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Alaska Facts and Figures

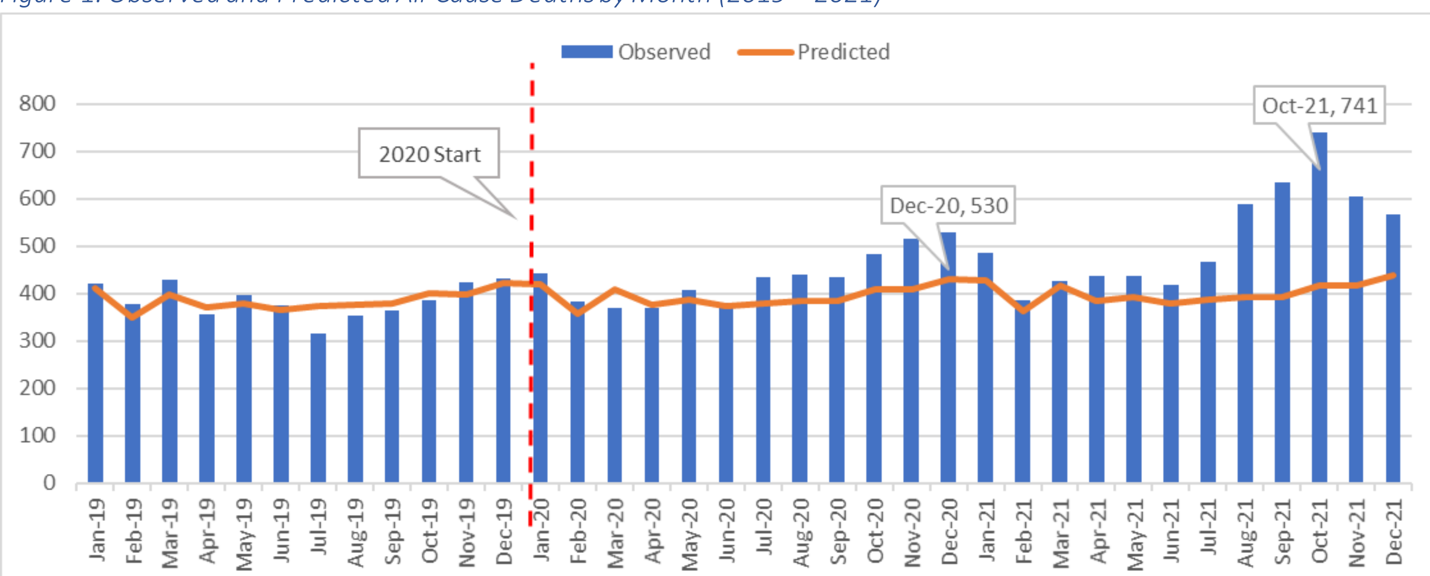
2020-2021 Excess Death Report (Updated June 16th, 2022)

Background
COVID-19, the disease caused by the SARS-COV-2 virus, is a significant cause of, and contributor to, mortality in Alaska. Monitoring trends in COVID-19 mortality over time is critical for detecting unexpected changes, identifying vulnerable populations, and keeping public health officials and the public informed about emerging risks.

This report provides a brief update on Alaska resident mortality in the context of "excess deaths" since the start of COVID-19 pandemic. Excess deaths (defined as the difference between observed and expected deaths) provides insight into both the direct impact of COVID-19, as well as indirect effects from the disease's impact on other forms of disease and injury.

Methods
The Alaska Health Analytics and Vital Records Section's Electronic Vital Records System was queried for Alaska resident certificates of death occurring both in-state or out-of-state between 2010 and 2021. Please note that 2021 data are provisional and subject to change. Using observed monthly deaths occurring between 2010–2019, we used statistical models to estimate the trajectory of expected deaths for 2020 and 2021. Excess deaths were calculated as the difference between the number of expected and observed deaths (see Technical Notes for additional detail). Crude death rates per 100,000 population were calculated using population estimates from the Alaska Department of Labor and Workforce Development.[1]

Results
Figure 1. Observed and Predicted All-Cause Deaths by Month (2019—2021)



Excess Deaths Summary

The model estimated 4,674 Alaska resident deaths would be expected from all causes during 2020. However, the number of deaths observed was 5,186, an excess of 512 deaths. In 2021, the model estimated 4,773 deaths rather than

[1] Alaska Department of Labor and Workforce Development. Research and Analysis. Population Estimates. http://live.laborstats.alaska.gov/pop/index.cfm

the 6,194 observed, an excess of 1,421 deaths (and a 178% increase in excess deaths compared to 2020). For both years, the observed number of deaths was statistically significantly different from what was expected at $\alpha = 0.05$. By month shown in Figure 1, deaths in 2020 peaked in December with 530 deaths (100 more deaths than expected), and deaths in 2021 peaked in October with 741 deaths (324 more deaths than expected). The 2021 peak corresponds to the spread of the highly infectious SARS-COV-2 Delta variant, which was common at the time.

Table 1. Observed vs Predicted All-Cause Deaths (Rates) by Sex (2020—2021)

Year, Sex	Observed (Rate)	Predicted (Rate)	Excess (Rate)
2020	**5,186 (707.1)**	**4,674 (637.3)**	**512 (69.8)***
Male	3008 (797.4)	2646 (701.4)	362 (96)*
Female	2178 (611.5)	2029 (569.7)	149 (41.8)
2021	**6,194 (843.5)**	**4,773 (650.0)**	**1,421 (193.5)***
Male	3638 (963.6)	2695 (713.9)	943 (249.8)*
Female	2556 (716.4)	2080 (583)	476 (133.4)*

Note: Rates per 100,000 population.

* Predicted estimate compared to the observed value differs significantly at the $\alpha = 0.05$ level.

Excess Deaths by Sex

In Table 1, both men and women experienced statistically significant excess deaths in 2021, with 943 and 476 more deaths than expected, respectively. The result for women was not significant in 2020, although men did experience a significant excess of 362 deaths.

Table 2. Observed vs Predicted All-Cause Deaths (Rates) by Bridged Race (2020—2021)

Year, Bridged Race	Observed (Rate)	Predicted (Rate)	Excess (Rate)
2020	**5,186 (707.1)**	**4,674 (637.3)**	**512 (69.8)***
Asian/Pacific Islander	291 (440.7)	220 (333.2)	71(107.5)*
American Indian/Alaska Native	1,295 (1,015.5)	1,107 (868.1)	188 (147.4)*
Black/African American	173 (482.5)	147 (410.0)	26 (72.5)
White/Caucasian	3,360 (672.7)	3,108 (622.2)	252 (50.5)*
2021	**6,194 (843.5)**	**4,773 (650.0)**	**1,421 (193.5)***
Asian/Pacific Islander	379	229	150*
American Indian/Alaska Native	1,560	1,130	430*
Black/African American	168	149	20
White/Caucasian	4,000	3,148	853*

Note: Rates per 100,000 population. 2021 estimates by bridged race are not yet available.

* Predicted estimate compared to the observed value differs significantly at the $\alpha = 0.05$ level.

Excess Deaths by Bridged Race

Almost all races experienced statistically significant excess deaths in both 2020 and 2021 shown in Table 2. In 2020, American Indian/Alaska Native people experienced 188 more deaths than expected, or 147.4 excess deaths per 100,000 population, the highest excess death rate by race.

Table 3. Observed and Predicted All-Cause Deaths (Rates) by Region (2020—2021)

Year, Public Health Region	Observed (Rate)	Predicted (Rate)	Excess (Rate)
2020	**5,186 (707.1)**	**4,674 (637.3)**	**512 (69.8)***
Anchorage	2,057 (706.3)	1,819 (624.6)	238 (81.7)*
Gulf Coast	607 (743.7)	612 (749.8)	-5 (-6.1)
Interior	679 (620.5)	610 (557.5)	69 (63.1)
Mat-Su	767 (716.3)	654 (610.8)	113 (105.5)*
Northern	198 (685.8)	201 (696.2)	-3 (-10.4)
Southeast	555 (767.8)	491 (679.2)	64 (88.5)
Southwest	315 (734.9)	285 (664.9)	30 (70)
2021	**6,194 (843.5)**	**4,773 (650.0)**	**1,421 (193.5)***
Anchorage	2,359 (814.3)	1,866 (644.1)	493 (170.2)*
Gulf Coast	778 (954.7)	617 (757.1)	161 (197.6)*
Interior	839 (753.8)	627 (563.3)	212 (190.5)*
Mat-Su	995 (914.5)	676 (621.3)	319 (293.2)*
Northern	227 (803.2)	203 (718.3)	24 (84.9)
Southeast	651 (898)	496 (684.2)	155 (213.8)*
Southwest	342 (809.1)	289 (683.7)	53 (125.4)

Note: Rates per 100,000 population.

* Predicted estimate compared to the observed value differs significantly at the α = 0.05 level.

Excess Deaths by Region

Both the Anchorage and Mat-Su regions experienced statistically significant excess deaths in 2020 and 2021 shown in Table 3. Results for other regions were not significant in 2020. However by 2021 nearly all regions in the state, with the exception Northern and Southwest, also experienced significant excess deaths.

Table 4. Observed and Predicted All-Cause Deaths (Rates) by Age (2020—2021)

Year, Age	Observed (Rate)	Predicted (Rate)	Excess (Rate)
2020	**5,186 (707.1)**	**4,674 (637.3)**	**512 (69.8)***
0-4 years	61 (124.6)	85 (173.6)	-24 (-49)*
5-14 years	35 (33.1)	27 (25.5)	9 (8.5)
15-24 years	132 (142)	119 (128)	14 (15.1)
25-34 years	238 (213.3)	236 (211.5)	2 (1.8)
35-44 years	287 (287.9)	239 (239.7)	48 (48.1)
45-54 years	410 (484.6)	357 (422)	53 (62.6)
55-64 years	857 (895.1)	763 (796.9)	95 (99.2)*
65-74 years	1,137 (1,777.5)	1,009 (1,577.4)	128 (200.1)
75-84 years	1,099 (4,700.2)	988 (4,225.5)	111 (474.7)*
85+ years	930 (13,911.7)	811 (12,131.6)	119 (1,780.1)*
2021	**6,194 (843.5)**	**4,773 (650)**	**1,421 (193.5)***
0-4 years	81 (173.4)	84 (179.8)	-3 (-6.4)
5-14 years	10 (9.5)	27 (25.6)	-17 (-16.1)*
15-24 years	143 (153.4)	124 (133)	19 (20.4)
25-34 years	302 (276.1)	244 (223)	58 (53)
35-44 years	375 (363.5)	256 (248.2)	119 (115.4)*
45-54 years	529 (639.7)	343 (414.8)	186 (224.9)*
55-64 years	998 (1,066.5)	746 (797.2)	252 (269.3)*
65-74 years	1,438 (2,117.2)	1,062 (1,563.6)	376 (553.6)*
75-84 years	1,273 (5,072.3)	1,052 (4,191.7)	221 (880.6)*
85+ years	1,045 (14,662.6)	856 (12,010.7)	189 (2,651.9)*

Note: Rates per 100,000 population.

* Predicted estimate compared to the observed value differs significantly at the α = 0.05 level.

Excess Deaths by Age

All age groups shown in Table 4 over 35 years experienced statistically significant excess deaths in 2021, with excess deaths highest among seniors aged 65-74 years (376 more deaths than expected). This was followed by ages 55-64 and 75-84 years (252 and 221 more deaths than expected, respectively). Infants and young children aged 0-4 years experienced a significant decrease in excess deaths in 2020 (24 fewer than expected), however this result was not significant in 2021. Children aged 5-14 years experienced a significant decrease in excess deaths 2021 (17 fewer than expected), however this result was not significant in 2020.

Years of Potential Life Lost (YPLL), defined as the difference between an expected natural lifespan of 75 years and the actual age of death before that age, provides a way to measure the impact of premature mortality. There were 64,461 YPLL in 2020, or 9,165.2 YPLL per 100,000 population. In 2021, YPLL had increased to 77,314, or 11,011.8 YPLL per 100,000 (a 20% increase compared to the 2020 YPLL rate). In 2021, the highest YPLL were among 55-64 years olds at 14,953 YPLL or 15,979.5 YPLL per 100,000; followed by 25 to 34-year-olds (13,554 YPLL or 12,389.6 YPLL per 100,000).

Table 5. Leading Underlying Causes of Death (2020—2021): Ranked by 2021 Deaths

Underlying Cause of Death (ICD-10 Code)	2020 Observed (Excess)	2021 Observed (Excess)
All Causes	**5,186 (512*)**	**6,194 (1,421*)**
#1. Malignant Neoplasms (C00-C97)	1,043 (42)	1,075 (56)
#2. Diseases of Heart (I00-I09, I11, I13, I20-I51)	915 (63)	993 (128*)
#3. COVID-19, Virus Identified (U071)	231 (NA)	742 (NA)
#4. Accidents (Unintentional Injuries) (V01-X59, Y85-Y86)	465 (32)	570 (127*)
#5. Cerebrovascular Diseases (I60-I69)	212 (0)	253 (36)
#6. Chronic Lower Respiratory Diseases (J40-J47)	205 (-5)	235 (26)
#7. Intentional Self-Harm (Suicide) (U03, X60-X84)	204 (-16.2)	218 (-12)
#8. Chronic Liver Disease and Cirrhosis (K70, K73-K74)	167 (46*)	186 (63*)
#9. Diabetes Mellitus (E10-E14)	174 (47*)	178 (51)
#10. Alzheimer Disease (G30)	139 (10)	135 (-4)

* Predicted estimate compared to the observed value differs significantly at the $\alpha = 0.05$ level.

Underlying Causes of Death

Underlying causes of death (defined as the disease or injury that initiated the train of morbid events resulting in death) are ranked by observed 2021 deaths and the top ten leading causes are summarized in Table 5. Diseases of the heart, accidents (unintentional injuries), and chronic liver disease and cirrhosis all experienced statistically significantly more deaths than expected in 2021 (128, 127, and 63 excess deaths, respectively). Diabetes mellitus deaths were higher than expected in 2020, but this result was not significant in 2021.

Accidental drug poisonings (overdoses) are one of the largest contributors to unintentional injury mortality. There were 242 accidental drug overdoses observed in 2021, 119 more deaths than expected. However, this result was not significant in 2020. Also of note, in both 2020 and 2021 there were significantly *fewer* assault (homicide) deaths than expected. In 2020, there were 55 homicides, 30 less than expected. In 2021 there were 48 homicides, 47 less than expected. Intentional self-harm (suicide) deaths were also lower than expected, but these results were not significant in 2020 or 2021.

Discussion

There were 973 deaths with COVID-19 as the underlying cause between 2020 and 2021. Including deaths where COVID-19 was cited as contributing cause (defined as all other conditions in the train of morbid events that resulted in death), there were 1,097 COVID-19-related deaths total. [2] This means COVID-19 played a verifiable role in approximately 57% of the 1,933 excess deaths estimated by the model. The remaining excess in mortality observed is a product of several

[2] More information on how COVID-19 deaths are reported is available online here: https://dhss.alaska.gov/dph/Epi/id/Pages/COVID-19/deathcounts.aspx

factors. This includes the secondary effects that COVID-19 and the pandemic has had on other causes of death, such as mortality resulting from a strained medical system during the pandemic, or a decrease in preventive care measures.

A possible limitation to this study is under-reporting of COVID-19 on death certificates. Misclassification can occur if testing results were not completed or unavailable, or due to incomplete/inaccurate information on medical history or presentation of symptoms provided to the certifying physicians who report the cause of death. The mortality data for 2021 is also preliminary and is subject to change.

In summary, the pandemic significantly impacted Alaska's mortality rates, which disparately affected populations by sex, race, region, and age. Although more elderly Alaskans tend to die from COVID-19, the pandemic increased premature deaths among non-elderly adults as well. Additional research is needed to fully understand the impact and drivers of excess mortality.

Additional Resources

More information about excess deaths, including the latest provisional estimates, is available from the Centers for Disease Control and Prevention: https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm.

More information about COVID-19 in Alaska, including the latest provisional case and death estimates, is available from the Alaska Department of Health and Social Services: https://covid19.alaska.gov/.

Technical Notes

A series of statistical models were fitted to estimate the trajectory of expected deaths for 2020 and 2021 using historical monthly patterns observed during 2010 – 2019. After validation, the final method was based on a quasi-Poisson model to account for over/under dispersion, and month-to-month variation under the form:

$$\ln(\lambda i) = \beta 0 + \beta mmYYXi + \beta mm.var\, Xi + \epsilon$$

Where, λi is the dependent variable of deaths during month and yeari, β0 is the intercept, βmmYY is the independent month and year, βmm.var is the proportional distribution of deaths observed by month during the years of data included in the model, and ϵ is an error term. We constructed seven models then averaged (bagged) across the model predictions. This method penalized trends observed in years more distal from 2020 and emphasized more recent trends. The 7 models implemented the same approach but were limited to specific years as follows:

- Model 1: based on years 2010–2019.
- Model 2: based on years 2018–2019.
- Model 3: based on years 2017–2019.
- Model 4: based on years 2016–2019.
- Model 5, 6, and 7: each based on a random sample of three years between 2010—2019.

This model provides a fitted estimate of the historical patterns observed and provides a mechanism for estimating expected deaths. This assumes that the trajectory of estimated deaths would continue and is useful for evaluating the potential impact of well-defined events when compared with the observed number of events.

The final model performance, flexibility, and ability to capture seasonality in reporting trends was compared against time-series seasonal-trend decomposition using locally estimated scatterplot smoothing (STL) bootstrapped models and Error, Trend, and Seasonal (ETS) models with bagged means using the surveillance and fpp3 packages in R. Additionally we explored the utility of implementing seasonal Autoregressive Integrated Moving Average (ARIMA) and feed-forward single hidden layer naive neural networks models using the R forecast and astsa packages, but ultimately selected the final method given comparable performance and ease of interpretation.

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