Public Health
Seattle & King County

Summary Report on Deaths Associated with COVID-19

February 4, 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 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 once national case classifications are finalized.

[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.

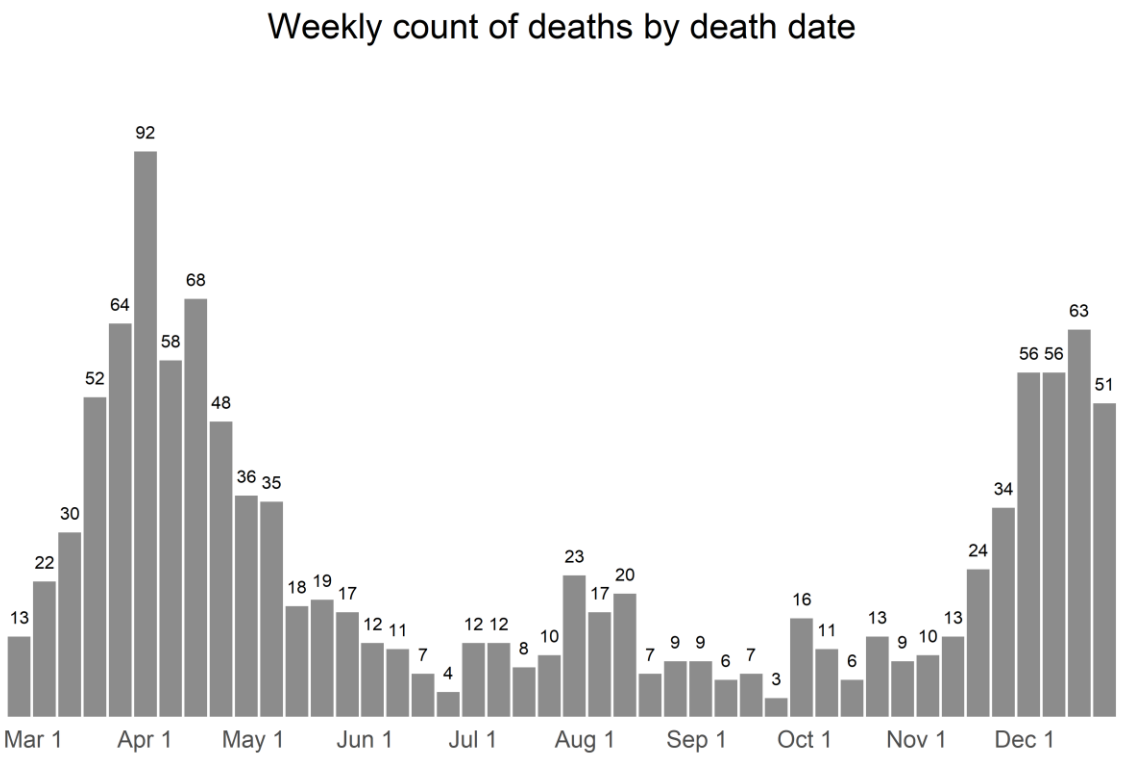
As of December 31 2020, 1126 deaths were associated with COVID-19:

- 94% (1053) are confirmed
- 6% (73) 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, 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. From late November through the end of the year, weekly deaths rose again, reaching almost the same levels as in March and April. Refer to PHSKC's COVID-19 Outbreak Summary, where the death count and trend is updated daily.



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

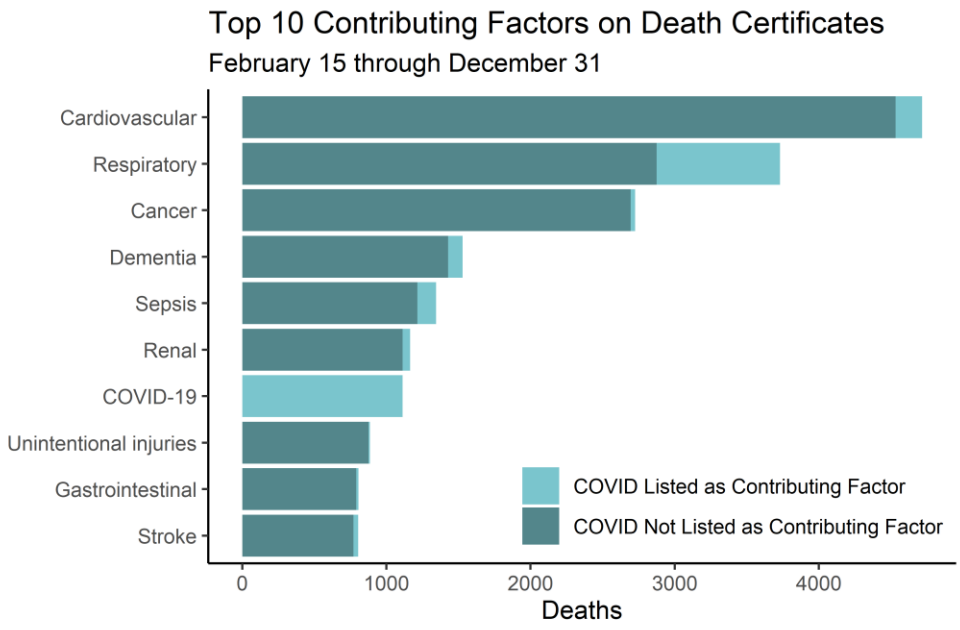
What are the leading contributing causes of death among persons with a COVID-19 associated death?

- During 2020, respiratory illness was a contributing cause for 77% of COVID-19 related deaths; 53% of all COVID-19 related deaths had pneumonia and 13% had acute respiratory distress syndrome.
- Cardiovascular disease (CVD) (17%) and sepsis (12%) were also leading contributing causes of death among persons who died of COVID-19.
- Among COVID-19 decedents with available data on symptoms, 95% had a symptomatic illness preceding death; fever, shortness of breath, and cough were the most commonly identified symptoms. 21% of decedents have no available data on symptoms.
- Among COVID-19 decedents with available data on underlying conditions, 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. 20% of decedents have no available data on underlying conditions.

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. Complete list of categories included in the Technical Notes at the end of the report. [2]
- Between February 15 and December 31, COVID-19 ranked 7th among 34 non-mutually exclusive contributing factors. As these are non-mutually exclusive categories, COVID may have also been listed alongside other contributing factors.
- Weekly COVID-19 deaths ranked as the 3rd most common contributing factor at the peak in March and early April and as the 22nd most common contributing factor at the lowest level during the week of September 23. During the last full week of 2020, COVID-19 deaths were the 4th most common contributing factor.
- 29.8% of deaths where respiratory disease was listed as a contributing factor also listed COVID-19, and 4.1% of deaths where cardiovascular disease was listed as a contributing factor also listed COVID-19. The ranking of the top 10 contributing factors does not change when deaths where COVID-19 was a contributing factor are excluded from all other categories.

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



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

Age and Sex

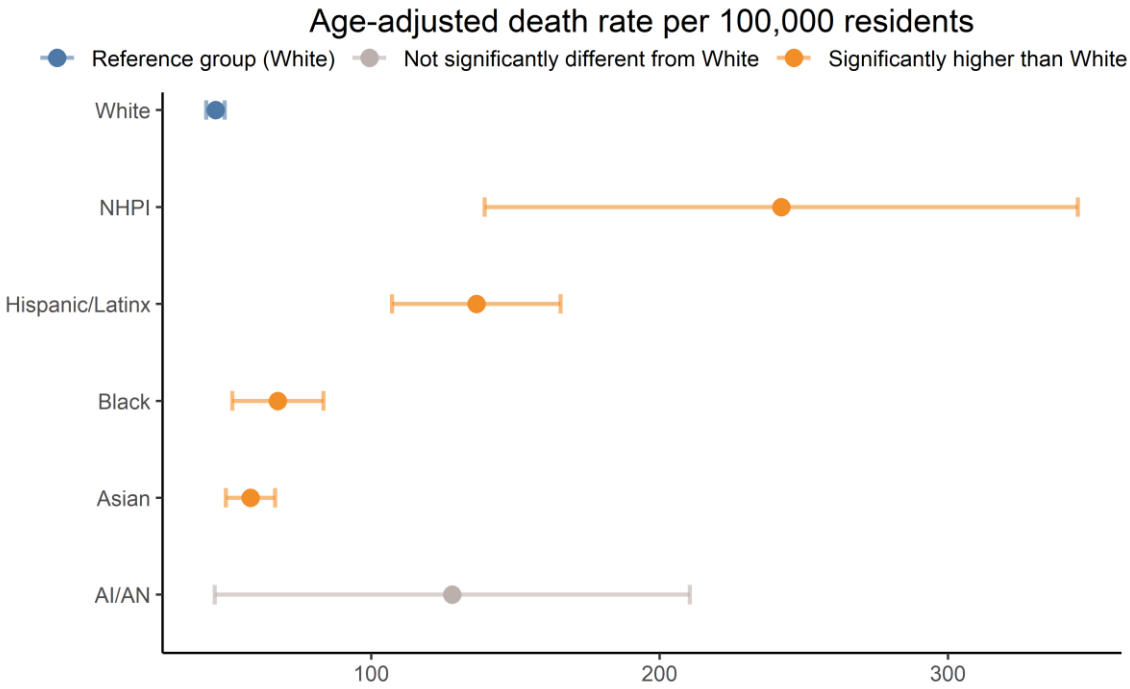
- Through December 31, nearly 53.8% of those who died from COVID-19 related illness were 80+ years old and more than 90.8% were 60+ years old. The median age for COVID-19 related deaths has remained around 81 years old since the beginning of the outbreak.
- COVID-19 deaths are more common among males than females (52% vs. 48%, respectively).

Race and Ethnicity

- Overall, White residents 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, Hispanic/Latinx residents account for a disproportionate share of COVID-19 deaths, comprising 38% 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 Native Hawaiian/Pacific Islander (NHPI) (242 per 100,000 residents), Hispanic/Latinx (136 per 100,000 residents), Black (68 per 100,000 residents), and Asian residents (58 per 100,000 residents) than among White residents (46 per 100,000 residents).
- Among American Indian/Alaska Native (AI/AN) residents, the death rate did not differ significantly from the rate among White residents.

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

- Racial misclassification, small populations, and missing data may affect the interpretation of these findings, especially regarding AI/AN.



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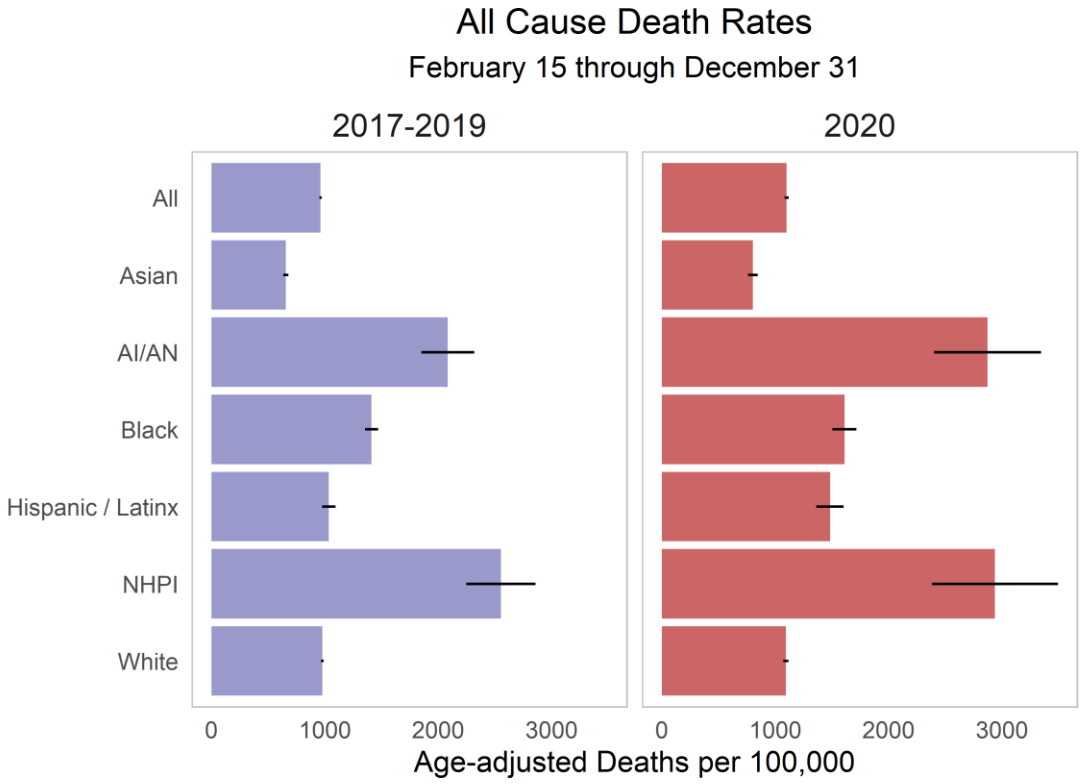
- A large number of COVID-19 deaths are among residents of skilled nursing and assisted living facilities, and the race/ethnicity composition of these facilities differs from the population at large. Among White individuals, 58% of deaths were among residents of these facilities, compared to 18% of deaths among Hispanic/Latinx and 13% among NHPI individuals. When residents of skilled nursing and assisted living facilities are excluded from the death rate analysis, disparities between White and Hispanic/Latinx individuals and between White and NHPI individuals are wider than in the broader population.
- 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.

After COVID-19 appeared in King County, did disparities in death rates for other causes by race and ethnicity change compared to previous years?

To see if disparities in death rates changed after the appearance of COVID-19, we compared age-adjusted death rates for all causes combined, cardiovascular disease, and respiratory disease during the pandemic period in 2020 (February 15 through December 31) and the same period in 2017-2019. This analysis looked 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 14% higher during the pandemic in 2020 relative to 2017-2019 (Supplementary Table 2).

- Among those where COVID was not a contributing cause of death, the **death rate for all causes** was 4.7% higher in 2020 relative to 2017-2019.
- After February 2020, the **death rate for all causes** (including COVID-related deaths) increased among almost all races and ethnicities (Hispanics/Latinx (44%), AI/AN (38%), Asians (22%), Blacks (14%) and Whites (12%)) 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 relative to Whites after the pandemic began.



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The overall **respiratory death rate** was 32% higher during the pandemic in 2020 relative to 2017-2019 (Supplementary Table 4).

- Among those where COVID was not a contributing cause of death, the **respiratory death rate** was 1.4% higher in 2020 relative to 2017-2019. This was not a statistically significant increase.
- Since February 2020, **respiratory death rates** (including COVID-related respiratory deaths) increased among almost all races and ethnicities (Hispanics/Latinx (103%), Asians (61%), NHPI (61%), Whites (26%) and Blacks (24%)) 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 relative to Whites after the pandemic began.

The overall **cardiovascular death rate** was 9% higher during the pandemic in 2020 relative to 2017-2019 (Supplementary Table 6).

- Among those where COVID was not a contributing cause of death, the **cardiovascular death rate** was 5.0% higher in 2020 relative to 2017-2019.
- Since February 2020, **cardiovascular disease death rates** (including COVID-related cardiovascular deaths) increased among AI/AN (76%), Hispanics/Latinx (27%), Asians (12%) and Whites (8%) 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 death rate** among Hispanics/Latinx was not significantly different relative to Whites in 2017-2019 but was significantly higher relative to Whites after the pandemic began.

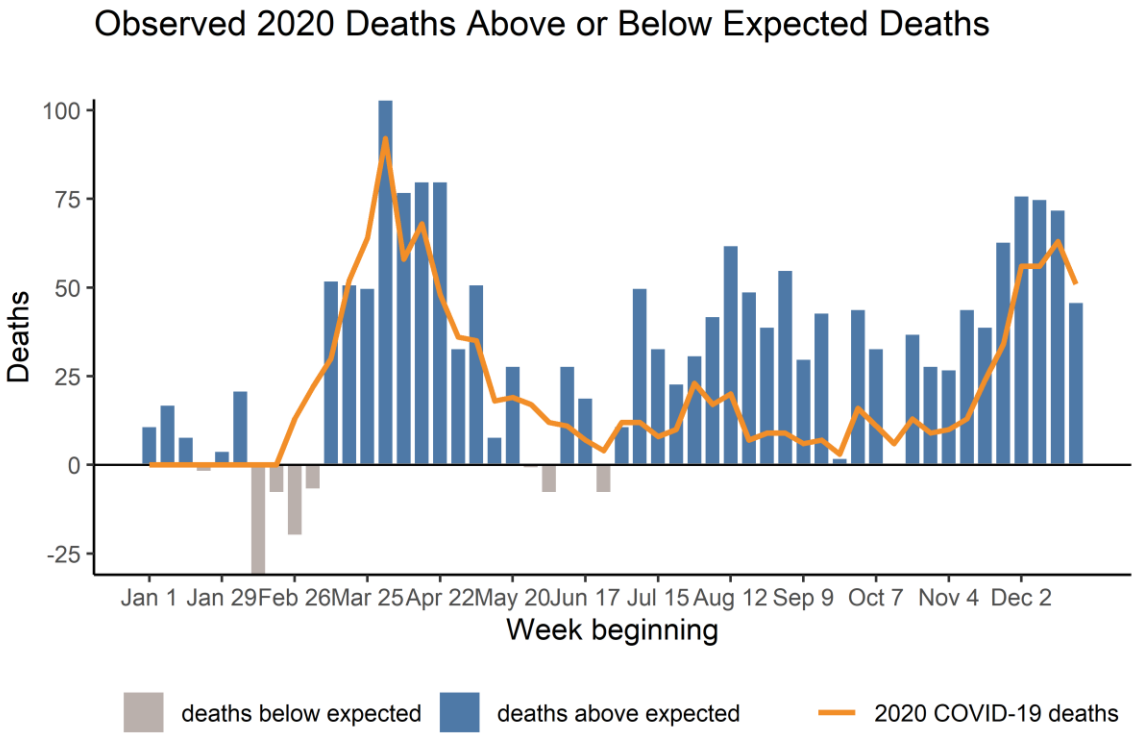
Together, these finding suggest existing disparities in death rates between race/ethnicity groups widened in 2020.

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. This method estimates weekly deaths in 2020 that are beyond what the county would expect using 2015-2019 as a reference.

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

- Comparing excess deaths to the number of confirmed and suspected COVID-19 deaths lets us assess whether the increase in deaths in 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.
- In 2020, PHSKC estimates there have been 1,775 excess deaths (compared to 2015-2019 levels). Excess deaths accounted for 11.8% of total King County deaths (14,812) during this period (Supplemental Table 1). During the same time period, the official PHSKC count includes 1,111 COVID-19 deaths.
- 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 512 statistically significant excess deaths. This accounts for 3.5% of King County deaths during this period.
- Excess deaths correlated closely with COVID-19 deaths early in the pandemic and in late November and December. However, there were consistently more excess deaths than COVID-19 deaths in the summer and early fall.
- This may be due to an increase in other (non-COVID) causes of death, including cardiovascular disease, or due to indirect impacts of the pandemic. PHSKC has just released an additional report with a more in-depth analysis of other causes of death, which can be found here.



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

Are COVID-19 deaths undercounted in King County?

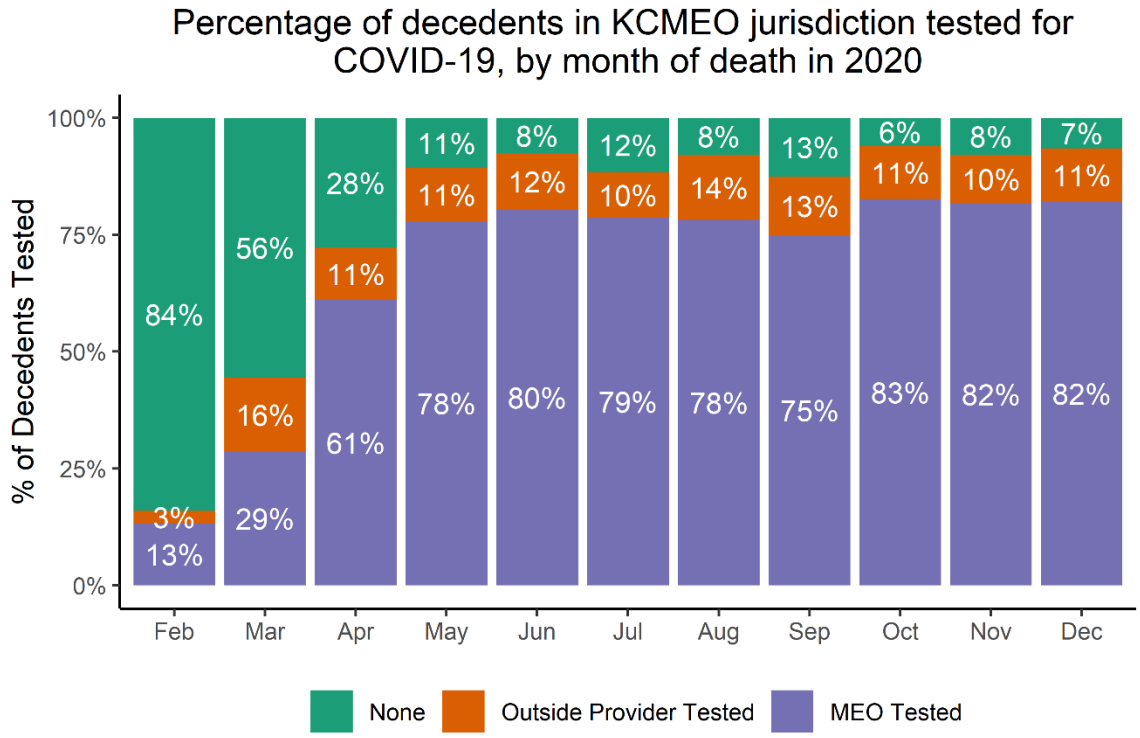
- COVID-19 deaths may be undercounted when there is insufficient testing, particularly at the start of the pandemic. To assess this possibility for the start of the pandemic in King County, we compared death rates during the three months prior to the outbreak (November 1, 2019 through February 15, 2020) 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, 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 pandemic, averaging over 70% tested per week from October through the end of the year.
- It is also unlikely that any large number of respiratory disease or pneumonia deaths were undiagnosed COVID-19 because the death rate among individuals who did not have a confirmatory COVID-19 test was not significantly different than the death rate for respiratory disease or pneumonia in previous years.

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 through December 31, KCMEO assumed jurisdiction of 3,547 decedents, tested 71% (2,508) of these decedents, and found 7% (176) of those tested were positive for COVID-19.
- KCMEO has increased its capacity to test decedents post-mortem throughout the outbreak. Since May, 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 (70% vs. 91%) and more likely to be male (61% 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 December 31, 2020, 38% (4,996) of King County deaths occurred in residences, 34% (4,417) occurred in hospitals, and 18% (2,303) occurred in long-term care facilities. These proportions are similar to those in recent years (2017-2019).
- During the same time window, 53% (694) of COVID+ deaths occurred in hospitals, 27% (358) of COVID+ deaths occurred in long-term care facilities, 12% (157) of COVID+ deaths occurred in residences, 2% (30) of COVID+ deaths occurred in hospices, and 5% (66) of COVID+ deaths occurred in other locations. These proportions have remained relatively stable over the year.
- Among decedents who were tested for COVID-19, deaths occurring in hospitals were more likely to have a positive result (23%) compared to deaths occurring in residences (7%).
- 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 December 29, 2020*

Week beginning	Observed	Expected	Excess	COVID	Percent excess
Jan 1	289	278	11	0	4%
Jan 8	296	279	17	0	6.1%
Jan 15	290	282	8	0	2.9%
Jan 22	272	274	0	0	-
Jan 29	283	279	4	0	1.5%
Feb 5	299	278	21	0	7.6%
Feb 12	243	274	0	0	-
Feb 19	265	273	0	0	-
Feb 26	254	274	0	13	-
Mar 4	261	268	0	22	-
Mar 11	318	266	52	30	19.7%
Mar 18	320	269	51	52	19%
Mar 25	317	267	50	64	18.6%
Apr 1	362	259	103	92	39.6%
Apr 8	333	256	77	58	30.3%
Apr 15	334	254	80	68	31.4%
Apr 22	331	251	80	48	31.7%
Apr 29	283	250	33	36	13.3%
May 6	296	245	51	35	20.8%
May 13	253	245	8	18	3.1%
May 20	271	243	28	19	11.5%
May 27	242	243	0	17	-
Jun 3	233	241	0	12	-
Jun 10	273	245	28	11	11.4%
Jun 17	261	242	19	7	8%
Jun 24	236	244	0	4	-
Jul 1	252	241	11	12	4.4%
Jul 8	290	240	50	12	20.7%
Jul 15	271	238	33	8	14%
Jul 22	263	240	23	10	9.4%
Jul 29	267	236	31	23	12.9%
Aug 5	273	231	42	17	18.2%
Aug 12	292	230	62	20	27%
Aug 19	278	229	49	7	21.5%
Aug 26	264	225	39	9	17.3%
Sep 2	282	227	55	9	24.2%
Sep 9	258	228	30	6	13.1%
Sep 16	278	235	43	7	18.1%
Sep 23	240	238	2	3	0.7%
Sep 30	285	241	44	16	18.1%

Oct 7	274	241	33	11	13.9%
Oct 14	249	249	0	6	-
Oct 21	286	249	37	13	14.8%
Oct 28	282	254	28	9	11.2%
Nov 4	281	254	27	10	10.5%
Nov 11	299	255	44	13	17.1%
Nov 18	294	255	39	24	15.5%
Nov 25	317	254	63	34	24.6%
Dec 2	333	257	76	56	29.7%
Dec 9	332	257	75	56	29.3%
Dec 16	340	268	72	63	26.9%
Dec 23	317	271	46	51	16.9%
Total	**14,812**	**13,122**	**1,775**	**1,111**	**12%**

**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 31, 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	11,249	13,064	7,243	1,305	962.3 (951.8 - 972.7)	1,101.0 (1,082.0 - 1,120.1)	1.14 (1.12 - 1.17)	Yes
AI/AN	103	143	77	10	2,085.4 (1,852.6 - 2,318.2)	2,873.9 (2,402.6 - 3,345.2)	1.38 (1.13 - 1.68)	Yes
Asian	1,073	1,395	778	190	656.3 (633.5 - 679.1)	803.4 (761.2 - 845.7)	1.22 (1.15 - 1.30)	Yes
Black	743	882	489	94	1,412.2 (1,353.2 - 1,471.1)	1,611.0 (1,504.4 - 1,717.6)	1.14 (1.06 - 1.23)	Yes
Hispanic	402	596	336	118	1,033.5 (974.2 - 1,092.8)	1,483.7 (1,363.7 - 1,603.8)	1.44 (1.30 - 1.58)	Yes
NHPI	91	108	63	21	2,553.8 (2,249.3 - 2,858.3)	2,940.0 (2,384.8 - 3,495.2)	1.15 (0.92 - 1.44)	No
White	8,661	9,730	5,395	857	977.8 (965.9 - 989.8)	1,094.9 (1,073.0 - 1,116.7)	1.12 (1.09 - 1.15)	Yes
Female	5,515	6,191	3,336	630	815.7 (803.2 - 828.2)	904.2 (881.7 - 926.8)	1.11 (1.08 - 1.14)	Yes
Male	5,734	6,757	3,793	674	1,174.7 (1,156.7 - 1,192.7)	1,360.4 (1,327.7 - 1,393.2)	1.16 (1.13 - 1.19)	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 31, 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	139	149	48	4	29.0 (26.2 - 31.8)	30.7 (25.8 - 35.7)	1.06 (0.88 - 1.28)	No
19-50	904	1,134	628	68	84.4 (81.2 - 87.6)	103.5 (97.5 - 109.5)	1.23 (1.14 - 1.31)	Yes
51-64	1,600	1,842	1,061	157	439.6 (427.1 - 452.0)	506.4 (483.2 - 529.5)	1.15 (1.09 - 1.22)	Yes
65-84	4,381	5,225	3,019	550	1,814.1 (1,783.1 - 1,845.1)	2,088.9 (2,032.2 - 2,145.5)	1.15 (1.12 - 1.19)	Yes
85+	4,225	4,713	2,487	526	12,888.2 (12,663.8 - 13,112.5)	14,679.7 (14,260.6 - 15,098.8)	1.14 (1.10 - 1.18)	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 31, 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	2,793	3,731	2,488	902	250.1 (244.7 - 255.5)	329.2 (318.5 - 339.8)	1.32 (1.27 - 1.37)	Yes
AI/AN	29	38	26	4	651.4 (515.2 - 787.7)	837.0 (570.7 - 1,103.2)	1.28 (0.88 - 1.88)	No
Asian	259	445	307	145	169.6 (157.6 - 181.6)	273.9 (248.4 - 299.4)	1.61 (1.44 - 1.81)	Yes
Black	179	231	159	61	368.4 (337.1 - 399.7)	457.9 (398.7 - 517.0)	1.24 (1.07 - 1.45)	Yes
Hispanic	88	184	130	83	274.0 (240.6 - 307.5)	556.4 (475.5 - 637.4)	2.03 (1.68 - 2.45)	Yes
NHPI	20	34	23	17	689.3 (515.9 - 862.6)	1,112.8 (738.3 - 1,487.3)	1.61 (1.06 - 2.46)	Yes
White	2,179	2,746	1,813	583	253.7 (247.6 - 259.9)	318.6 (306.6 - 330.5)	1.26 (1.20 - 1.31)	Yes
Female	1,395	1,791	1,165	425	213.1 (206.7 - 219.6)	270.2 (257.6 - 282.7)	1.27 (1.20 - 1.34)	Yes
Male	1,398	1,903	1,286	477	304.2 (294.9 - 313.6)	407.1 (388.6 - 425.5)	1.34 (1.27 - 1.41)	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 31, 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	30	37	8	0	6.18 (4.90 - 7.46)	7.63 (5.17 - 10.1)	1.24 (0.84 - 1.81)	No
19-50	110	141	101	30	10.3 (9.19 - 11.4)	12.9 (10.8 - 15.0)	1.25 (1.03 - 1.52)	Yes
51-64	329	453	287	104	90.5 (84.8 - 96.1)	124.5 (113.1 - 136.0)	1.38 (1.23 - 1.54)	Yes
65-84	1,229	1,677	1,158	412	508.9 (492.5 - 525.3)	670.4 (638.4 - 702.5)	1.32 (1.24 - 1.40)	Yes
85+	1,095	1,423	934	356	3,339.2 (3,225.0 - 3,453.4)	4,432.2 (4,202.0 - 4,662.5)	1.33 (1.25 - 1.41)	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 31, 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	4,253	4,716	2,487	241	379.4 (372.7 - 386.1)	414.8 (402.9 - 426.7)	1.09 (1.06 - 1.13)	Yes
AI/AN	33	58	30	5	731.5 (586.5 - 876.4)	1,288.9 (957.0 - 1,620.8)	1.76 (1.27 - 2.44)	Yes
Asian	403	479	258	42	263.8 (248.8 - 278.7)	295.2 (268.7 - 321.7)	1.12 (1.01 - 1.24)	Yes
Black	314	361	191	21	650.1 (608.5 - 691.8)	718.1 (643.9 - 792.4)	1.10 (0.98 - 1.25)	No
Hispanic	123	162	86	16	390.3 (350.1 - 430.4)	495.9 (419.2 - 572.6)	1.27 (1.06 - 1.53)	Yes
NHPI	37	47	23	3	1,262.8 (1,026.2 - 1,499.5)	1,563.0 (1,115.6 - 2,010.3)	1.24 (0.88 - 1.74)	No
White	3,280	3,540	1,863	152	379.3 (371.8 - 386.8)	408.1 (394.6 - 421.6)	1.08 (1.04 - 1.12)	Yes
Female	2,043	2,206	1,145	111	309.9 (302.1 - 317.7)	330.7 (316.9 - 344.5)	1.07 (1.02 - 1.12)	Yes
Male	2,209	2,474	1,307	129	482.1 (470.3 - 493.9)	530.9 (509.8 - 551.9)	1.10 (1.05 - 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 31, 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	22	32	9	0	4.51 (3.42 - 5.61)	6.60 (4.31 - 8.89)	1.46 (0.96 - 2.23)	No
19-50	174	198	113	9	16.2 (14.8 - 17.6)	18.1 (15.6 - 20.6)	1.12 (0.95 - 1.31)	No
51-64	552	642	362	43	151.7 (144.4 - 159.0)	176.5 (162.8 - 190.1)	1.16 (1.06 - 1.27)	Yes
65-84	1,660	1,931	1,076	96	687.5 (668.4 - 706.6)	772.0 (737.6 - 806.4)	1.12 (1.07 - 1.18)	Yes
85+	1,845	1,913	927	93	5,629.1 (5,480.8 - 5,777.4)	5,958.5 (5,691.4 - 6,225.5)	1.06 (1.00 - 1.11)	No

** 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.[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

No significant changes since last update on January 5, 2021.

[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.