisdiction tested for COVID-19, by month of death in 2020



## Appendices

*Supplementary Table 1. Summary of Excess Deaths\* between January 1 and December 1, 2020*

Week beginning	Observed	Expected	Excess	COVID	Percent excess
Jan 1	289	278	11	0	4%
Jan 8	294	279	15	0	5.3%
Jan 15	287	282	5	0	1.8%
Jan 22	272	274	0	0	-
Jan 29	282	279	3	0	1.1%
Feb 5	299	278	21	0	7.6%
Feb 12	242	274	0	0	-
Feb 19	263	273	0	0	-
Feb 26	253	274	0	13	-
Mar 4	261	268	0	22	-
Mar 11	317	266	51	30	19.3%
Mar 18	319	269	50	52	18.6%
Mar 25	318	267	51	64	19%
Apr 1	362	259	103	92	39.6%
Apr 8	333	256	77	58	30.3%
Apr 15	333	254	79	69	31%
Apr 22	329	251	78	48	30.9%
Apr 29	283	250	33	36	13.3%
May 6	296	245	51	35	20.8%
May 13	252	245	7	18	2.7%
May 20	270	243	27	19	11.1%
May 27	242	243	0	17	-
Jun 3	233	241	0	12	-
Jun 10	272	245	27	11	11%
Jun 17	261	242	19	7	8%
Jun 24	236	244	0	4	-
Jul 1	251	241	10	12	4%
Jul 8	288	240	48	12	19.9%
Jul 15	271	238	33	8	14%
Jul 22	264	240	24	10	9.8%
Jul 29	266	236	30	23	12.5%
Aug 5	273	231	42	17	18.2%
Aug 12	290	230	60	20	26.1%
Aug 19	272	229	43	7	18.9%
Aug 26	261	225	36	9	16%
Sep 2	280	227	53	9	23.3%
Sep 9	258	228	30	6	13.1%
Sep 16	274	235	39	7	16.4%
Sep 23	238	238	0	4	-
Sep 30	282	241	41	16	16.8%

Oct 7	271	241	30	11	12.7%
Oct 14	247	249	0	6	-
Oct 21	286	249	37	13	14.8%
Oct 28	282	254	28	9	11.2%
Nov 4	280	254	26	10	10.1%
Nov 11	297	255	42	13	16.3%
Nov 18	290	255	35	24	13.9%
Nov 25	311	254	57	34	22.2%
<b>Total</b>	<b>13,430</b>	<b>12,069</b>	<b>1,452</b>	<b>887</b>	<b>10.8%</b>

*\*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 December 1, 2020*

Strata	Ave Deaths 2017-2019	Deaths 2020	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020	Ratio (95% CI)	Significant
All	10,140	11,610	6,180	1,014	866.82 (856.88 — 876.76)	977.74 (959.81 — 995.67)	1.13 (1.10 — 1.15)	Yes
Asian	967	1,206	654	146	590.98 (569.36 — 612.59)	693.74 (654.5 — 732.99)	1.17 (1.10 — 1.26)	Yes
AI/AN	93	120	62	6	1879.71 (1658.86 — 2100.56)	2407.56 (1976.56 — 2838.55)	1.28 (1.03 — 1.59)	Yes
Black	669	773	412	65	1269.02 (1213.18 — 1324.86)	1411.42 (1311.71 — 1511.13)	1.11 (1.02 — 1.21)	Yes
Hispanic	361	544	301	98	923.97 (868.02 — 979.92)	1349.52 (1235.2 — 1463.84)	1.46 (1.32 — 1.62)	Yes
NHPI	80	96	54	16	2255.07 (1969.42 — 2540.72)	2604.55 (2082.86 — 3126.24)	1.15 (0.91 — 1.46)	No
White	7,817	8,684	4,608	670	882.18 (870.81 — 893.55)	976.74 (956.15 — 997.34)	1.11 (1.08 — 1.13)	Yes
Female	4,970	5,521	2,848	493	734.8 (722.94 — 746.65)	806.06 (784.76 — 827.36)	1.10 (1.06 — 1.13)	Yes
Male	5,169	5,993	3,240	521	1058.2 (1041.16 — 1075.25)	1205.85 (1175.04 — 1236.67)	1.14 (1.11 — 1.17)	Yes

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

*Supplementary Table 3. Age stratified all-cause death rates and ratios between February 15 and December 1, 2020*

Strata	Ave Deaths 2017-2019	Deaths 2020	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020	Ratio (95% CI)	Significant
0-18	126	137	42	3	26.24 (23.6 — 28.89)	28.26 (23.53 — 32.99)	1.08 (0.89 — 1.31)	No
19-50	814	1,035	566	50	75.95 (72.94 — 78.96)	94.48 (88.72 — 100.23)	1.24 (1.16 — 1.34)	Yes
51-64	1,445	1,637	914	126	396.97 (385.15 — 408.79)	450 (428.2 — 471.8)	1.13 (1.07 — 1.20)	Yes
65-84	3,962	4,596	2,547	420	1640.6 (1611.1 — 1670.09)	1837.43 (1784.31 — 1890.55)	1.12 (1.08 — 1.16)	Yes
85+	3,793	4,202	2,111	415	11569.36 (11356.78 — 11781.94)	13088.06 (12692.33 — 13483.79)	1.13 (1.09 — 1.17)	Yes

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

*Supplementary Table 4. Age-adjusted respiratory death rates and ratios between February 15 and December 1, 2020*

Strata	Ave Deaths 2017-2019	Deaths 2020	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020	Ratio (95% CI)	Significant
All	2,522	3,231	2,082	707	225.69 (220.54 — 230.84)	284.93 (275.05 — 294.81)	1.26 (1.21 — 1.32)	Yes
Asian	234	375	257	114	152.99 (141.64 — 164.34)	230.74 (207.34 — 254.13)	1.51 (1.33 — 1.71)	Yes
AI/AN	25	28	18	2	562.56 (435.94 — 689.18)	616.68 (388.16 — 845.19)	1.10 (0.71 — 1.69)	No
Black	162	194	128	43	333.27 (303.5 — 363.04)	384.44 (330.26 — 438.62)	1.15 (0.98 — 1.36)	No
Hispanic	80	162	114	70	248.84 (216.96 — 280.71)	489.56 (413.65 — 565.47)	1.97 (1.61 — 2.40)	Yes
NHPI	18	28	18	13	598.6 (437.08 — 760.12)	916.03 (576.33 — 1255.72)	1.53 (0.97 — 2.42)	No
White	1,970	2,397	1,521	458	229.26 (223.39 — 235.14)	277.97 (266.82 — 289.11)	1.21 (1.16 — 1.27)	Yes
Female	1,263	1,542	969	330	192.75 (186.59 — 198.92)	232.47 (220.85 — 244.09)	1.21 (1.14 — 1.28)	Yes
Male	1,259	1,660	1,084	377	274.02 (265.14 — 282.89)	355.04 (337.84 — 372.24)	1.30 (1.22 — 1.37)	Yes

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

*Supplementary Table 5. Age stratified respiratory death rates and ratios between February 15 and December 1, 2020*

Strata	Ave Deaths 2017-2019	Deaths 2020	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020	Ratio (95% CI)	Significant
0-18	26	33	8	0	5.48 (4.28 — 6.69)	6.81 (4.48 — 9.13)	1.24 (0.83 — 1.86)	No
19-50	101	124	85	24	9.46 (8.39 — 10.52)	11.32 (9.33 — 13.31)	1.20 (0.97 — 1.48)	No
51-64	295	396	244	89	81.06 (75.72 — 86.4)	108.86 (98.14 — 119.58)	1.34 (1.19 — 1.51)	Yes
65-84	1,110	1,442	968	320	459.49 (443.89 — 475.1)	576.49 (546.74 — 606.25)	1.25 (1.18 — 1.33)	Yes
85+	989	1,236	777	274	3017.92 (2909.34 — 3126.49)	3849.8 (3635.17 — 4064.42)	1.28 (1.19 — 1.36)	Yes

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

*Supplementary Table 6. Age-adjusted cardiovascular death rates and ratios between February 15 and December 1, 2020*

Strata	Ave Deaths 2017-2019	Deaths 2020	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020	Ratio (95% CI)	Significant
All	3,836	4,218	2,132	177	342.2 (335.86 — 348.54)	370.94 (359.69 — 382.2)	1.08 (1.05 — 1.12)	Yes
Asian	361	418	218	32	236.32 (222.2 — 250.44)	257.41 (232.7 — 282.12)	1.09 (0.97 — 1.22)	No
AI/AN	29	46	22	3	648.19 (511.86 — 784.51)	1020.34 (725.34 — 1315.34)	1.57 (1.10 — 2.25)	Yes
Black	285	315	160	13	588.23 (548.61 — 627.85)	626.01 (556.76 — 695.25)	1.06 (0.94 — 1.21)	No
Hispanic	110	151	78	11	347.51 (309.68 — 385.35)	461.48 (387.57 — 535.39)	1.33 (1.10 — 1.61)	Yes
NHPI	33	43	20	2	1145.2 (920.11 — 1370.3)	1426.38 (999.53 — 1853.24)	1.25 (0.87 — 1.78)	No
White	2,962	3,186	1,604	114	342.55 (335.39 — 349.72)	367.32 (354.55 — 380.1)	1.07 (1.03 — 1.12)	Yes
Female	1,841	1,971	983	81	279.31 (271.91 — 286.71)	295.53 (282.46 — 308.59)	1.06 (1.01 — 1.11)	Yes
Male	1,995	2,218	1,121	96	435.17 (423.96 — 446.37)	475.72 (455.8 — 495.65)	1.09 (1.04 — 1.15)	Yes

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

*Supplementary Table 7. Age stratified cardiovascular death rates and ratios between February 15 and December 1, 2020*

Strata	Ave Deaths 2017-2019	Deaths 2020	COVID Tested	COVID+	Rate (95% CI) 2017-2019	Rate (95% CI) 2020	Ratio (95% CI)	Significant
0-18	21	28	8	0	4.37 (3.29 — 5.45)	5.78 (3.64 — 7.91)	1.32 (0.85 — 2.06)	21
19-50	155	177	99	5	14.46 (13.15 — 15.78)	16.16 (13.78 — 18.54)	1.12 (0.94 — 1.33)	155
51-64	504	579	311	35	138.49 (131.51 — 145.47)	159.16 (146.2 — 172.13)	1.15 (1.04 — 1.26)	504
65-84	1,501	1,722	926	70	621.68 (603.52 — 639.83)	688.44 (655.92 — 720.95)	1.11 (1.05 — 1.17)	1,501
85+	1,655	1,712	788	67	5048.5 (4908.08 — 5188.93)	5332.4 (5079.81 — 5585)	1.06 (1.00 — 1.12)	1,655

\* Significant = "Yes" indicates statistically significant increase in the rate of death in 2020 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.<sup>5</sup> 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).

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<sup>5</sup> [https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess\\_deaths.htm](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<sup>6</sup> in the R surveillance package<sup>7</sup>. 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

Previously, if a specific age, race/ethnicity and cause of death category (e.g., 0-18-year olds, Hispanic/Latinx, pneumonia) had no deaths, it was counted as missing. This meant the population for categories with no deaths did not contribute to the denominator when calculating death rates, skewing the rates upwards. This was corrected so now categories with no deaths contribute to both the numerator and denominator of the death rate. This revision resulted in lower death rates for some populations, most noticeably among AI/AN and NHPI.

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<sup>6</sup> 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](https://doi.org/10.2307/2983331)

<sup>7</sup> 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.