Quarterly COVID-19 Update

Hospitalizations, Deaths, Repeat, and Vaccine Breakthrough Infections

Through March 2022

The Section of Epidemiology, Alaska Division of Public Health

Introduction

This document is intended to provide routine updates on COVID-19 hospitalizations, deaths, repeat, and vaccine breakthrough infections in Alaska. Hospitalization and death data are those displayed on the Alaska Cases Dashboard. Repeat and vaccine breakthrough infections and multisystem inflammatory syndrome in children (MIS-C) statistics are produced with additional data collected by the Section of Epidemiology (SOE). This report is not designed to track the burden of COVID-19 on hospitals; other data sources, such as the Unified Hospital Data Surveillance System or facility-level statistics may be more appropriate for those questions. Data included are not final; efforts to increase completion and ensure data quality are ongoing and these numbers will change. More detailed summaries and reports will be produced in the future. Data are for cases from March 2020 through March 2022.

Hospitalizations

SOE removes hospitalizations that are not due to COVID-19; for example, asymptomatic behavioral health patients or laboring mothers tested on admission are excluded. A total of 3,547 COVID-19 hospitalizations with a known admission date among Alaska residents were included in this analysis. For people with multiple admissions, the most severe/longer admission was counted.

Demographics

During March 2020 through March 2022, the mean age of COVID-19 hospitalized patients was 59 years (range: newborn to 99 years). For patients admitted in 2020, the mean age was 62 years (range: 1 month to 98 years). For patients admitted in 2021, the mean age was 4 years younger at 58 years (range: newborn to 99 years). For patients admitted in 2022, the mean age was 57.6 years (range: 1 month to 98 years). Hospitalizations by sex and race are shown in Table 1.

Table 1. Sex and race among COVID-19 hospitalized Alaska residents — March 2020 through March 2022

Characteristic	Q1 2022		2021		2020		All**	
	Count (%)	Rate*	Count (%)	Rate*	Count (%)	Rate*	Count (%)	Rate*
Sex								
Female	160 (45)	42.7	951 (45)	253.6	486 (45)	129.6	1,502 (45)	400.5
Male	193 (55)	54.5	1172 (55)	331.2	585 (55)	165.3	1,838 (55)	519.4
Race								
AIAN	97 (27)	85.8	433 (20)	383.2	300 (28)	265.5	771 (23)	682.2
Asian	14 (4)	28.9	121 (6)	250.1	99 (9)	204.6	224 (7)	463.0
Black	14 (4)	53	64 (3)	242.4	37 (3)	140.1	106 (3)	401.4
NHOPI	13 (4)	111.1	118 (6)	1008	111 (10)	948.2	236 (7)	2016.1
White	181 (51)	38.3	1037 (49)	219.5	343 (32)	72.6	1,409 (42)	298.3
Other	15 (4)		76 (4)		46 (4)		144 (4)	
Multiple	4 (1)	7	52 (2)	91.2	48 (4)	84.2	121 (4)	212.2
Unknown	15 (4)		222 (10)		87 (8)		329 (10)	
Total	353	48.4	2123	291.3	1071	146.9	3,340	458.2

**Rate is per 100,000 people within each group.*
***March 2020 to March 2022*

Length of Stay, Intensive Care, and Mechanical Ventilation

Table 2 describes the amount of time patients stayed in the hospital. This analysis is restricted to 2,390 patients for whom both an admission and discharge date have been entered. Patients who were admitted and discharged on the same day were counted as one day of hospitalization. Similarly, patients who were intubated and extubated on the same day were counted as one day of ventilation.

Table 2. Duration of COVID-19 hospital stay — March 2020 through March 2022

	2020			2021			Q1 2022		
	N	Mean	Range	N	Mean	Range	N	Mean	Range
All hospitalizations	985	9.6 days	1–124 days	1453	8.9 days	1–154 days	172	7.6 days	1–57 days
Non-ICU patients	600	7 days	1–124 days	705	6.8 days	1–128 days	68	5.8 days	1–21 days
ICU patient (total duration of hospital stay)	295	14.9 days	1–75 days	350	12.4 days	1–53 days	34	8.9 days	1–46 days
ICU patient (duration of ICU stay)	254*	9.7 days	1–75 days	281*	8.5 days	1–50 days	30*	6.5 days	1–24 days
Ventilator days	110	10.3 days	1–44 days	124	9.6 days	1–41 days	5	7.6	1-17 days

**Duration of ICU stay was not available at the time of this report for some patients who were known to have been in the ICU at some point during their hospital stay.*

Multisystem inflammatory syndrome in children

Twenty-three children hospitalized with multisystem inflammatory syndrome in children (MIS-C) have been reported to the Alaska Section of Epidemiology since the beginning of the pandemic. MIS-C is defined by fever, laboratory evidence

of inflammation, and evidence of clinically severe illness requiring hospitalization with multisystem organ involvement. The definition requires that the patient is <21 years of age with current or recent SARS-CoV-2 infection or exposure to a suspected or confirmed COVID-19 case within the 4 weeks prior to the onset of symptoms and no alternative plausible diagnoses.

Eight of the 23 children met the MIS-C case definition because of a positive antibody test, so they are not included in the above description of SARS-CoV-2 positive hospitalized patients; the other 15 were included in analysis of that patient population provided above because they had a positive COVID diagnostic test (e.g., PCR or antigen). Thirteen of the 23 children were male. Eleven were aged 0–4 years at the time of admission, six were aged 5–10 years, and six were aged 11–20 years. Five children had a pre-existing condition. All children were admitted to the hospital, and 13 were admitted to an intensive care unit. None of the children have died.

Deaths

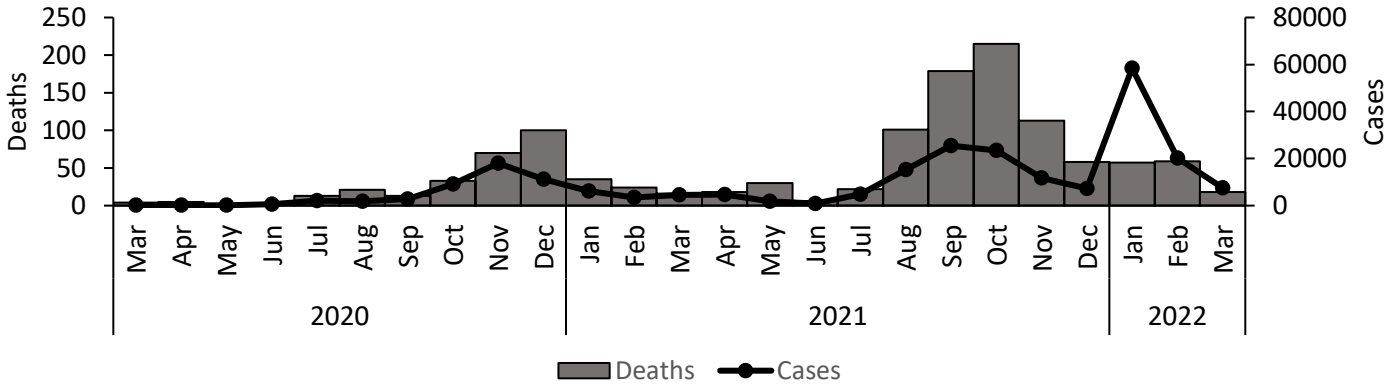
Methods

Deaths are counted as COVID-19-related in accordance with national standards and reflect the recorded date of death. This process includes auditing death certificates to verify that COVID-19 was included as a primary or contributory cause of death, medical records review, or provider determination that the cause of death was COVID-19 based on laboratory testing and a consistent clinical presentation (e.g., respiratory signs and symptoms, fever or chills, and fatigue). Rates were calculated using Alaska Department of Labor and Workforce Development population estimates and are listed per 100,000 population. Death statistics are calculated for quarter 1 of 2022, annually for 2020 and 2021, and cumulatively since the beginning of the pandemic. Cases are attributed geographically to their permanent residence, which may or may not correlate to location of exposure, illness, or death. Cases are attributed to report date and deaths to date of death. All data are preliminary, subject to change, and were congruent with public state data displays as of April 26, 2022.

Results

From January 1, 2020 – March 31, 2022, Alaska recorded 1,217 COVID-19-related deaths for a statewide death cumulative incidence of 167 per 100,000 persons. For this same period, the US death cumulative incidence was 295 per 100,000 persons, which was approximately 1.77-times higher than the Alaska death rate.

Figure 1. COVID-19 deaths and cases, by month among Alaska residents — March 2020 through March 2022



Note: Data are shown beginning in March 2020, which was the first month in which there was a death in an Alaska resident that was attributed to COVID-19.

Demographic characteristics

Table 3. Sex of Alaska residents with a COVID-19-related death — March 2020 through March 2022

Sex	Q1 2022		2021		2020		All**	
	Count (%)	Rate*	Count (%)	Rate*	Count (%)	Rate*	Count (%)	Rate*
Female	58 (43.3)	16.4	316 (38.6)	89.3	109 (41.3)	30.8	483 (39.7)	136.5
Male	76 (56.7)	20.3	503 (61.4)	134.1	155 (58.7)	41.3	734 (60.3)	195.7
AK total	134	18.4	819	112.4	264	36.2	1217	167.0

**Rate is per 100,000 people within each group*

***March 2020 to March 31, 2022*

Table 4. Age of Alaska residents with a COVID-19-related death — March 2020 through March 2022

Age in Years	Q1 2022		2021		2020		All**	
	Count (%)	Rate*	Count (%)	Rate*	Count (%)	Rate*	Count (%)	Rate*
≤19	0 (0)	NA	2 (0.2)	1.0	0 (0)	NA	2 (0.2)	1.0
20–29	2 (1.5)	2.0	15 (1.8)	15.2	3 (1.1)	3.0	20 (1.6)	20.3
30–39	1 (0.7)	0.9	34 (4.2)	30.4	6 (2.3)	5.4	41 (3.4)	36.7
40–49	5 (3.7)	5.8	62 (7.6)	72.2	11 (4.2)	12.8	78 (6.4)	90.9
50–59	14 (10.4)	15.4	125 (15.3)	137.8	17 (6.4)	18.7	156 (12.8)	172.0
60–69	33 (24.6)	38.7	201 (24.5)	235.8	50 (18.9)	58.6	284 (23.3)	333.1
70–79	41 (30.6)	98.8	199 (24.3)	479.4	85 (32.2)	204.8	325 (26.7)	783.0
80+	38 (28.4)	247.9	181 (22.1)	1180.6	92 (34.8)	600.1	311 (25.6)	2028.6
AK total	134	18.4	819	112.4	264	36.2	1217	167.0

**Rate is per 100,000 people within each group*

***March 2020 to March 31, 2022*

Table 5. Race of Alaska residents with a COVID-19-related death — March 2020 through March 2022

Race/Ethnicity	Q1 2022		2021		2020		All**	
	Count (%)	Rate*	Count (%)	Rate*	Count (%)	Rate*	Count (%)	Rate*
AIAN	31 (23.1)	27.4	193 (23.6)	170.8	95 (36.0)	84.0	319 (26.2)	282.3
Asian	4 (3.0)	8.3	54 (6.6)	111.6	28 (10.6)	57.9	86 (7.1)	177.8
Black	4 (3.0)	15.2	18 (2.2)	68.2	9 (3.4)	34.1	31 (2.5)	117.4
NHOPI	4 (3.0)	34.2	39 (4.8)	333.2	15 (5.7)	128.1	58 (4.8)	495.5
White	87 (64.9)	18.4	477 (58.2)	101.0	111 (42.0)	23.5	675 (55.5)	142.9
Multiple races	2 (1.5)	3.5	22 (2.7)	38.6	5 (1.9)	8.8	29 (2.4)	50.9
Race other/unknown	2 (1.5)	NA	16 (2.0)	NA	1 (0.4)	NA	19 (1.6)	NA
Hispanic (of any race)	4 (3.0)	NA	22 (2.7)	41.4	11 (4.1)	20.7	37 (3.0)	70.0
Ethnicity unknown	2 (1.5)	NA	1 (0.4)	NA	1 (0.4)	NA	4 (0.3)	NA
AK total	134	18.4	819	112.4	264	36.2	1217	167.0

n/a = not available

**Rate is per 100,000 people within each group*

***March 2020 to March 31, 2022*

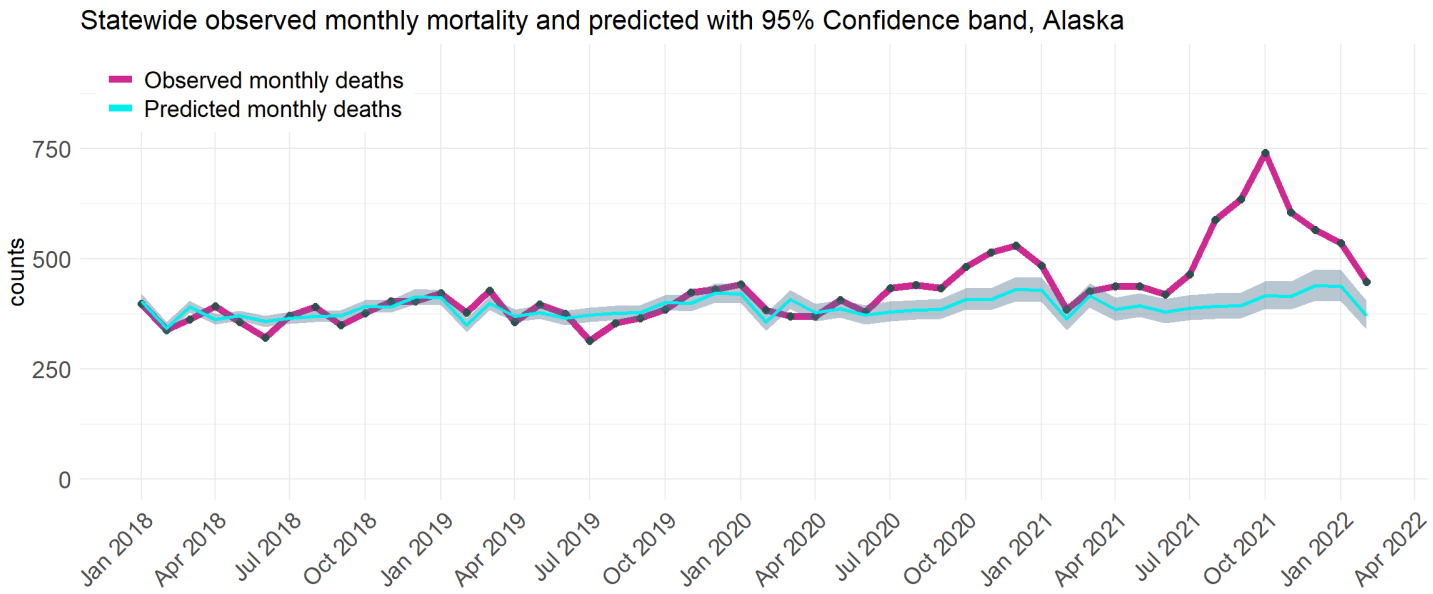
Excess All-Cause Mortality

Excess mortality is the difference between the total number of deaths (from all causes, not specifically COVID-19) that occurred during a given period of time (e.g., one month) and the number of deaths expected during that period based on historical trends (from 2010 through 2019 in this model). Excess mortality is not affected by diagnostic practices or how death certificates are coded.

Figure 2 shows in magenta the total monthly number of deaths among Alaska residents from January 2018 through February 2022. The blue line shows the number of deaths that would be expected based on pre-pandemic observed trends over the decade 2010 through 2019. The grey shaded bands around the predicted monthly deaths correspond to 95% confidence intervals used to describe the level of uncertainty surrounding predicted monthly death counts. Importantly, all 2021 and 2022 data are preliminary and subject to change. Most deaths are registered within 3 weeks of the date of death, but a smaller number are not registered until later, which would lead to underestimating the number of deaths in the most recent months. Monthly all-cause mortality is shown only through February 2022.

Trends in excess mortality in Alaska reflect the course of the COVID-19 pandemic. All-cause excess mortality was elevated from July 2020 through January 2021, which corresponds to the initial large wave of COVID-19 in Alaska. Pronounced increases in excess mortality occurred during the Delta wave from July through December 2021 with a cumulative excess mortality count of 1,155 deaths. This equates to 47% more deaths than expected for this time period. In January and Feburary 2022 when the Omicron variant was dominant, the number observed deaths was still more that predicted, though the magnitude of excess mortality was not as marked as was observed during the Delta wave. These estimates are preliminary and different estimation approaches may yield somewhat different results.

Figure 2. Statewide observed and predicted monthly mortality, Alaska



Vaccine Breakthrough Infections and Repeat Infections

Key Points

- COVID-19 vaccines continue to provide strong protection against hospitalization and death during the Omicron era.
- Most COVID-19 hospitalizations in Alaska might have been prevented by vaccination.
- COVID-19 cases have become more common among fully vaccinated persons than they were in the initial months after vaccine roll-out. Evidence from SARS-CoV-2 testing in schools shows that people who are up to date on COVID-19 vaccinate are less likely to have COVID-19 than people who are not.
- People who are up to date on COVID-19 vaccination (i.e., have received a booster dose if eligible) are better protected than people who are fully vaccinated but are overdue for a booster.
- Prior infection confers partial protection against COVID-19, but this protection has weakened during the Omicron era. Vaccination provides additional protection in those who have been infected and is recommended regardless of history of prior infection.

Introduction

COVID-19 vaccines were first administered in Alaska in mid-December 2020. In March 2021, all persons who lived or worked in Alaska and were aged ≥16 years became eligible for vaccination. After the Pfizer/BioNTech vaccine was authorized for persons aged ≥12 years, eligibility was expanded accordingly in May 2021 to anyone aged ≥12 years. In November, vaccination was authorized for persons aged 5 through 11 years. In late September, CDC recommended a booster dose for certain persons who received the Pfizer/BioNTech primary series. The following month, booster doses were recommended for persons who received the Moderna or Johnson & Johnson/Janssen primary series.

Randomized clinical trials showed that COVID-19 vaccines provide strong protection against symptomatic COVID-19. Subsequent observational studies have confirmed this finding in numerous real-world settings and have further demonstrated that COVID-19 vaccines reduce the risk of infection with SARS-CoV-2 and greatly reduce the risk of COVID-19 hospitalizations and deaths.[1] However, waning immunity decreases vaccine effectiveness (particularly against SARS-CoV-2 infection and mild COVID-19 disease) over time, thus necessitating booster dosing.[2]

While reinfections with SARS-CoV-2 are known to occur, they can be difficult to diagnose due to a lack of a widely accepted definition. Observational studies have found that prior infection with SARS-CoV-2 confers substantial partial protection against reinfection with Delta and prior circulating variants for at least 6 months.[3] The extent to which prior infection confers protection against infection with the Omicron variant is still being investigated. There is evidence that even in persons with a history of SARS-CoV-2 infection, vaccination provides an added layer of protection.[4]

By late December 2021, the Omicron variant replaced the Delta variant as the dominant circulating SARS-CoV-2 lineage in Alaska. Estimates from the first quarter of 2022 represent outcomes resulting primarily from Omicron cases.

Methods

A vaccine recipient is considered fully vaccinated 14 days after receiving the second dose in a two-dose series (e.g., Pfizer/BioNTech or Moderna) or a single dose in a one-dose series (e.g., Johnson & Johnson/Janssen). Cases of COVID-19 that occur in fully vaccinated persons are classified as “vaccine breakthrough” (VB) cases.

Recommendations regarding additional and booster doses have changed at multiple time points since mid-2021, varying based on age, manufacturer of primary series, and time since completion of primary series. To facilitate comparisons over time, we apply to all time points booster recommendations as they currently exist: persons aged 12 years and older should receive a booster dose 5 months (150 days) after completion of the primary series of an mRNA vaccine and persons who received the Johnson & Johnson/Janssen primary vaccination should receive a booster dose (preferably of an mRNA vaccine) 2 months (60 days) later. A person is considered up to date if they are fully vaccinated and have either received a booster dose or if they are not yet eligible for a booster dose. (Second booster doses for persons aged 50 years and older and for certain immunocompromised persons were authorized at the end of March and are not analyzed in this report.)

All case and hospitalizations data were obtained from the Section of Epidemiology’s case-based surveillance system. Hospitalization and death data were identified as described above. This analysis is limited to data on Alaska residents; vaccination status of non-residents diagnosed in Alaska cannot be consistently ascertained. All data and analyses are preliminary and subject to change.

Cases, hospitalizations, and deaths were attributed to date of specimen collection in all analyses. This date was used because it corresponds most closely to the definition of vaccine breakthrough. For example, if a person tested positive 12 days after completing the vaccination series, that would not be counted as a vaccine breakthrough case and, consequently, neither would a subsequent hospitalization due to COVID-19, even if the hospitalization itself occurred 14 or more days after series completion. Hospitalizations and deaths are included in this analysis if the corresponding specimen collection date was on or before March 31, 2022, and the hospitalization or death was documented by the Section of Epidemiology by May 13, 2022.

VacTrAK data were linked to COVID-19 case records to determine vaccination status of cases and to estimate the amount of person-time at risk stratified by primary series vaccination status (including vaccine manufacturer and time since completion of primary vaccine series), vaccine booster status (whether person was eligibility for a booster and

booster manufacturer among those who had received a booster dose), history of prior SARS-CoV-2 infection (including time since most recent prior infection), geographic region of residence (11 behavioral health regions), calendar day, and age group (0–4, 5–9, 10–11, 12–14, 15–19, … 85–89, and ≥90 years). One limitation of the VacTrAK dataset is that it does not include vaccines administered by the Department of Defense or the Department of Veterans Affairs or doses Alaska residents may have received outside Alaska. Reports from case investigators on the vaccination status of COVID-19 cases were used to supplement VacTrAK data. The number of persons in each demographic group with no documented history of either SARS-CoV-2 infection or COVID-19 vaccination was inferred by subtracting the number of persons with a history of vaccination and/or infection from 2020 Alaska Department of Labor and Workforce Development population estimates.

COVID-19 cases are classified as reinfections if positive specimen collection occurred ≥90 days after the specimen collection date of the prior case. Very rarely, the Section of Epidemiology may revise a classification based on health care provider input. For this analysis, all person-time <90 days from a case's first specimen collection date was excluded because per the surveillance definition of reinfection used here, reinfections occur at least 90 days after a prior infection. (One patient with a positive test result 89 days after a prior positive test who subsequently died from COVID-19 was counted for the purpose of this analysis at day 90 and included as a reinfection. Note that surveillance definitions may differ from clinical judgements; persons who develop symptoms compatible with COVID-19 within 90 days of a prior infection are advised to consult with a health care provider.)

Age-standardized COVID-19 case rates and hospitalization rates were calculated by direct standardization to the Alaska resident population aged 5 years and older using the age categories as above, except the 5–9, 10–11, 12–14, and 15–19 year age categories were combined.[5] Ninety-five percent confidence intervals were calculated using gamma distributions.[6]

Adjusted incidence rate ratios were calculated using the Mantel-Haenszel method.[7] Estimates were adjusted for age group, region, and calendar day.

Results

Vaccine breakthrough cases over time

Through the end of March 2022, a total of 71,743 vaccine breakthrough COVID-19 cases were documented among Alaska residents (Table 6). An additional 8,178 cases occurred among Alaska residents who were partially vaccinated. The proportion of cases occurring in fully vaccinated persons has continued to increase and in March was greater than the proportion of the population fully vaccinated. Vaccine effectiveness cannot be readily inferred from the proportion of cases in vaccinated persons. Many factors in addition to vaccine effectiveness may affect this proportion, including differential likelihood of seeking testing by vaccination status and the extent to which transmission is disproportionately occurring in places in Alaska with higher or lower vaccination coverage.

Table 6. Reported COVID-19 vaccine breakthrough cases, by month of specimen collection among Alaska residents aged ≥5 years — January 16, 2021, through March 31, 2022

Month	Total cases	VB cases (% of total monthly cases)	Proportion of AK residents aged ≥5 years who were fully vaccinated*
January 2021[±]	2,170	2 (0.1)	1.1
February 2021	3,254	46 (1.4)	5.5
March 2021	4,380	119 (2.7)	17
April 2021	4,454	209 (4.7)	28.6
May 2021	1,717	137 (8.0)	39.1
June 2021	882	182 (20.6)	43.4
July 2021	4,613	1,260 (27.3)	46.7
August 2021	14,646	4,392 (30.0)	48.3
September 2021	22,980	7,041 (30.6)	50.3
October 2021	21,090	7,078 (33.6)	52.4
November 2021	10,571	3,786 (35.8)	54.1
December 2021	7,832	3,724 (47.5)	55.9
January 2022	58,604	30,889 (52.7)	57.6
February 2022	15,857	8,883 (56.0)	58.5
March 2022	6,193	3,995 (64.5)	59.1

**Mean daily estimated percentage of Alaska residents aged ≥5 years who were fully vaccinated.*
[±]January 2021 data are from the period January 16, 2021, through January 31, 2021. January 16, 2021 was the first date that any Alaska residents were fully vaccinated.

Test-negative analysis of SARS-CoV-2 testing among symptomatic persons at schools

A test-negative case-control analysis is a widely used approach to assessing vaccine effectiveness that can overcome some of the limitations that arise when comparing the proportion of cases that are vaccinated to population-wide vaccination coverage levels.[8] This analysis only includes people who share a reason for getting tested (e.g., they have symptoms). The vaccination coverage among those who test positive ("cases") is compared to the vaccination coverage in those who test negative ("controls"). The more effective the vaccine, the more cases are disproportionately likely to occur among unvaccinated people, and people who test negative are disproportionately likely to be vaccinated.

Certain schools/school districts in Alaska that perform SARS-CoV-2 testing report the symptom onset date of persons being tested. It is therefore possible to focus analyses specifically on symptomatic persons tested in school settings. Among persons tested and with symptom onset during the first quarter of 2022, 26% of those who tested positive were up to date on vaccination, whereas 41% of those who tested negative were up to date (Table 7). In an analysis adjusted for age and calendar day, people who were up to date were 61% (95% CI: 44%-72%) less likely to test positive than those who were unvaccinated. The results were similar for students and staff in adjusted analyses restricted by age. Among the 583 persons in the analysis <20 years old, those who were up to date were 62% less likely to test positive than those who were unvaccinated, whereas the 354 persons ≥20 years old were 63% less likely to test positive than those who were unvaccinated.

Table 7. Vaccination status of persons aged 5 and older who were tested at schools in Alaska with known symptom onset date and specimen collection date — January through March 2022

	Case (test positive)		Control (test negative)		Adjusted odds ratio (95% CI)
Unvaccinated	191	44.5%	172	33.9%	1 (reference group)
Fully vaccinated but not up to date	102	23.8%	109	21.5%	0.70 (0.49–1.00)
Partially vaccinated	25	5.8%	29	5.7%	0.72 (0.40–1.28)
Up to date	111	25.9%	198	39%	0.39 (0.28–0.56)

Vaccine breakthrough hospitalizations over time

Among vaccine breakthrough cases with specimen collection date on or prior to March 31, 2022, 538 hospitalizations due to COVID-19 were documented (Table 8). An additional 107 hospitalizations occurred among partially vaccinated Alaska residents.

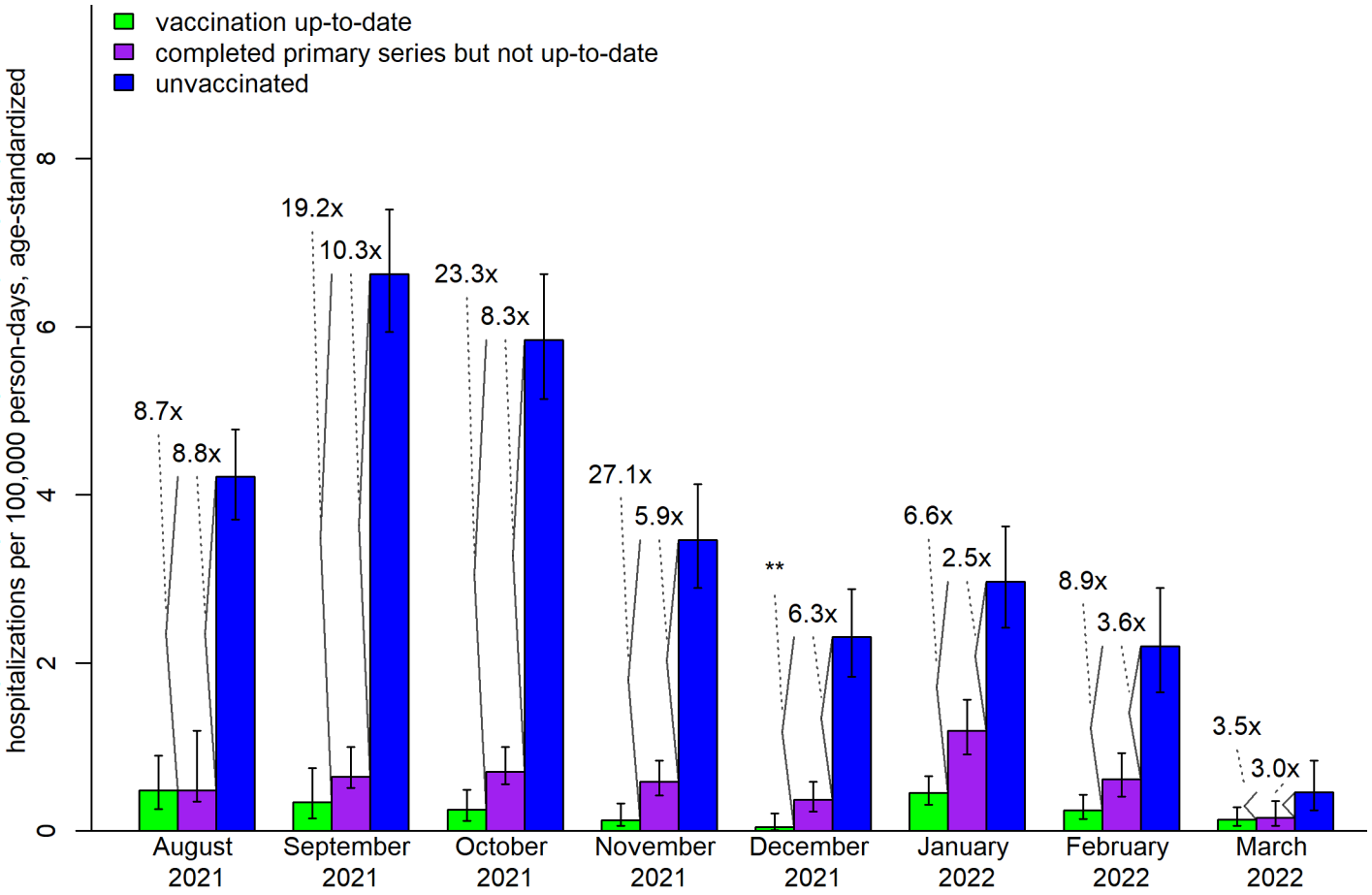
While vaccine effectiveness has declined since the Omicron variant became dominant, persons up to date on COVID-19 vaccination continued to be much less likely to be hospitalized due to COVID-19 than persons who were unvaccinated (Figure 3). Based on COVID-19 cases with specimen collection dates in January through March 2022 and adjusted for age, region, and calendar day, unvaccinated persons aged ≥5 years were hospitalized due to COVID-19 at 7.3 times the rate of up-to-date persons (95% CI: 5.5–9.6) and 3.1 times the rate of persons who were fully vaccinated but not up to date (95% CI: 2.5–4.0). Persons who were fully vaccinated but not up to date were hospitalized at 2.5 times the rate of up-to-date persons (95% CI: 1.9–3.4).

Table 8. Reported hospitalizations due to COVID-19 vaccine breakthrough infections, by month of specimen collection among Alaska residents aged ≥5 years — January 16, 2021, through March 31, 2022

Month	Total hospitalizations	VB hospitalizations (% of total monthly hospitalizations)
January 2021-March 2021*	206	3 (1.5)
April 2021	128	7 (5.5)
May 2021	66	3 (4.5)
June 2021	42	5 (11.9)
July 2021	176	35 (19.9)
August 2021	345	67 (19.4)
September 2021	472	86 (18.2)
October 2021	377	85 (22.5)
November 2021	202	52 (25.7)
December 2021	121	25 (20.7)
January 2022	226	100 (44.2)
February 2022	109	47 (43.1)
March 2022	35	18 (51.4)

**Data are from January 16, 2021, onwards. January, February, and March 2021 data have been aggregated to protect patient privacy.*

Figure 3. Age-adjusted incidence of hospitalization due to COVID-19 among Alaska residents aged ≥5 years by vaccination status, stratified by month of first positive specimen collected from August 2021–March 2022



***Especially when rates are very low, the estimates of fold-differences between rates may be imprecise. Fold-differences are not calculated if one of the rates is based on <6 cases.*

Vaccine breakthrough cases and hospitalizations, by age

Vaccine breakthrough cases occurred during quarter 1 of 2022 among Alaskans of all vaccine-eligible age-groups (Table 9). The proportion of cases who were up to date with COVID-19 vaccination generally increased with age, which primarily reflects higher vaccination coverage at higher ages. As discussed above, it is difficult to infer vaccine effectiveness from comparing the proportion of cases by vaccination status to the population vaccine coverage estimates.

Table 9. Reported COVID-19 cases by COVID-19 vaccination and by age among Alaska residents — January through March 2022

Age group	Total cases	Cases by vaccination status (% of total cases per age group)		Percentage of AK residents by vaccination status*	
		Up to date	Fully vaccinated but not up to date	Up to date	Fully vaccinated but not up to date
5–11	9,763	9,764	2,103 (21.5)	0 (0.0)†	18.8
12–19	10,807	10,807	1,982 (18.3)	3,831 (35.4)	19.3
20–34	24,305	24,302	4,892 (20.1)	7,548 (31.1)	22.3
35–49	18,507	18,511	5,516 (29.8)	5,931 (32.0)	32.3
50–64	11,709	11,707	4,313 (36.8)	3,639 (31.1)	40.1
65+	5,566	5,563	2,675 (48.1)	1,337 (24.0)	57

**Mean of the daily estimated percentage for each day in quarter 1 of 2022 of Alaska residents by vaccination status and by age group.*

†Booster doses are not authorized for children ages 5–11, so in this age category there is no distinction between being fully vaccinated and being up to date.

Vaccination reduced the incidence of COVID-19 hospitalizations across all age groups in the first quarter of 2022. People who were up to date on COVID-19 vaccination were better protected than those who were fully vaccinated but not up to date (Table 10). Younger age categories were combined to improve statistical precision. While the point estimates vary between age groups, the confidence intervals are wide, precluding detailed comparisons.

Table 10. Reported COVID-19 hospitalizations by COVID-19 vaccination and by age among Alaska residents and adjusted incidence rate ratios — January through March 2022

Age group	Total hospitalizations	Hospitalizations by vaccination status (% of total hospitalizations per age group)		Percentage of AK residents by vaccination status*		Incidence rate ratios (95% C.I.)+		
		Up to date	Fully vaccinated but not up to date	Up to date	Fully vaccinated but not up to date	Unvaccinated vs. up to date	Unvaccinated vs. fully vaccinated but not up to date	Fully vaccinated but not up to date vs. up to date
5-49	94	15 (16)	16 (17)	24.3	26.3	4.2 (2.4–7.3)	3.5 (2.1–5.9)	1.1 (0.5–2.3)
50-64	79	15 (19)	23 (29.1)	40.1	27.6	5 (2.6–9.6)	1.9 (1.1–3.1)	2.4 (1.2–4.6)
65+	197	39 (19.8)	57 (28.9)	57	24.3	12.4 (8.4–18.4)	3.7 (2.7–5.2)	3.5 (2.3–5.2)

**Mean of the daily estimated percentage for each day in first quarter of 2022 of Alaska residents by vaccination status and by age group.*

+Incidence rate ratios adjusted for age, region, and calendar day with 95% confidence intervals. An incidence rate ratio >1 means that unvaccinated persons were more likely to be hospitalized due to COVID-19 than those who were vaccinated.

Vaccine breakthrough cases by region

Vaccine breakthrough cases occurred in all regions of Alaska during the first quarter of 2022 (Table 11). A variety of factors may affect the proportion of vaccine breakthrough cases by behavioral health region. In communities with higher vaccination coverage, a larger proportion of cases is expected to occur among fully vaccinated persons. Other potential factors include the extent of prior infection in a region and differences in testing practices between regions.

Table 11. Reported COVID-19 vaccine breakthrough cases by region among Alaska residents aged ≥5 years — January through March 2022

Behavioral Health Region	Total cases	Cases by vaccination status (% of total cases per region)		Percentage of residents by vaccination status*	
		Up to date	Fully vaccinated but not up to date	Up to date	Fully vaccinated but not up to date
Anchorage Municipality	34,523	9,161 (26.5)	9,537 (27.6)	35.4	27.8
Fairbanks North Star Borough	8,777	1,660 (18.9)	2,346 (26.7)	25.8	24.7
Juneau City and Borough	3,376	1,150 (34.1)	1,122 (33.2)	47.2	29.8
Kenai Peninsula Borough	5,143	1,066 (20.7)	1,191 (23.2)	27.2	21.9
Matanuska-Susitna Borough	8,394	1,403 (16.7)	2,042 (24.3)	20.8	21.3
Northwest Region	6,429	2,601 (40.5)	1,809 (28.1)	35.1	25.3
Other Interior Region	1,957	460 (23.5)	602 (30.8)	31.8	26.4
Other Southeast Region - Northern	1,896	640 (33.8)	545 (28.7)	45.7	28.4
Other Southeast Region - Southern	2,176	599 (27.5)	680 (31.2)	34.6	28.9
Southwest Region	3,839	1,159 (30.2)	1,097 (28.6)	33.8	33.5
Y-K Delta Region	4,144	1,582 (38.2)	1,315 (31.7)	40.7	31.4

**Mean of the daily estimated percentage for each day in quarter 1 of 2022 of Alaska residents by vaccination status and by region.*

Vaccine breakthrough deaths

Among the 131 documented COVID-19 deaths with specimen collection date during the first quarter of 2022, 24 occurred in persons up to date on COVID-19 vaccination, 27 in persons who were fully vaccinated but not up to date, and 78 occurred in unvaccinated persons. (Two occurred in partially vaccinated persons.) Accounting for age, calendar day, and region, unvaccinated persons died from COVID-19 at 11.5 times the rate of up-to-date persons (95% CI: 7.0–18.9). Compared to fully vaccinated but not up to date persons, unvaccinated persons died from COVID-19 at a 5.0 times higher rate (95% CI: 3.2–7.8). These numbers may change as death certificates are completed and processed and ongoing data quality assurance processes are implemented.

Reinfection

A total of 14,019 SARS-CoV-2 reinfections were documented among Alaska residents since the beginning of the pandemic; 291 persons were reinfected twice (i.e., counted as a case 3 times) and 4 persons were counted as a case 4 times. During July–November 2021 among unvaccinated persons, the incidence of COVID-19 in persons without a prior documented history of SARS-CoV-2 infection was 5.7 times higher (95% CI: 5.4–6.0) than the incidence in persons with a history of infection. But in the first quarter of 2022, the incidence of COVID-19 in persons without a prior documented history of SARS-CoV-2 infection was 2.4 times higher (95% CI: 2.3–2.5), suggesting that prior infection was less protective after Omicron became dominant. Likewise, evidence suggests that during the first quarter of 2022 among unvaccinated people, prior infection may have been less protective against hospitalization than it had been during July through

November 2021 (IRR in quarter 1 of 2022: 0.10, 95% CI: 0.06, 0.19; IRR in July through November: 0.07; 95% CI: 0.04–0.12). However, the estimates are imprecise, and the confidence intervals overlap.

Reinfection and Vaccination

Of the 226,224 Alaska residents with at least one documented case of COVID-19, 43,229 (19.1%) became fully vaccinated after their first infection. Complex patterns of primary series vaccination, booster vaccination, and re-infection make it difficult to use routine surveillance data to assess the combined protective effects of vaccination and prior infection.

Discussion

Even during the Omicron wave, COVID-19 vaccines continue to be our single most important tool to prevent COVID-19 cases, hospitalizations, and deaths.

The proportion of vaccine breakthrough cases during the first quarter of 2022 was higher than the proportion in previous months. Multiple factors determine the proportion of documented COVID-19 cases among fully vaccinated persons, but the most likely contributors to the increased proportion of vaccine breakthrough cases include waning immunity and the fact that the Omicron variant, which was the dominant variant in Alaska during the first quarter of 2022, has an increased ability to evade prior immunity compared to prior SARS-CoV-2 variants.

COVID-19 vaccines in Alaska continue to provide effective protection against hospitalization and death. Compared to vaccine effectiveness against infection or mild/moderate illness, vaccine effectiveness against hospitalization remains comparatively robust, though it has declined somewhat as well.

Importantly, persons who are up to date on COVID-19 vaccination are better protected during the Omicron wave against hospitalization and death than those who are fully vaccinated but not up to date (i.e., overdue to receive a booster dose). This finding is in line with evidence from elsewhere in the United States.[9]

In addition to protection against severe disease, a test-negative case-control analysis based on SARS-CoV-2 testing in schools showed that persons who were unvaccinated were more than twice as likely to have symptomatic COVID-19 than persons who were up to date on COVID-19 vaccination. Waning immunity over time and increased immune evasion by the omicron variant are likely the predominant reasons why fully vaccinated but not up-to-date persons were found to be less protected against becoming a COVID-19 case in this sub-analysis.

The data presented here were collected for public health surveillance purposes and may be subject to unmeasured confounding and bias. For example, adherence to COVID-19 mitigation measures (e.g., mask wearing and avoiding indoor crowded spaces) may vary by vaccination status. Moreover, the magnitude of these differences may vary over time and by age group. Additionally, COVID-19 cases among vaccinated persons may be more likely to be detected than COVID-19 cases among persons who are not vaccinated (e.g., health care workers are more likely to be vaccinated than the general population and may be more likely to get tested), which would artificially increase the proportion of detected cases among vaccinated persons. Furthermore, infection-induced immunity may build up in the unvaccinated population faster than in the vaccinated population, thereby making vaccination appear less effective over time.[10] Finally, receipt of outpatient COVID-19 treatments such as oral antivirals and monoclonal antibodies may vary by vaccination status and are not accounted for in this analysis.

The magnitude of bias and confounding may differ across settings; consequently, direct comparisons to data from other jurisdictions or to prospective evaluations of vaccine effectiveness are difficult. Additionally, this analysis is not a formal evaluation of vaccine effectiveness. It is biologically implausible that COVID-19 vaccines would perform differently in

Alaska compared to other parts of the United States. In fact, a test-negative case-control analysis using Alaska data yielded similar results to a methodologically similar national analysis.[11]

Prior infection with SARS-CoV-2 confers partial protection against subsequent reinfection. COVID-19 hospitalizations and deaths have been documented among Alaska residents who previously had COVID-19. Vaccination is safe in persons who have previously been infected and evidence from Alaska and published analyses indicate that vaccination confers additional protection among persons with a prior history of SARS-CoV-2 infection.[4,11] Reinfections became more frequent during the first quarter of 2022 compared to previous months. This is not surprising, given that the Omicron variant is antigenically distinct from prior circulating variants and is better at evading prior infection-induced immunity.

As of May 17, 2022, COVID-19 vaccination is recommended for persons aged 5 years and older in the United States for the prevention of COVID-19. The age groups approved/authorized to receive vaccination vary by vaccine product. CDC recommends that people get up to date with COVID-19 vaccination as soon as feasible, which includes the completed primary series and any recommended booster doses for which they are eligible.[12,13]

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13. CDC. Who Is Eligible for a COVID-19 Vaccine Booster Shot? Available at: https://www.cdc.gov/coronavirus/2019-ncov/vaccines/booster-shot.html

Additional Resources

- CDC. Older Adults and COVID-19. Available at: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html
- CDC. Certain Medical Conditions and Risk for Severe COVID-19 Illness. Available at: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html
- CDC. Health Equity Considerations and Racial and Ethnic Minority Groups. Available at: https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html
- CDC. Understanding Death Data Quality: Cause of Death from Death Certificates. Available at: https://www.cdc.gov/nchs/nvss/covid-19.htm#understanding-death-data-quality
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- State of Alaska. Epidemiology *Bulletins*. Available at http://www.epi.alaska.gov/bulletins/
- CDC. SARS-CoV-2 Variant Classifications and Definitions. Available at: https://www.cdc.gov/coronavirus/2019-ncov/variants/variant-info.html