State of Alaska Epidemiology **Bulletin** Recommendations and Reports

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Epidemiology of the COVID-19 Pandemic — Alaska, 2020–2023

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Executive Summary

The COVID-19 pandemic stands out as one of the most significant global health crises in modern history. It profoundly impacted public health, global economies, and societies worldwide, resulting in a devastating loss of life. By the end of the Federal Public Health Emergency in Alaska, over 1,500 deaths were attributed to COVID-19 infection (approximately one in every 500 Alaska residents).

In Alaska, a public health response of immense scale and duration was mounted in March 2020. This report aims to provide an overview of both the public health response and the epidemiology of COVID-19 in Alaska throughout the 2020–2023 pandemic. To achieve this, the report categorizes the pandemic in Alaska into seven distinct "eras." These classifications are based on Alaska's epidemiological data, the implementation of non-pharmaceutical interventions (NPIs), and the rollout of COVID-19 vaccinations. Additionally, national and state genomic sequencing data were utilized to characterize circulating SARS-CoV-2 variants across these eras.

COVID-19 was first detected in Alaska on March 12, 2020. During this initial pandemic onset era (March–May 2020), Alaska's geographic location and the implementation of NPIs prior to the first detected case prevented widespread community transmission. This resulted in a smaller initial COVID-19 wave and lower rates of morbidity and mortality compared to many areas in the contiguous U.S. for the same period. However, during the second era (June 2020–January 2021), despite expanded state contact tracing efforts and increased COVID-19 testing capacity, community transmission and COVID-19 incidence increased rapidly. Statewide NPIs were relaxed, COVID-19 vaccination was still largely unavailable, and COVID-19 outbreaks began to occur throughout the state. Healthcare facilities in Alaska also grappled with surges in critically ill COVID-19 patients. Substantial disparities in rates of COVID-19 mortality and hospitalizations began emerging during this era, with older adults, American Indian/Alaska Native (AI/AN) persons, and Asian/Pacific Islander (Asian/PI) persons most disproportionately impacted. For example, during this era in Alaska, age-adjusted COVID-19 mortality rates among AI/AN and Asian/PI persons were 5.5 and 3.6 times as high as the rate among White persons: 148.5 per 100,000 (95% CI: 120.2–182.4) for AI/AN persons, 95.3 (95% CI: 67.9–130.6) for Asian/PI persons, and 26.7 (95% CI: 21.8–32.4) for White persons. These racial disparities in both COVID-19 mortality and hospitalizations continued for the entirety of the pandemic in Alaska.

During the third pandemic era (February–June 2021), Alaska increased COVID-19 vaccination distribution, administering over half (n=289,287) of all COVID-19 primary vaccine series delivered during the pandemic within this 5-month period. There was also further easing of locally applied NPIs around the state and rapid point-of-care antigen tests had emerged as a new rapidly scalable testing method in Alaska, supplementing laboratory testing and shortening the test result notification time for people. During this third era, there was a notable decline in rates of reported COVID-19 cases, hospitalizations, and mortality in Alaska. However, disparities in hospitalizations and mortality persisted, notably among older adults, AI/AN persons, and Asian/PI persons, who continued to experience significantly higher rates of both COVID-19 mortality and hospitalizations than White persons in Alaska.

The emergence of the Delta SARS-CoV-2 variant in Alaska in July 2021 marked the beginning of the fourth pandemic era in Alaska, which lasted through December 2021. This era, dominated by the circulating Delta variant, was Alaska's most severe. Of all 1,564 COVID-19 deaths that occurred during the pandemic, nearly half (46%; n=719) occurred during this era. Moreover, COVID-19 became the leading cause of death in Alaska during this era, and COVID-19 mortality rates in Alaska rose above the national average for the first time (3.6 versus 2.7 per 100,000 population for Alaska and the U.S., respectively). The Delta variant also had a more pronounced impact on people in younger age brackets in Alaska compared to other variants, with 64% (n=156) of all deaths among persons aged <55 years occurring in this era. Vaccination with the COVID-19 primary vaccine series had a substantial protective impact on COVID-19 mortality during the Delta era; the age-adjusted rate of COVID-19 mortality among fully vaccinated persons in Alaska (35.3 deaths [95% CI: 29.7–41.9] per 100,000 population) was nearly one-eighth that of unvaccinated persons (275.1 deaths [95% CI: 252.8–299.4] per 100,000 population).

By January 2022, Omicron (BA.1) emerged as the predominant circulating variant, marking the onset of the fifth pandemic era (January–March 2022). The Omicron variant resulted in a 90% increase in cases compared to the preceding period and an average weekly reported case rate of 827.5 cases per 100,000 population. Although this rise in cases was not accompanied by substantial increases in hospitalization and mortality rates relative to the preceding Delta era, considerable challenges in healthcare capacity were observed due to the increase in the absolute number of cases, staff shortages, and supply chain disruptions. By March 2022, because of increased availability of COVID-19 vaccines and therapeutics, the ubiquity of the Omicron variant, and updated guidance from the Centers for Disease Control and Prevention (CDC), Alaska ceased contact tracing activities and shifted to a strategic approach focused on outbreak investigation and mitigation in congregate settings.

During the sixth pandemic era (April–October 2022), Alaska experienced shifts in circulating Omicron subvariants. By April 2022, BA.2 had replaced BA.1 as the predominant subvariant but did not result in a subsequent increase in cases relative to the preceding era. BA.5 then became the dominant subvariant by July; however, despite its widespread circulation, COVID-19 hospitalizations and deaths remained lower than during the fifth pandemic era. Reduced case rates were likely influenced by reduced case detection through reportable testing, as at-home (non-reportable) rapid antigen tests became widely available, and the closure of many drive-through testing sites by June 2022.

During the seventh pandemic era (November 2022–May 2023), the circulating Omicron subvariant BA.5 was gradually replaced by the XBB.1.5 Omicron subvariant, which became the predominant strain in Alaska by February 2023. Alaska also saw continued reductions in reported COVID-19 cases, influenced by changes in testing and reporting practices, along with the overall decline in COVID-19 transmission. Hospitalizations and deaths were also lower than preceding eras with weekly averages of 1.5 hospitalizations per 100,000 population, and 0.3 deaths per 100,000 population. Despite these low rates, hospitalization rates remained higher among AI/AN persons compared to other racial groups. This era also marked a shift towards fully incorporating COVID-19 response activities into routine public health operations.

The primary purpose of this report is to serve as a summary of the changing epidemiology and public health response throughout the pandemic for historical and future pandemic preparedness and response purposes. It also brings attention to several ongoing public health challenges in Alaska.

1.0 Introduction

On March 12, 2020, Alaska reported its first case of novel coronavirus disease 2019 (COVID-19). As was true for communities worldwide, Alaskans faced enormous challenges during the subsequent 3 years of the COVID-19 pandemic. These challenges included the loss of many lives, high rates of hospitalization, prolonged strain on healthcare systems, disruptions to work and education, widespread mental health challenges, and economic and supply chain instability. The pandemic highlighted and exacerbated preexisting conditions associated with poor health outcomes, disproportionately affecting certain populations. These challenges have affected all communities, leaving a lasting impact on individuals, families, and organizations.

An overview of the epidemiology of COVID-19 and the public health response to the pandemic in Alaska is warranted for both historical purposes and to inform future pandemic preparedness efforts. This report provides an overview of COVID-19 epidemiology in Alaska, from the first detected cases in March 2020 through the end of the Federal COVID-19 Public Health Emergency (PHE) on May 11, 2023.[1] COVID-19-attributable deaths were identified according to national standards, defined as those where COVID-19 was listed as the underlying or a contributing cause of death. The analysis considers key factors such as age, race and ethnicity, geographic location, and vaccine uptake throughout the federal PHE. The report also describes Alaska's public health response to provide context for interpreting the epidemiologic trends and to support future preparedness efforts.

2.0 Methods

To describe the epidemiology of COVID-19 in Alaska throughout the entire PHE, the pandemic was divided into seven distinct eras. These eras were determined by analyzing epidemiological data on reported case and hospitalization counts and circulating SARS-CoV-2 variants alongside contextual information, including the implementation of non-pharmaceutical interventions (NPIs) and the rollout of COVID-19 vaccinations.[2,3] It is important to note that these eras are specific to Alaska and were tailored to reflect local conditions. They are not intended to be generalizable or predictive of future pandemics, which might vary considerably.

The seven eras consisted of the following time periods:

1. Pandemic onset (March 2020 through May 2020),
2. Pre-vaccination (June 2020 through January 2021),
3. Rapid increase in vaccination and mix of novel variants (February through June 2021),
4. Delta variant (July through December 2021),
5. First Omicron, BA.1 (January through March 2022),
6. Second Omicron, BA.2/BA.5 (April through October 2022),
7. End of the federal PHE (November 2022 through May 11, 2023).

For a full description of the seven pandemic eras, see Figure 1 and Table 1.

Cumulative and weekly average rates of reported COVID-19 cases, inpatient hospitalizations, and COVID-19–attributed mortality in Alaska for each era of the pandemic are presented. Data were obtained from multiple statewide surveillance systems, each of which is described in detail below. Rates were calculated per 100,000 population for each era, using the corresponding midyear state population estimates from the Alaska Department of Labor and Workforce Development, Research and Analysis Section.[4] Age-adjusted rates were calculated to facilitate comparisons between population groups for COVID-19 hospitalizations and deaths; the direct method of standardization was applied utilizing the 2000 U.S. Standard Census population weighting. Ninety-five percent confidence intervals (95% CI) were calculated for rates using a normal distribution approximation of the Poisson-distribution for categories with >100 counts and the gamma approximation of the Poisson distribution for categories with ≤100 counts. Rates based on fewer than five events were not calculated because such small numbers can lead to unreliable and unstable results.

For COVID-19 mortality and hospitalization rates, results were stratified by age, race and ethnicity, and region, with distinctions made between urban and rural areas. Urban areas were defined as residences within the Anchorage Municipality, Fairbanks North Star Borough, or City and Borough of Juneau, while rural areas encompassed residences in all other boroughs/census areas. Race was categorized as American Indian or Alaska Native (AI/AN), any Asian, Native Hawaiian, or Other Pacific Islander (Asian/PI), Black or African American (Black), or White. Because ethnicity and race information are collected separately in Alaska, persons identifying as Hispanic can also identify with any of the specified race categories such as Hispanic White, Non-Hispanic White, etc. In other words, Hispanic counts are not mutually exclusive with race counts and can reflect any race.

COVID-19 Cases

COVID-19 case data were obtained from the Alaska Section of Epidemiology. COVID-19 cases were defined in accordance with CDC's National Notifiable Disease Surveillance System,[5] with infection status determined from nucleic acid amplification test or antigen test results. The only exception to this case definition were cases that met clinical and epidemiological criteria but lacked confirmatory or presumptive laboratory evidence of SARS-CoV-2; these cases were excluded due to difficulties in accurate tabulation. All cases were assigned into one of the seven pandemic eras based on reported first specimen collection date. When this date wasn't available, cases were attributed to the earliest date they were reported to the Section of Epidemiology. Reported cases reflected cases in Alaska residents only, consistent with national disease reporting practices by residency.[6]

COVID-19 testing practices in Alaska evolved continually throughout the pandemic in line with developing testing guidance from the State of Alaska (SOA) and CDC. To maintain clarity and simplicity, this analysis presents case rates as a descriptive summary across the seven pandemic eras, focusing on shorter term trends rather than detailed comparisons between population subgroups or regions.

COVID-19 Mortality

Death certificates of Alaska residents collected by the Alaska Vital Records system were obtained for deaths that occurred from March 2020 through May 2023. COVID-19 deaths were classified as those deaths in which the underlying or a contributing cause of death was reported as COVID-19, consistent with national COVID-19 death reporting practices.[7] This process involved auditing death certificates to confirm the inclusion of COVID-19 (as per ICD-10 [International Classification of Diseases, 10th Revision-Clinical Modification]: U07.1) as either an underlying or contributory cause.

To assess the epidemiological characteristics of COVID-19 mortality throughout the pandemic, all COVID-19 deaths were assigned to one of the seven eras based on the recorded date of death. For COVID-19 mortality by region, deaths were assigned based on the individual's permanent residence. This means the reported location might differ from where the person was exposed to the virus, became ill, or died. COVID-19 mortality rates during key periods of the pandemic were compared with other leading causes of death in Alaska. To ensure accurate comparisons by cause of death, each death was assigned to a single underlying cause based on its ICD-10 code. This approach provides a clear representation of leading causes of death, allowing each death to be categorized into a single cause category.

COVID-19 Hospitalizations

Alaska's Health Facilities Data Reporting (HFDR) system is a comprehensive system that collates inpatient and outpatient discharge data from healthcare facilities across the state. We used the HFDR to obtain data on inpatient COVID-19 hospitalizations from March 2020 through May 2023; HFDR data covers all inpatient facilities in Alaska except for the two Department of Defense hospitals.

To classify COVID-19 hospitalization records, HFDR uses the Clinical Classifications Software Refined for the ICD-10-CM to identify people with COVID-19 (ICD-10-CM: U07.1) as a principal diagnosis.[8] This approach allows for the exclusion of cases such as asymptomatic behavioral health patients or laboring mothers who tested positive upon admission, allowing the analysis to focus on COVID-19 hospitalizations, excluding patients admitted for other reasons who tested positive incidentally. This contrasts with other hospitalization surveillance systems such as CDC's COVID-19–Associated Hospitalization Surveillance Network, which presents data on all laboratory-confirmed SARS-CoV-2–positive patients regardless of their underlying cause of hospitalization.[9] It is important to note that the HFDR differs from other surveillance systems relevant to Alaska, such as the case-based and syndromic surveillance efforts by the Section of Epidemiology and the CDC's National Healthcare Safety Network (NHSN) COVID-19 hospitalization surveillance. These systems were used for real-time operational purposes during the pandemic, while HFDR is used here for retrospective analysis. Understanding this distinction is important for interpreting why HFDR's data collection and public reporting practices differ from those used in real-time during the pandemic in Alaska.

Cumulative and weekly average COVID-19 hospitalization rates for each pandemic era were calculated. Weekly average COVID-19 hospitalization rates were calculated by prorating hospitalizations during partial weeks based on overlap and incorporating them into the averages. Hospitalizations were assigned to an era based on recorded admission dates. Additionally, age-adjusted rates of COVID-19 hospitalization were calculated by race, age and region for each era. For hospitalization rates by region, admissions were assigned based on the patient's recorded place of residence, recognizing that this might differ from the location where the exposure occurred or where the hospitalization took place.

COVID-19 Vaccinations

COVID-19 vaccines were first administered in Alaska in December 2020. By March 2021, Alaska became the first state in the country to expand vaccination eligibility to all persons aged ≥16 years who lived or worked in the state.[10] To assess temporal and geographic trends in COVID-19 vaccine uptake we used the data submitted from the state's immunization program registry, VacTrAK to the CDC's COVID-19 Data Tracker database.[11] These data include COVID-19 vaccine administration data from jurisdictional partner clinics, hospitals, retail pharmacies, long-term care facilities, dialysis centers, Federal Emergency Management Agency and Health Resources and Services Administration partner sites, and federal entity facilities. Data were primarily submitted throughout the pandemic to CDC via VacTrAK as well as through other federal agencies (e.g., Bureau of Prisons, Department of Defense, Indian Health Service, Veterans Health Administration). For each pandemic era where COVID-19 vaccination data were available, we assessed the numbers of persons who completed a COVID-19 primary vaccine series. Completion of the primary series was defined as receipt of either a second dose of a two-dose mRNA vaccine (Pfizer/Moderna) or a single dose of Johnson & Johnson's Janssen vaccine. We also assessed the number of persons who received at least one booster dose defined as persons who completed a primary series and received at least one documented booster dose, which could be monovalent, bivalent, or both.[11]

To better understand vaccine uptake across geographic regions in Alaska, we also analyzed the distribution of COVID-19 primary vaccine series and booster doses administered within each of Alaska's seven Public Health Regions. Regions were assigned based on people's reported residence, which might differ from the location where the vaccine was administered. To evaluate vaccination coverage by region, we used population counts from the Alaska Department of Labor and Workforce Development Research and Analysis Section for each Public Health Region.[4]

To examine rates of COVID-19 mortality by vaccination status in Alaska, we linked immunization data from VacTrAK with Alaska's COVID-19 death certificate records. Persons were classified as unvaccinated if they had not completed a COVID-19 primary vaccine series (defined as receipt of two vaccine doses for persons who received Pfizer-BioNTech, Moderna, or an unspecified U.S.-authorized or approved mRNA COVID-19 vaccine, or receipt of one dose for persons who received the Janssen vaccine) at least 14 days before their recorded date of death from COVID-19. Persons under age 12 years were excluded from the analysis due to their ineligibility for vaccination until May 2021, and because they represented only 0.7% of all COVID-19 deaths in Alaska throughout the pandemic. Age-adjusted COVID-19 mortality rates for vaccinated and unvaccinated persons were calculated for each pandemic era. Era-specific rates were based on the cumulative number of vaccinated and unvaccinated persons in each age group at the midpoint of each era. To calculate COVID-19 mortality rates among unvaccinated persons, we subtracted the number of age-specific vaccinated people who had completed a primary COVID-19 vaccine series from the 2020 age-specific population estimates for Alaska. Age-adjusted rate ratios and 95% confidence intervals for COVID-19 mortality were calculated using the Mantel-Haenszel method.[12]

3.0 Results

March–May 2020: Pandemic Onset Era

COVID-19 was first reported in Alaska on March 12, 2020. The day before, the SOA issued a Public Health Disaster Emergency Declaration enabling health mandates to be issued when deemed necessary by the Office of the Governor, the Alaska Department of Health and Social Services (now the Alaska Department of Health), the Alaska Chief Medical Officer, and the Alaska Division of Public Health. These led to the implementation of statewide NPIs to control the transmission of SARS-CoV-2. Key actions included the closure of public schools on March 13, which was later extended through the end of the school year (May 2020).[13] On March 14, visitations in congregate living settings were suspended and restricted.[13] Public venues, restaurants, and nonessential businesses were closed on March 18.[13] On March 25, testing and quarantine procedures were enacted for incoming interstate and international travelers.[13] On March 28, Health Mandate 011 required all Alaskans, except those involved in essential healthcare, government services, and business activities, to stay home and practice social distancing.[14]

Similar emergency orders were also enacted by local governments. For example, the Municipality of Anchorage closed public venues, restaurants, and nonessential businesses on March 16, followed by a "hunker down" order effective March 20.[15] By the end of March, many remote villages suspended all air travel, except for medical emergencies, as tribal and local officials sought to protect isolated Alaska Native communities from exposure to the virus.[16,17]

Implementation of these extensive NPIs in combination with Alaska's isolated geographic location likely explain why the onset of community transmission was delayed compared to most other parts of the U.S., helping Alaska avoid the severe initial wave experienced in other states. During this period, the availability of testing in Alaska was limited due to the absence of in-state commercial laboratories. Samples had to be sent to the Alaska State Public Health Laboratories (ASPHL) in Anchorage and Fairbanks, where testing capacity was limited. Even so, ASPHL began validating the CDC's SARS-CoV-2 RT-PCR assay in early February 2020, earlier than many other states, which enabled them to start testing COVID-19 samples by March 2020.

During the 12-week onset period of the pandemic in Alaska, the average rates of COVID-19 cases, hospitalizations, and deaths were at their lowest levels throughout the entire pandemic, with 68.3 cases, 3.0 hospitalizations, and 1.6 deaths per 100,000 population (Table 2). Due to these low rates, visible trends among population subgroups had not yet emerged. The only available COVID-19 treatment during this time was the antiviral remdesivir, which became available for use in hospitalized patients with severe illness in Alaska in May 2020.

By April 24, the SOA began easing NPI restrictions, and by May 22, all mandated NPIs were lifted except for testing and quarantine requirements for out-of-state travelers, the closure of K-12 schools for the remainder of the academic year, and the use of non-congregate shelter solutions.[18] Similarly, on May 25, the Municipality of Anchorage lifted its emergency orders, easing restrictions on business operations and gatherings.[19]

June 2020–January 2021: Pre–vaccination Era

During the second era of the pandemic, before widespread availability of COVID-19 vaccines, some Alaska communities continued NPIs to varying degrees based on localized decision-making.

At this time, Alaska also saw a substantial increase in COVID-19 community transmission, with the average weekly reported case rate approximately 37 times higher than that observed during the pandemic onset era (Table 2).

During this era, the SOA increased testing capacity by scaling up state-run testing programs. In contrast with the pandemic onset era, when COVID-19 testing primarily targeted symptomatic people, this second era saw widespread introduction of testing among asymptomatic persons in Alaska. This shift was driven by mounting evidence of asymptomatic and presymptomatic SARS-CoV-2 transmission, underscoring that unlike the 2003 SARS outbreak, symptom-based screening alone would be insufficient to contain this virus's spread. In May 2020, COVID-19 testing was implemented for all critical infrastructure workers arriving in Alaska. However, June 2020 marked the onset of widespread traveler testing in Alaska. All travelers arriving by air, sea, or road were required to undergo molecular SARS-CoV-2 testing or self-quarantine for 14-days after arrival to reduce travel-associated SARS-CoV-2 importation and transmission. While the majority of laboratory-based COVID-19 testing at this time was conducted by ASPHL, point of care COVID-19 tests were also deployed to facilitate community testing in more remote areas. Strong collaboration with Alaska's tribal health partners played a crucial role in the deployment of rapid COVID-19 tests, with over 50% of statewide testing sites being operated by tribal health organizations by August 2020. As a result of these ongoing efforts and proactive testing strategies, Alaska's weekly average test positivity rate during this era was half the national average for the same period (4.0% vs. 8.3%).[20] By August 2020, Alaska had become the most tested state (per capita) in the nation.[21] State testing capacity was further accelerated by the establishment of Alaska's first commercial laboratory for SARS-CoV-2 testing in December 2020, alongside the introduction of the first federal point-of-care testing program in the state.[22]

By July 2020, following the relaxing of several state mandated NPIs, SOA began to expand its contact tracing workforce to help prevent the spread of COVID-19. This included hiring additional staff in the Alaska Division of Public Health (DPH), partnering with the Alaska Department of Education and Early Development and other school districts to engage school nurses, deploying Alaska Air National Guard members with health and public health experience, collaborating with the University of Alaska Anchorage's College of Health to establish a training system for contact tracers, and directly hiring more contact tracers. Additionally, DPH implemented new contact tracing software to securely manage information related to COVID-19 cases and aid contact tracing efforts.

Despite these increases in statewide testing and contact tracing capacity, COVID-19 community transmission continued to increase during this era, resulting in Alaska's first notable surge in cases, hospitalizations, and deaths, with weekly average rates of 199.7, 3.8, and 1.1 per 100,000 population, respectively (Table 2). In particular, the surge in COVID-19 cases and hospitalizations throughout the fall and winter of 2020 (Figure 1) placed considerable strain on hospital resources due to the high number of critically ill COVID-19 patients.

This second era was also characterized by COVID-19 outbreaks across Alaska. These outbreaks occurred in congregate settings, such as seafood processing plants,[23] correctional facilities, long-term care and assisted living facilities, and healthcare institutions, as well as non-congregate settings, including large gatherings in the general population.

It was also during this second era of the pandemic that substantial disparities in the rates of COVID-19 hospitalizations and deaths among different population subgroups in Alaska began to emerge. Consistent with national trends, rates of COVID-19 mortality were notably highest among people in older age groups, with the greatest mortality and hospitalization rates observed in those aged over 85 years (1,119.8 and 1,457.0 per 100,000 population for mortality (Table 3a) and hospitalization (Table 3b) rates, respectively. Moreover, age-adjusted rates of mortality were highest among AI/AN and Asian/PI persons (148.5 [95% CI: 120.2–182.4] and 95.3 [95% CI: 67.9–130.6] per 100,000 population, respectively) (Figure 2). Similarly, age-adjusted hospitalization rates for AI/AN and Asian/PI persons were 367.0 (95% CI: 322.9–411.1) and 274.9 (95% CI: 230.7–319.0) per 100,000 population, respectively, which corresponded to rates 4.6 and 3.4 times that of the White population in Alaska, respectively (Figure 3). This was also the only era in which there was a clear disparity between urban and rural regions. Urban areas experienced significantly higher mortality rates (61.3 [95% CI: 54.5–74.9] per 100,000 population) compared to rural areas (40.2 [95% CI: 32.7–49.1] per 100,000) (Figure 4).

In November 2020, the U.S. Food and Drug Administration (FDA) granted an emergency use authorization (EUA) for bamlanivimab, the first monoclonal antibody treatment for mild-to-moderate COVID-19. Shortly thereafter, they also authorized the combined use of the monoclonal antibody treatment casirivimab and imdevimab (Regeneron). Following these approvals, Alaska quickly established a monoclonal antibody infusion site in December 2020 at the Alaska Airlines Center in Anchorage, becoming one of the first states in the country to do so. That same month, the Alaska Department of Corrections began providing infusions to inmates, again becoming one of the first states to do so.

Also in December 2020, the U.S. FDA granted an EUA for the Pfizer-BioNTech and Moderna COVID-19 vaccines. This enabled the initial distribution of vaccine doses in Alaska, which was limited to frontline healthcare workers, essential personnel, and medical staff.[24] By January 11, 2021, the vaccination effort expanded to include persons aged 65 years and older.[25] During this era, 25,467 Alaska residents completed their COVID-19 primary vaccine series; most of these persons (72%, n=18,457) were aged 65 years and over.

February–June 2021: Rapid Increase in Vaccination and Mix of Novel Variants Era

During the third era of the COVID-19 pandemic in Alaska, genomic sequencing capacity improved, resulting in increased availability of SARS-CoV-2 variant data. This era also witnessed the replacement of variants that drove the prior fall/winter wave of 2020 with the B.1.1.519 variant, which became the predominant circulating variant statewide around March 2021.[26] There was also further easing of NPIs. For instance, Anchorage School District resumed in-person schooling, travelers entering Alaska no longer needed to show proof of a negative COVID-19 test upon arrival, and most businesses had transitioned back to in-person operations. Additionally, rapid point-of-care antigen tests emerged as a new high-volume testing method in Alaska,[27] supplementing state laboratory testing and shortening the notification time for COVID-19 test results.

In early 2021, two additional monoclonal antibody treatments received EUAs. Bamlanivimab and etesevimab were authorized for combined use in February 2021, but bamlanivimab's standalone EUA was revoked in April 2021 due to variant resistance. Sotrovimab was approved in May but had limited availability in Alaska, as it was only commercially available and not purchased by the U.S. government.

However, the defining aspect of Alaska's third era of the COVID-19 pandemic was the rapid progress in COVID-19 vaccination efforts. During February through April 2021, Alaska had initiated widespread distribution of the COVID-19 vaccine for the general population, expanding eligibility to encompass all residents and employees aged 16 years and older, relying heavily on tribal and community partners for distribution.[28] In May 2021, eligibility was further expanded to include anyone aged 12 years and over. As a result, over this 5-month period, 289,287 persons received their primary COVID-19 vaccine series in Alaska, constituting approximately 61% of all primary series administered throughout the pandemic (Table 4a). This marked the largest state vaccination campaign ever undertaken. Notably, among persons aged ≥65 years, 77% (equivalent to 62,995 doses) of all primary COVID-19 vaccine series administered during the pandemic were administered during this era (Table 4a). During this era of widespread vaccination efforts, the age-adjusted mortality rate among unvaccinated persons was 10.4 times as high as the mortality rate among vaccinated persons (33.3 [95% CI: 26.6–41.6] versus 3.2 [95% CI: 1.6–10.3], per 100,000, respectively) (Table 8).

During this era, considerable declines in rates of reported COVID-19 cases, hospitalizations, and mortality in Alaska were observed (Table 2). Weekly average COVID-19 case rates fell by 52% to 94.9 per 100,000 population, hospitalization rates decreased by 40% to 2.3 per 100,000 population, and mortality rates decreased by 45% to 0.6 per 100,000 population relative to the previous era. There were fewer disparities in mortality rates observed between racial groups or regions during this time (Figure 2); this was likely due to the overall reduction in COVID-19 deaths relative to the preceding era reducing absolute differences across groups. However, for hospitalization rates, AI/AN (76.5 [95% CI: 58.8–99.1]) and Asian/PI (79.2 [95% CI: 58.0–107.1]) persons continued to experience significantly higher age-adjusted rates of COVID-19 hospitalization in Alaska than White (37.84 [95% CI: 32.68–43.68]) persons; per 100,000 population (Figure 3).

July–December 2021: Delta Variant Era

The Delta variant era was the most severe era of the COVID-19 pandemic in Alaska. Initially identified in the state in June 2021, the Delta variant of SARS-CoV-2 (B.1.617.2) swiftly became the dominant strain by July 2021, marking a critical turning point in the pandemic. Throughout this era, average weekly rates of reported COVID-19, hospitalizations, and deaths surpassed all other preceding eras of the pandemic. Hospitals experienced unprecedented strain on staff and bed capacity; SOA brought an additional >400 healthcare workers to Alaska for support.

During this 6-month period, 719 people died from COVID-19 in Alaska, resulting in an average weekly mortality rate of 3.6 per 100,000 population, the highest recorded rate throughout the pandemic (Table 2). Within the 6-month span of the Delta period, 46% (n=719) of all COVID-19 deaths in Alaska throughout the entire pandemic occurred. During this era, COVID-19 also became the leading cause of death in Alaska (Table 9), with the average weekly rate of COVID-19 mortality (3.4 per 100,000 population), surpassing all of Alaska's prior leading causes of death, including cancer (3.0 per 100,000 population), heart disease (2.8 per 100,000 population), and unintentional injuries (1.7 per 100,000 population). The median age at death for COVID-19 during this period was 75 years (range: 27–99 years), with 80% (n=575) of deaths occurring in persons who were unvaccinated against COVID-19 at the time of their death.

Vaccination with a COVID-19 primary vaccine series offered significant protection against COVID-19 mortality during the Delta variant era. COVID-19 mortality rates among unvaccinated persons (275.1 [95% CI: 252.8–299.4] deaths per 100,000 population) were 7.8 times the rate among persons who had completed a COVID-19 primary vaccine series (35.3 [95% CI: 29.7–41.9] per 100,000 population) (Table 8). This finding aligns with a separate study conducted in Alaska, which similarly showed that unvaccinated people were significantly more likely to die from COVID-19 than those who were fully vaccinated during the Delta era.[29]

While older age groups continued to bear the highest burden of both mortality and hospitalizations, the Delta variant's influence on younger demographics in Alaska was also pronounced relative to that observed in the other eras (Table 3a, Table 3b). For example, persons aged 45–54 years experienced a COVID-19 mortality rate during the Delta variant era that was more than double the combined rate of all other pandemic eras (101.4 per 100,000 population versus 50.6 per 100,000 population, respectively). Among persons aged 45–54 years who died from COVID-19 during the Delta variant period, 92% (n=79/86) were unvaccinated.

A total of 2,021 Alaskans required hospitalization due to COVID-19 during the Delta era (median age: 61 years; range: 0–99 years). Alaska's COVID-19 hospitalization rates reached their peak for all age groups during the Delta era. There was also an increase in hospitalization rates among younger age groups compared to previous eras. For example, persons aged 25–44 years experienced a hospitalization rate of 140.0 per 100,000 population, marking a six-fold relative increase compared to the preceding era (22.3 per 100,000 population; Table 3b).

During the Delta variant period, there were significant racial disparities in COVID-19 mortality and hospitalization rates in Alaska. For example, age-adjusted rates of COVID-19 hospitalization and death were 471.7 (95% CI: 426.5–521.4) and 194.7 (95% CI: 163.1–231.6) per 100,000 population among AI/AN persons in Alaska, compared to 212.0 (95% CI: 199.4–225.2) and 84.3 (95% CI: 76.0–93.3) per 100,000 population among White persons, respectively. Similarly, COVID-19 hospitalization and death rates among Asian/PI persons in Alaska were notably higher compared to rates among White persons. Specifically, hospitalization rates were 289.0 [95% CI 246.6–337.9] per 100,000 population for Asian/PI persons compared to 212.0 per 100,000 population for White persons (95% CI: 199.4–225.2), while mortality rates stood at 151.4 per 100,000 population [95% CI: 118.4–131.7] for Asian/PI persons versus 84.3 per 100,000 population [95% CI: 76.0–93.3] for White persons. Additionally, during the Delta variant era, hospitalization rates were significantly higher among residents of rural areas in Alaska compared to urban areas (316.8 per 100,000 population [95% CI: 297.05–337.72] versus 220.65 per 100,000 population [95% CI: 206.14–236.1], respectively; Figure 5).

During the Delta era, Alaska's supply of monoclonal antibodies—specifically bamlanivimab and etesevimab, and casirivimab and imdevimab (Regeneron)—was strained. Demand peaked at 1,000 doses delivered in a single week in October 2021. Administering such high volumes presented logistical challenges, as these treatments required administration in specialized infusion centers, with an infusion followed by a one-hour observation period. The broad eligibility for adults and pediatric patients (aged 12 years and over) with a positive SARS-CoV-2 result and high risk of severe illness also further stretched the availability of these treatments.

In October 2021, the FDA authorized the Pfizer-BioNTech COVID-19 vaccine for children aged 5–11 years under the EUA. During the Delta variant era, 20% of people received their COVID-19 primary vaccine series (Table 4a). However, by the end of December 2021, 46% of Alaskans remained unvaccinated. Vaccine uptake was lowest in the Mat-Su and Gulf Coast regions, where only 36% and 42% of residents, respectively, had completed their primary series by the end of the Delta era. In contrast, the Southwest and Southeast regions had the highest uptake, with 64% and 67% of their populations having completed their primary series (Figure 6).

It was also during the Delta era, in September 2021, the FDA amended the EUA to allow a single booster dose of the Pfizer-BioNTech COVID-19 vaccine to be administered at least 6 months after completion of the vaccine's primary series in certain populations.[30] In October 2021, this authorization was expanded to cover the Moderna and Janssen COVID-19 vaccines, while also allowing heterologous mixing and matching of booster doses relative to the completed primary series. By November, booster eligibility was expanded to cover all adults aged 18 years and older to receive a booster dose of COVID-19 vaccines.

During Alaska's Delta variant era, 143,539 persons received a COVID-19 booster; 60% of all those who received a booster throughout the pandemic did so during the Delta Era (Table 4b). Regional patterns in COVID-19 booster dose uptake closely reflected those of primary vaccine series uptake, with the highest uptake being observed in the Southeast region, Anchorage, and Southwest region; 29%, 21%, and 20% of their respective populations received a COVID-19 booster dose during this time. The lowest booster dose uptake was observed in Mat-Su, where only 11% of the population received a COVID-19 booster dose during the Delta era (Figure 7).

January–March 2022: First Omicron Era (BA.1/BA.2)

The Omicron variant (BA.1) of SARS-CoV-2 was first detected globally in November 2021. By late December 2021, it had replaced the Delta variant as the dominant SARS-CoV-2 variant in Alaska, reflecting a global trend. Characterized by its enhanced transmissibility,[31] ability to evade immunity, and associated high reinfection rates,[32,33] the Omicron variant raised considerable public health concerns regarding its impact on the pandemic's trajectory. The high case volume, despite many being mild, risked overwhelming hospitals due to the increase in total cases requiring hospitalization.

During the first Omicron era, bebtelovimab became the final monoclonal antibody authorized for COVID-19 treatment, though it remained scarce in Alaska following its EUA approval. However, in January 2022, the oral antivirals Paxlovid (nirmatrelvir/ritonavir) and molnupiravir (Lagevrio) became available in Alaska under FDA EUAs as more accessible treatment options for high-risk patients. Paxlovid initially arrived in very limited supply, with only six locations in Alaska receiving allocations, and its scarcity persisted for several months, easing only after the first Omicron wave subsided. Molnupiravir was also introduced in January 2022 but was distributed to just three locations, with demand significantly lower than for Paxlovid.

By this fifth era, most of the COVID-19 testing had shifted to widespread use of over-the-counter antigen tests. In January 2022, the White House launched COVIDTests.gov, a program that allowed all U.S. households to order free at-home test kits from the federal government, distributed by the U.S. Postal Service.[34] Additionally, the federal government announced a requirement for insurance companies and group health plans to cover the cost of over the counter, at-home COVID-19 tests, enabling people with private health coverage to obtain them for free.[35]

In January 2022, the Alaska Section of Epidemiology began including influenza data along with COVID-19 data in a public weekly report. This provided a more comprehensive overview of epidemiologic trends for both pathogens circulating in Alaska. By March 2022, due to widespread vaccine availability, advancements in therapeutics, a better understanding of SARS-CoV-2, the prevalence of the Omicron variant, and updated federal guidance, DPH also ended universal COVID-19 case investigation and contact tracing. Instead, it adopted a strategic approach focusing on outbreak investigation and mitigation in congregate settings.

As expected, due to the Omicron variant's ability to spread more easily and infect vaccinated and previously infected persons, reported COVID-19 cases increased by 90% compared to the preceding era, reaching an average weekly case rate of 827.5 per 100,000 population. Notably, in January 2022, Alaska recorded its highest number of monthly COVID-19 cases during the entire pandemic, with 60,036 cases. However, despite this surge in cases, there was a relative decrease in COVID-19 hospitalizations and mortality compared to the Delta era. While still high relative to pre-Delta eras, average weekly hospitalizations dropped by 60% to 4.1 per 100,000, and deaths decreased by 33% to 2.4 per 100,000 population (Table 2).

Despite the decline in COVID-19 hospitalizations, hospital capacity in Alaska remained limited at times throughout the first Omicron era, particularly in January 2022. Staff sick calls, supply chain disruptions, and a high number of ill patients continued to create capacity challenges for hospitals. Furthermore, despite the declining rates of COVID-19 hospitalizations compared to the Delta era, significant racial disparities in hospitalization rates persisted; AI/AN persons had a COVID-19 hospitalization rate 2.5 times that of White persons in Alaska (144.7 [95% CI: 119.4–174.9] versus 57.7 [95% CI: 38.7–84.0] per 100,000, respectively; Figure 3).

During this era, the number of persons completing a COVID-19 primary vaccine series declined, with only 8% (n=38,696) of persons completing their primary series. By the end of this era, primary vaccine series coverage ranged from 40% in the Mat-Su Region to 71% in the Southeast Region. Twenty percent (n=47,157) of persons who opted to receive a COVID-19 booster did so during the first Omicron era. In January 2022, children aged 12–15 years became eligible to receive a Pfizer COVID-19 vaccine booster dose, and a third vaccine dose was authorized for immunocompromised children aged 5–11 years.

Nationally, during the Omicron wave, the incidence of reported COVID-19 cases in vaccinated persons became similar to the incidence in unvaccinated persons.[36] This trend might have reflected multiple factors, such as waning vaccine-induced immunity, possible differential COVID-19 testing among vaccinated vs. unvaccinated persons who were symptomatic, and higher rates of infection-induced immunity among unvaccinated persons. However, COVID-19 vaccination was still shown to reduce the likelihood of severe COVID-19 illness in those people who experienced a vaccine breakthrough infection. During the 4-week period in the first Omicron era (January 30, 2022 through February 26, 2022), unvaccinated persons were 3.4 times as likely to be hospitalized due to COVID-19 than those who had completed the COVID-19 primary vaccine series.[37] Furthermore, the rate of COVID-19 mortality among unvaccinated persons in Alaska was 5.0 times that of vaccinated persons during the first Omicron era (70.3 [95% CI: 58.5–84.1] versus 14.2 [95% CI: 10.6–18.4] per 100,000 population, respectively; Table 8). This is consistent with national research which found that persons who had completed at least the COVID-19 primary vaccine series were less likely to be hospitalized or die than people with similar risk factors who are not vaccinated.[38,39]

April–October 2022: Second Omicron Era (BA.2/BA.5/BA.2.12.1)

In April 2022, a shift in the circulating SARS-CoV-2 Omicron subvariant was observed in Alaska, with the BA.2 subvariant replacing the previously dominant BA.1 subvariant as the dominant sublineage. Despite the rapid observed increase in BA.2 prevalence, its impact on overall COVID-19 cases was relatively small due in part to its timing as it occurred amidst a sharp decline in BA.1 cases and the emergence of sublineages BA.2.1.12.1 and BA.5. These latter sublineages swiftly became the prevalent Omicron strains circulating in Alaska by June 2022 and represented the majority of COVID-19 cases during the second omicron era.

During this era, many COVID-19 testing sites closed and healthcare facilities returned to more normal referral capacities for higher-level and specialty care. The state public health emergency declaration ended July 1, 2022. In June 2022, Alaska's state contract for monoclonal antibody treatments ended, leaving EUA-authorized monoclonal antibody treatments available only through the commercial market, though their effectiveness had diminished due to evolving SARS-CoV-2 variants. In July 2022, however, the FDA authorized state-licensed pharmacists to prescribe Paxlovid to eligible patients, further expanding COVID-19 treatment accessibility in Alaska, particularly in more remote communities and offering a treatment option less susceptible to viral resistance compared to monoclonal antibodies.

In April 2022, the Alaska Section of Epidemiology updated its COVID-19 reporting requirements to align with federal COVID-19 reporting requirements and streamlined data collection.[40] The revised guidelines no longer required reporting of certain test results, including serologic (antibody) and negative antigen results. By August 2022, this was further expanded to exclude any negative COVID-19 test results that were not submitted electronically. This change was implemented to streamline the data collection process and focus on more critical epidemiologic data for managing the pandemic response.

During this era, weekly average cases (193 per 100,000 population), hospitalizations (2.0 per 100,000 population), and deaths (0.7 per 100,000 population) were much lower than during the first Omicron (BA.1/BA.2) era (Table 2). Despite the overall decline in COVID-19 hospitalization rates, the rate for AI/AN persons was 129.3 (95% CI: 105.2–158.1) per 100,000 population, compared to 63.3 (95% CI: 56.0–71.4) per 100,000 population for White persons (Figure 3).

Negligible increases were observed in the uptake of the COVID-19 primary vaccine series during the second Omicron era (Table 4a). However, the uptake of COVID-19 booster doses continued, with 16% (n=36,856) of all booster doses having been administered during this era (Table 4b). In May 2022, boosters were approved for persons aged 5–11 years; in June 2022, Moderna and Pfizer-BioNTech vaccines were authorized for children aged 6 months and up. In September 2022, HHS issued a directive for bivalent boosters for persons aged 12 years and older, followed by a directive in October 2022 for those aged 5 years and older.

November 2022–May 2023: End of Federal Public Health Emergency Era

In late October 2022, the Omicron subvariant BA.5 represented a smaller proportion of sequences in Alaska and, starting in November, was gradually replaced by the subvariants BQ.1.1 and XBB.1.5 as the predominant circulating sublineages. During this era, average weekly rates of COVID-19 declined to 59.8, 1.5, and 0.3 cases, hospitalizations, and deaths per 100,000 population, respectively (Table 2). However, hospitalization rates were still highest among AI/AN persons (84.9 per 100,000 population [95% CI: 66.2–108.4]; Figure 3).

Minimal increases were observed in the primary vaccine series during this era with 1% (n=4,880) and 4% (n=9,982) of primary COVID-19 vaccine series and booster doses being administered during this era (Table 4a, Table 4b). By the end of this final pandemic era, 477,376 Alaska residents had received the COVID-19 primary vaccine series and 237,534 received at least one booster dose. Approximately 65% of Alaska residents were vaccinated with a primary dose and 32% with at least one COVID-19 booster. Rates of uptake were heterogenous by region, however, ranging from 74% in the Southeast region to 42% in Mat-Su region. This was more evident for boosters where only 19% of Mat-Su residents had received a COVID-19 booster dose, compared to 43.9% of Southeast region residents and 31% of Anchorage residents (Figure 7).

In 2023, important shifts in public health strategies, vaccination efforts, pandemic response measures and increased levels of infection-induced immunity reshaped the landscape of the COVID-19 pandemic, both nationally and in Alaska. By February 2023, numerous COVID-19 activities had merged back into routine programmatic operations within DPH. For example, most of the COVID-19 vaccine-related efforts became fully integrated into the broader activities of the Section of Epidemiology's Immunization Program. For COVID-19 case reporting, all facilities or organizations administering or interpreting COVID-19 tests were required to report only positive cases to the Section of Epidemiology, preferably through electronic means, aligning with protocols for other reportable infectious diseases. Commercial laboratories also scaled back COVID-19 testing efforts as OTC testing had emerged as the predominant and more accessible testing method.

By November 2022, the FDA revoked the emergency use authorization (EUA) for bebtelovimab, the last monoclonal antibody approved for COVID-19 treatment, due to its ineffectiveness against the circulating Omicron subvariants BQ.1 and BQ.1.1. However, at this point, since state-licensed pharmacists could prescribe Paxlovid in Alaska, as an oral antiviral it provided a more accessible and affordable COVID-19 treatment for patients at risk of severe COVID-19 illness.

The Section of Epidemiology's Infectious Disease program also began to initiate steps towards further integrating COVID-19 surveillance with other seasonal respiratory viral pathogen monitoring (i.e., influenza and respiratory syncytial virus [RSV]), enabling a more comprehensive understanding of circulating respiratory viruses. This is an approach that has also since been adopted by the CDC and World Health Organization (WHO) in response efforts for respiratory virus activity.[41,42] In addition, outbreak response efforts for COVID-19 were reintegrated into routine infectious disease outbreak response efforts within DPH.

Due to the widespread availability of safe and effective COVID-19 vaccines, accessible treatments that reduce disease severity, and a notable decline in COVID-19-related deaths and hospitalizations nationwide, the Federal Government scheduled the conclusion of the Federal PHE for May 11, 2023. While this did not signal the end of COVID-19 activity in the U.S., it did result in the health care sector transitioning back to the pre-pandemic state, with most COVID-19-related health care services accessible through pre-existing and traditional modes of care.[43]

After the conclusion of the Federal PHE, DPH maintained efforts to mitigate the impact of COVID-19 on Alaskans. These efforts included ensuring that COVID-19 vaccines remained cost-free for most people through programs such as the Vaccines for Children Program, the Alaska Vaccine Assessment Program, Medicare, and Medicaid. Additionally, the Section of Epidemiology's Respiratory Virus Snapshot continued to provide weekly updates on reported COVID-19 cases in Alaska.[44] This ongoing surveillance facilitated tracking emerging variants, monitoring trends, and detecting outbreaks. Finally, DPH has also continued to reflect on the lessons learned throughout the pandemic.[45]

4.0 Discussion

This report represents an overview of Alaska's public health response and the epidemiology of the COVID-19 pandemic across seven distinct eras. Each era presented unique challenges that demanded rapid, scalable, and often adaptive public health responses.

During the first pandemic onset era (March–May 2020), NPIs were successfully implemented to decrease community transmission throughout much of Alaska. However, by the second era (June 2020 through January 2021), community transmission had risen considerably, state testing and contact tracing efforts expanded, and notable disparities began to emerge among certain population groups in rates of COVID-19 hospitalizations and mortality. By the third era (February–June 2021), the rollout of COVID-19 primary vaccine series coincided with a decline in cases, hospitalizations, and mortality. However, following this, the emergence of the Delta variant ushered in the most severe era of the COVID-19 pandemic in Alaska. With a rapid surge in cases, hospitalizations, and deaths, the Delta variant era accounted for 84% of all COVID-19 deaths in Alaska in 2021. Mortality rates across all ages, including among younger age groups, more than doubled compared to previous eras. During the Delta era, COVID-19 became the leading cause of death in Alaska. Alaska was not alone in being severely affected by the Delta variant; however, Alaska's mortality rates were higher than the national U.S. average for the same period. Racial disparities also persisted during the Delta variant era, with significantly higher mortality and hospitalization rates among AI/AN and Asian/PI persons. Despite vaccination efforts, a large proportion (44%) of Alaska's population also remained unvaccinated by the end of the Delta variant era. Furthermore, high demand, limited supply, and logistical challenges in administering monoclonal antibody treatments resulted in significant shortages of monoclonal antibody therapies during the Delta era.

The public health response underwent several strategic shifts as resources increased, scientific understanding of SARS-CoV-2 improved, and emerging variants with higher transmissibility required new approaches. In March 2020, severe national shortages of testing supplies led to innovative local solutions in Alaska. Small businesses 3D-printed plastic nasopharyngeal swabs compatible with viral PCR testing, and the Alaska State Virology Laboratory produced its own viral transport medium. As state and commercial laboratory capacity expanded, thousands of tests could be performed daily. The introduction and widespread adoption of antigen testing—initially in healthcare settings and later for home use—further improved access and reduced turnaround times, enabling Alaskans to make timely and informed decisions about their health and precautions around others. Contact tracing, which initially required intensive efforts by state staff, was later supported through partnerships with the University of Alaska Anchorage and other organizations. By March 2022, following updated federal guidance and broad immunization coverage, the focus shifted from individual contact tracing to mitigation efforts in congregate settings and outbreak response. These strategic shifts, along with evolving epidemiologic and virologic knowledge, were communicated to clinicians, public health partners, and the public through regular community meetings, press briefings, video conferences, website updates, and other outreach methods throughout the pandemic.

This report focuses on deaths directly attributed to COVID-19 and does not include estimates of excess deaths. Excess deaths refer to fatalities from all causes that exceed the expected number of deaths for a given time and place. These figures offer a more comprehensive understanding of the pandemic's impact on mortality, capturing both direct and indirect effects. Previous reports have highlighted higher-than-expected mortality rates in Alaska during the pandemic from causes other than COVID-19, including heart disease, unintentional injuries, and drug overdoses.[46] These excess deaths reflect the broader consequences of the pandemic on the public's health. Further research is necessary to fully understand the factors driving excess mortality and the broader public health impact of the pandemic in Alaska.

The COVID-19 pandemic exacerbated inequalities across the globe. This report highlights the noteworthy inequalities within Alaska, where racial disparities in COVID-19 mortality and hospitalization emerged as a significant finding. Throughout all eras of the pandemic, AI/AN and Asian/PI persons experienced disproportionately high rates of COVID-19 hospitalization and mortality. Even as rates declined, AI/AN people continued to be disproportionately affected. For example, during the final era of the pandemic in Alaska, COVID-19 hospitalization rates among AI/AN persons remained more than double that of those among White persons. This mirrors national trends where AI/AN persons were more likely to die from COVID-19 than any other racial group.[47,48] The underlying causes of these observed disparities are likely multifaceted. Further research is needed to better understand the roles that social and structural inequalities played in the disparities in health outcomes that occurred during the pandemic.

This report highlighted Alaska's success in the rapid rollout of COVID-19 vaccinations. During the third era (February–June 2021), approximately 289,287 persons completed a COVID-19 primary vaccine series. This equated to an average of approximately 1,900 people becoming fully vaccinated per day during this era of the pandemic. Based on the significant difference in age-adjusted mortality rates between vaccinated and unvaccinated persons, high vaccine uptake during this era likely saved numerous lives in Alaska. The success of the COVID-19 vaccination effort in Alaska was supported by pre-existing state infrastructure for vaccine ordering, distribution, and administration; strong partnerships with Tribal organizations to promote and deliver vaccines; collaborations with industry that enabled vaccination of workers regardless of state residency; and free public vaccination clinics located in accessible settings such as airports and drive-through sites.

Despite the initial success in COVID-19 vaccine uptake, by the middle of the Delta era in September 2021, uptake of the COVID-19 primary vaccine series slowed, with approximately 53% of Alaskans remaining unvaccinated against severe COVID-19. The reasons for this slowdown in uptake are likely complex, involving a range of factors that drive vaccine hesitancy across the country. These factors, which likely evolved throughout the different eras of the pandemic, include perceived risk of infection,[49] social norms, government mistrust,[50] perceived risk of side effects,[51] and sociopolitical factors.[52] Constant changes in sources of mis/disinformation also likely played a role.[53] In Alaska, there was considerable variation in vaccine uptake by public health region.

Fourteen percent (n=64,944) of persons who received a COVID-19 primary vaccine series in Alaska completed their vaccine series more than 10 months after vaccine rollout began in the general population. Several factors might explain this observed delay: first, children aged <5 years were not eligible for vaccination under the Emergency Use Authorization (EUA) until June 2022, likely accounting for a substantial portion of these late vaccinations. Second, people who moved to Alaska during the pandemic and were not previously recorded in VacTrAK might have been incorrectly classified as receiving a primary dose when they were receiving a COVID-19 booster. Third, employment-based vaccine requirements, such as those for federal employees and the Department of Defense, which remained in place until 2023, might have led to vaccination among people who might not otherwise have chosen to be vaccinated. Similarly, travel-related vaccination requirements could have contributed to increased vaccination rates among those who might not have otherwise received the vaccine. Lastly, some people might have chosen to receive their COVID-19 primary vaccine series later in the pandemic.

This report found that for every era of the pandemic during which COVID-19 vaccination was widely available in Alaska, unvaccinated people were more likely to die than those who had completed their primary dose series. However, during the later pandemic eras, we observed a reduction in mortality rate ratios between unvaccinated and vaccinated people. This pattern likely reflects multiple factors including the emergence of variants that are less well-matched to the original vaccine strain, waning vaccine-induced immunity over time, and the build-up of infection-induced immunity in the unvaccinated population. While these estimates are adjusted for age, they are not adjusted for other factors that affect risk of infection or death, nor are they adjusted for receipt of subsequent doses beyond the primary series.

This report is subject to several limitations. First, when calculating mortality rates among vaccinated and unvaccinated persons in Alaska, it's possible that Alaska residents might have received their COVID-19 vaccination outside of Alaska, meaning that they would not be included in state vaccine data, potentially leading to an underestimate in the vaccinated population. Second, although our vaccination data were for Alaska residents only, counts of vaccinated persons might have occasionally included non-residents of the state (e.g., seasonal workers listing Alaska as a temporary residence in vaccination registries). Both sources of misclassification have the potential to distort the calculated mortality rate ratios. However, given the substantial significant difference in age-adjusted mortality rates between the vaccinated and unvaccinated, this bias is unlikely to alter the overall conclusion that vaccination significantly reduced risk of mortality. Our findings are also consistent with extensive evidence from both national data and additional analyses conducted within Alaska.[29,54,55]

Additionally, certain racial groups are more prone to misclassification in surveillance and administrative data systems, which could result in underreporting of the racial disparities in this report. For hospitalization data, the methods used to collect race and ethnicity information can vary by facility, and these data might not always be self-reported by patients. For mortality data, the race of the decedent is recorded based on information provided on the death certificate, typically by the informant (usually a family member or close associate of the decedent).

The Federal Public Health Emergency for COVID-19 officially ended on May 11, 2023, signaling a shift towards more routine public health operations. While COVID-19 transmission and severity are no longer at the peak levels seen earlier in the pandemic, and effective vaccines and treatments are widely available, the virus remains an important cause of morbidity and mortality globally. Staying up to date on COVID-19 vaccines and taking precautions to prevent the spread of respiratory viruses when ill remain central strategies to limit the spread of COVID-19 and prevent outbreaks in congregate settings.

5.0 Future Pandemic Preparedness in Alaska

The COVID-19 pandemic exposed gaps both nationally and in Alaska between pre-pandemic preparedness efforts and the observed needs of public health practitioners, clinicians, and other stakeholders when confronted with a novel, rapidly evolving pandemic. Addressing these gaps requires a sustained investment in a robust public health workforce. This workforce can help develop more efficient and effective data systems. This includes enhancing data linkage capabilities to integrate crucial elements such as genomic and hospitalization data. The pandemic also revealed how labor-intensive large-scale case-based surveillance can be. To mitigate this, there is an important need for better automation of data processes. Additionally, more research is needed on the optimal design of surveillance systems, specifically, what data should be collected and how it should be analyzed to transform raw data into actionable, timely, pathogen-specific insights that can inform public health responses during future pandemics.

NPIs are one of many effective tools available to respond to pathogens such as COVID-19 when vaccines and therapeutics are not yet available. Early implementation of NPIs, both nationally and in Alaska, during the early stages of the pandemic was found to contribute to a reduction in SARS-CoV-2 transmission.[56-59] However, certain NPIs can also be economically costly and lead to significant social disruption, with wider impacts on health and wellbeing. The effectiveness and optimal design of specific NPIs used during COVID-19 in Alaska, such as travel restrictions (both interstate and intrastate), remain uncertain. There is a need for continued research and scenario planning to develop evidence-based strategies tailored to Alaska's unique context, including its geographic isolation and seasonal population changes. Early access to resources such as testing capabilities, efficient data systems to return test results quickly, and mechanisms to deliver actionable data to local and tribal leaders is also important. These resources support the development of tailored NPI decisions that reflect the specific risks and needs of each region. There is no universal NPI strategy for public health emergencies; NPI effectiveness varies with each pathogen. What worked for COVID-19 might not be suitable for future pandemics. Therefore, NPIs must be customized to the characteristics of each disease and aligned with specific policy goals, whether the focus is on suppression or mitigation.

The pandemic also exposed critical gaps in Alaska's disease tracking (surveillance) infrastructure. Delays in laboratory reporting, manual data entry, and inconsistent reporting of certain data elements (e.g., race and ethnicity) limited the precision of real-time analyses. Additionally, limited genomic sequencing capacity in the early phases of the pandemic hindered rapid detection of emerging variants. Ongoing investments in modernized, interoperable public health data systems are essential for effective future response.

Integrated community engagement and culturally responsive communication were critical to reaching diverse populations and maintaining public trust during the pandemic. Trusted messengers, including Tribal Elders, faith leaders, community health aides, and local clinicians, helped disseminate accurate information through tailored messaging and community-based clinics. However, evolving guidance, fluctuating risk perceptions, growing fatigue with public health interventions, and the circulation of both official public health recommendations and alternative viewpoints from online and other non-traditional sources contributed to communication fatigue and declining adherence to mitigation measures over time. This underscores the need for communication approaches that reinforce clarity and trust across the duration of prolonged public health emergencies.

Asymptomatic infectious periods are common for nearly all infectious pathogens and the infectivity of people without symptoms has long complicated the control of communicable disease outbreaks. Routine infection-control and public health strategies rely heavily on early disease detection to contain spread and provide an understanding of disease epidemiology. However, the presence of asymptomatic transmission necessitates improved surveillance, expanded testing and screening programs, and enhanced laboratory capacity. In Alaska, the COVID-19 pandemic was the first large-scale public health response to include asymptomatic people. Routine asymptomatic testing strategies, isolation of cases and contacts, and point-of-entry health screening all aimed to reduce population-level SARS-CoV-2 transmission caused by asymptomatic spread. Looking forward, it remains uncertain whether future pandemic pathogens will exhibit similar asymptomatic transmission properties necessitating such widespread NPI use. If so, achieving high levels of adherence to NPIs might be challenging.

This report demonstrates the considerable differences in COVID-19 morbidity and mortality experienced by certain population groups in Alaska. Racial differences, notably with AI/AN and Asian/PI communities, were evident, with overrepresentation in hospitalizations and mortality rates. The ongoing collaboration between state public health and tribal health must remain a priority in future public health crises.

The pandemic placed extraordinary strain on Alaska's health care system. During multiple surges, particularly in fall 2021 and early 2022, hospitals across the state operated at or near capacity, prompting the activation of crisis standards of care. Staffing shortages, exacerbated by worker illness and burnout, led to reliance on traveling clinicians, volunteers, and support from the National Guard. These workforce challenges exposed the vulnerability of Alaska's health care infrastructure and underscored the importance of sustained investments in surge capacity and workforce resilience.

This report, as an epidemiological summary, does not address the social and contextual factors that influenced human behaviors during the COVID-19 pandemic. Future research on these aspects is essential for pandemic preparedness. During the pandemic, over 1,500 deaths were attributed to COVID-19 infection in Alaska (approximately one in every 500 Alaska residents), and 74% of those who died and were eligible for COVID-19 vaccine had opted not to receive it. This stark statistic challenges pre-pandemic assumptions that safe vaccines providing substantial protection against a deadly disease would be broadly sought after by the public and underscores the importance of building and maintaining public trust.

Finally, the COVID-19 pandemic underscores the ongoing imperative to systematically learn from public health emergencies. The findings presented in this report provide Alaska leaders with critical insights to inform continuous improvement efforts and strengthen Alaska's preparedness for future pandemics.

Tables and Figures

Figure 1. COVID-19 Monthly Case and Hospitalization Rates Among Alaska Residents by COVID-19 Era — March 2020 through May 2023

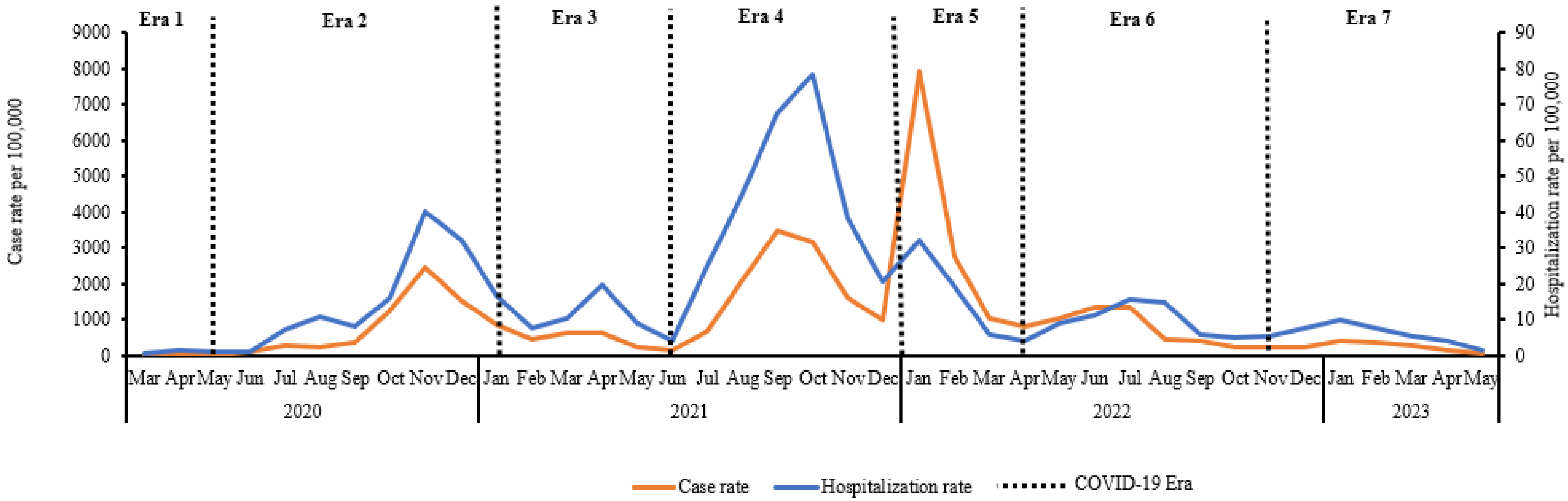


Table 1. COVID-19 Eras — Alaska, March 2020 – May 2023

Era (Date)	Description
1. Pandemic Onset Era (March–May 2020)	Period of initial COVID-19 detections in Alaska. Mandated state-wide non-pharmaceutical interventions (NPIs) and limited community transmission. COVID-19 testing still limited at this time. Remdesivir authorized for treatment of severe COVID-19 in Alaska.
2. Pre-vaccination Era (June 2020–January 2021)	Primarily pre-vaccination era. Locally implemented NPIs varied by location. Increasing community transmission with a large increase in COVID-19 cases. Substantial burden placed on Alaska healthcare facilities through the fall and winter of 2020. Increases in state COVID-19 testing and contact tracing capacity.
3. Rapid Increase in vaccination and mix of novel variants (February–June 2021)	Introduction and rollout of COVID-19 primary vaccination series and some relaxing of widespread NPIs. Significant strides in genomic sequencing efforts, resulting in increased availability of SARS-CoV-2 variant data for Alaska. Further gradual easing of locally applied NPIs around the state. Rapid point-of-care antigen tests emerged as the new high-volume testing method in Alaska.
4. Delta Variant Era (July–December 2021)	Delta variant (B.1.617.2) predominant circulating SARS-CoV-2 variant in Alaska. Single booster of the Pfizer BioNTech, Moderna and Janssen vaccines authorized by FDA under Emergency Use Authorization.
5. First Omicron (BA.1) Era (January–March 2022)	Omicron variant (BA.1) becomes predominant circulating SARS-CoV-2 variant. Nirmatrelvir/ritonavir (Paxlovid) and molnupiravir (Lagevrio), became available in Alaska for the treatment of COVID-19 in people at high-risk of developing severe disease. Widespread use of over-the-counter COVID-19 testing. SOA ended universal COVID-19 case investigation and contact tracing. CDC recommends additional booster doses for certain people.
6. Second Omicron (BA.2/BA.5) Era (April–October 2022)	Emergence of Omicron sublineages BA.2 and BA.5 in Alaska. Many testing sites closed. Authorization of state-licensed pharmacists to prescribe the COVID-19 antiviral nirmatrelvir/ritonavir (Paxlovid) increasing treatment access. COVID-19 reporting no longer required for serologic, negative antigen, and non-electronic negative test results. Bivalent COVID-19 booster recommendation issued by HHS.
7. End of Public Health Emergency Era (November 2022–May 2023)	Widespread availability of COVID-19 vaccination and treatment. Planned conclusion of Federal Public Health Emergency. Scaling back of COVID-19 testing by commercial laboratories. Planned integration of COVID-19 surveillance with other seasonal respiratory viral pathogens by Alaska Section of Epidemiology, the CDC, and the WHO.

Table 2. Counts and Crude COVID-19 Case, Hospitalization, and Mortality Rates among Alaska Residents by COVID-19 Era — March 2020 – May 2023

Era	Dates	Hospitalization Count	Death Count	Case Rate	Hospitalization Rate	Mortality Rate	Weekly Mean Case Rate	Weekly Mean Hospitalization Rate	Weekly Mean Mortality Rate	Weekly Mean Test Positivity
1.	Mar–May 2020	22	12	68.3	3.00	1.63	5.3	0.3	0.2	1.4%
2.	Jun 2020–Jan 2021	968	291	7188.1	131.99	34.64	199.7	3.8	1.1	4.0%
3.	Feb–Jun 2021	373	98	2090.1	50.86	13.31	94.9	2.3	0.6	1.9%
4.	Jul–Dec 2021	2021	719	11,782.1	275.57	97.68	436.4	10.2	3.6	7.0%
5.	Jan–Mar 2022	419	162	11,584.7	57.13	22.00	827.5	4.1	2.4	–*
6.	Apr–Oct 2022	480	167	6175.8	65.44	22.68	193.0	2.0	0.7	–*
7.	Nov 2022–May 2023	302	55	1675.2	41.18	7.47	59.8	1.5	0.3	–*

Rates calculated per 100,000 population.

** Negative COVID-19 test results no longer required to be reported to the State of Alaska meaning test positivity no longer calculated.*

Table 3a. COVID-19 Mortality Rates among Alaska Residents by Age Group (years) and COVID-19 Era — March 2020 – May 2023

Era	Dates	<25	25-44	45-54	55-64	65-74	75-84	85+
1.	Mar–May 2020	-	0.8	1.2	1.1	6.1	8.5	30.7
2.	Jun 2020–Jan 2021	-	5.4	14.2	37.7	112.0	353.7	1119.8
3.	Feb–Jun 2021	-	3.9	8.3	12.6	47.6	184.1	184.1
4.	Jul–Dec 2021	-	27.7	101.4	150.7	288.4	613.6	1288.5
5.	Jan–Mar 2022	-	3.5	15.3	34.5	95.1	191.7	398.8
6.	Apr–Oct 2022	3.0	2.7	8.3	11.5	53.7	140.6	582.9
7.	Nov 2022–May 2023	-	-	-	5.2	15.3	85.2	230.1

Rates with < 5 counts not shown.
Rates calculated per 100,000 population

Table 3b. COVID-19 Hospitalization Rates among Alaska Residents by Age Group (years) and COVID-19 Era — March 2020 – May 2023

Era	Dates	<25	25-44	45-54	55-64	65-74	75-84	85+
1.	Mar–May 2020	0	0	0	0	13.8	12.8	0
2.	Jun 2020–Jan 2021	13.6	41.9	112.0	217.0	376.0	810.0	1457.0
3.	Feb–Jun 2021	6.1	22.3	88.4	94.2	129.0	170.0	215.0
4.	Jul–Dec 2021	32.8	140.0	314.0	504.0	725.0	1125.0	1626.0
5.	Jan–Mar 2022	22.7	15.0	42.4	70.1	153.0	388.0	629.0
6.	Apr–Oct 2022	22.7	11.2	41.3	64.9	153.0	541.0	1258.0
7.	Nov 2022–May 2023	19.2	6.2	20.0	38.7	120.0	332.0	583.0

Rates with < 5 counts not shown.
Rates calculated per 100,000 population

Table 4a. People Receiving COVID-19 Primary Series* overall and among <65 and 65+ years of age by COVID-19 Era — Alaska, March 2020 – May 2023

Era	Dates	Total (%)	65+ years	<65 years
1.	Mar–May 2020	-	-	-
2.	Jun 2020–Jan 2021	25,467 (5%)	7,010	18,457
3.	Feb–Jun 2021	289,287 (61%)	62,995	226,292
4.	Jul–Dec 2021	97,678 (20%)	7,155	90,523
5.	Jan–Mar 2022	38,696 (8%)	1,222	37,474
6.	Apr–Oct 2022	21,368 (5%)	2,827	18,541
7.	Nov 2022–May 2023	4,880 (1%)	746	4,132
	Total	477,376	81,955	395,421

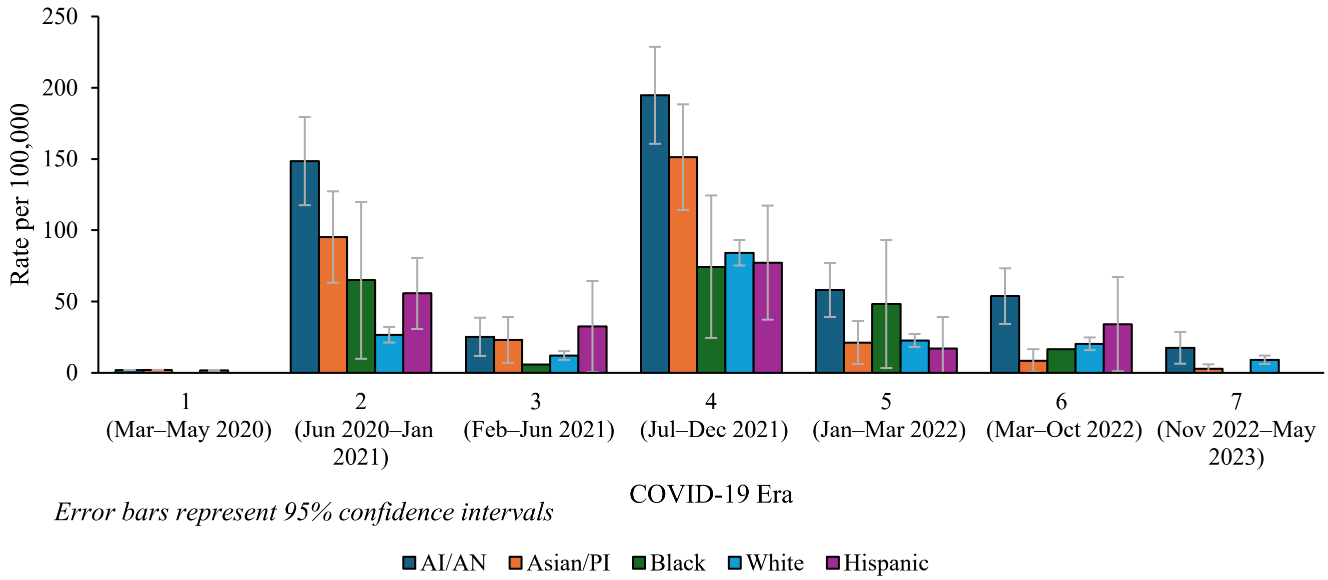
**Primary COVID-19 vaccine series completion defined as receipt of 2 vaccine doses for persons who received Pfizer-BioNTech, Moderna, or unspecified U.S.-authorized or approved mRNA COVID-19 vaccine, or receipt of 1 dose for persons who received Janssen. Primary series vaccine product is defined by the vaccine administered as the first dose for 1-dose series and the second dose for 2-dose series.*

Table 4b. People Receiving COVID-19 Booster Dose* overall and among <65 and 65+ years of age by COVID-19 Era — Alaska, March 2020 – May 2023

Era	Dates	Total (%)	65+ years	<65 years
1.	Mar–May 2020	-	-	-
2.	Jun 2020–Jan 2021	-	-	-
3.	Feb–Jun 2021	-	-	-
4.	Jul–Dec 2021	143,539 (60%)	49,478	94,061
5.	Jan–Mar 2022	47,157 (20%)	6,940	40,217
6.	Apr–Oct 2022	36,856 (16%)	6,488	30,368
7.	Nov 2022–May 2023	9,982 (4%)	1,482	8,500
	Total	237,534	64,388	173,146

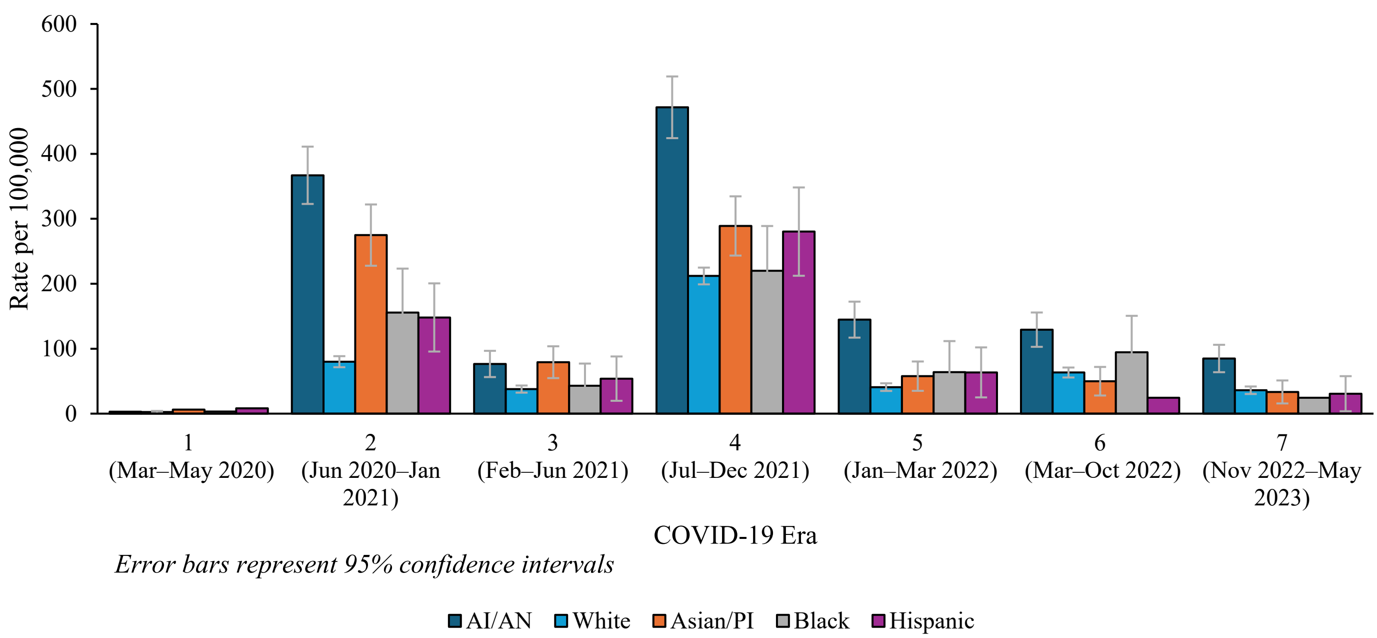
**People who completed a primary series and have received at least one booster (or additional) dose.*

Figure 2. Age-Adjusted COVID-19 Mortality Rates among Alaska Residents by Race and COVID-19 Pandemic Era — March 2020 – May 2023



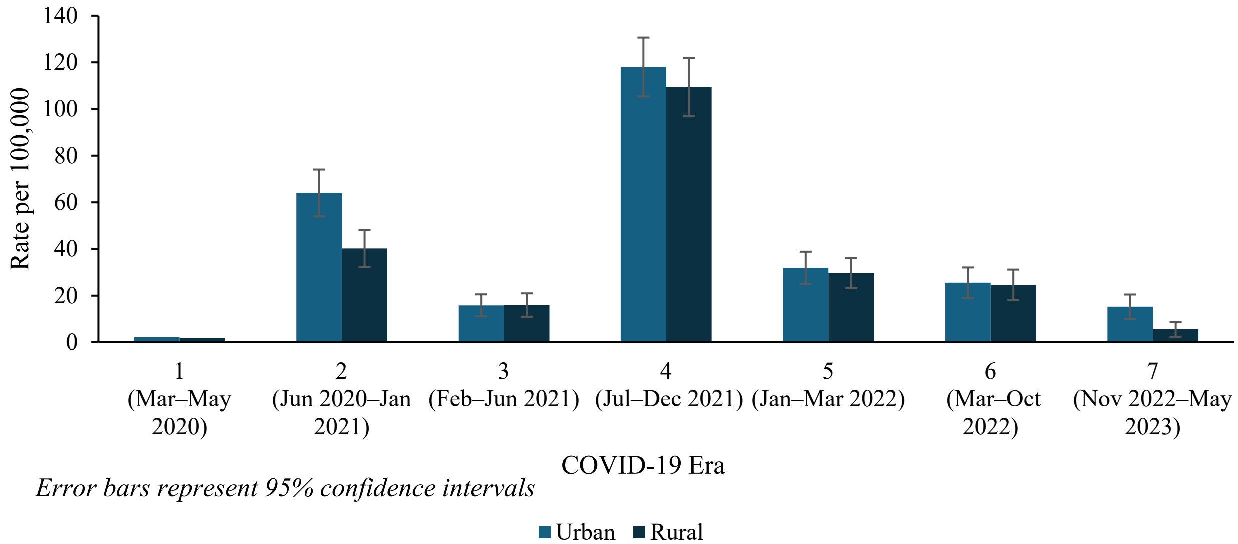
Error bars represent 95% confidence intervals

Figure 3. Age-Adjusted COVID-19 Hospitalization Rates among Alaska Residents by Race and COVID-19 Wave — March 2020 – May 2023



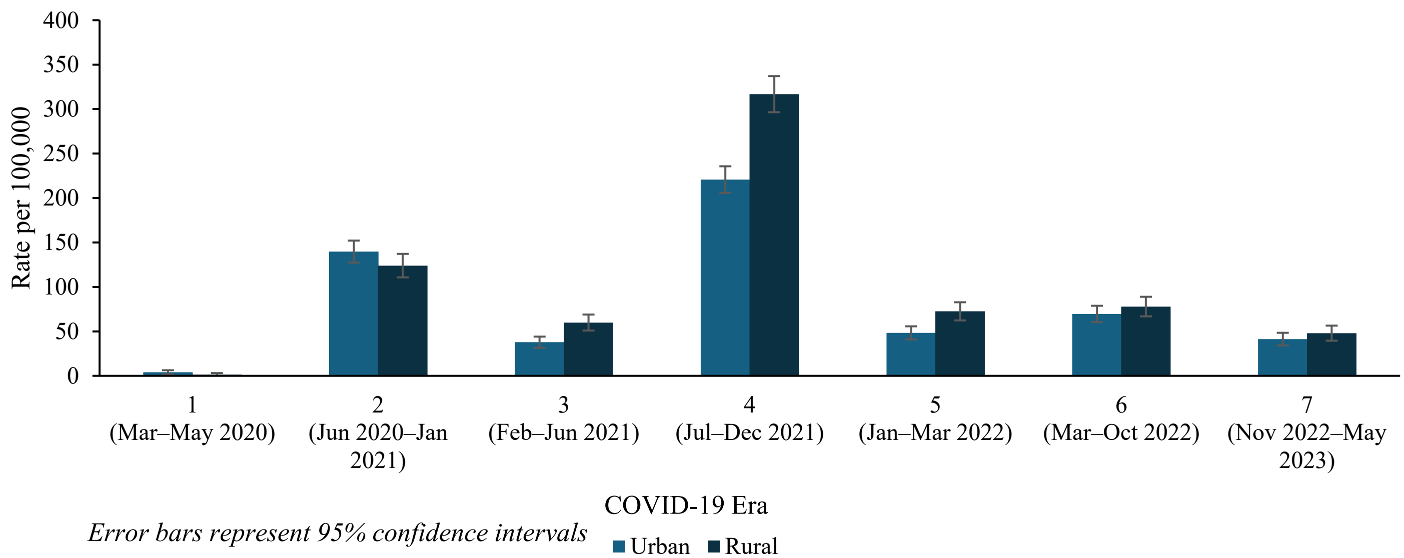
Error bars represent 95% confidence intervals

Figure 4. Age-Adjusted COVID-19 Mortality Rates among Alaska Residents by Region* and COVID-19 Era — March 2020 – May 2023



**Urban; Anchorage Municipality, Fairbanks North Star Borough, or City and Borough of Juneau. Rural; All other boroughs/census areas.*

Figure 5. Age-Adjusted COVID-19 Hospitalization Rates among Alaska Residents by Region* and COVID-19 Era — March 2020 – May 2023



**Urban; Anchorage Municipality, Fairbanks North Star Borough, or City and Borough of Juneau. Rural; All other boroughs/census areas.*

Figure 6. Cumulative Percentage of Alaska Residents Who Completed a COVID-19 Primary Vaccine Series by COVID-19 Era and Public Health Region — March 2020 – May 2023

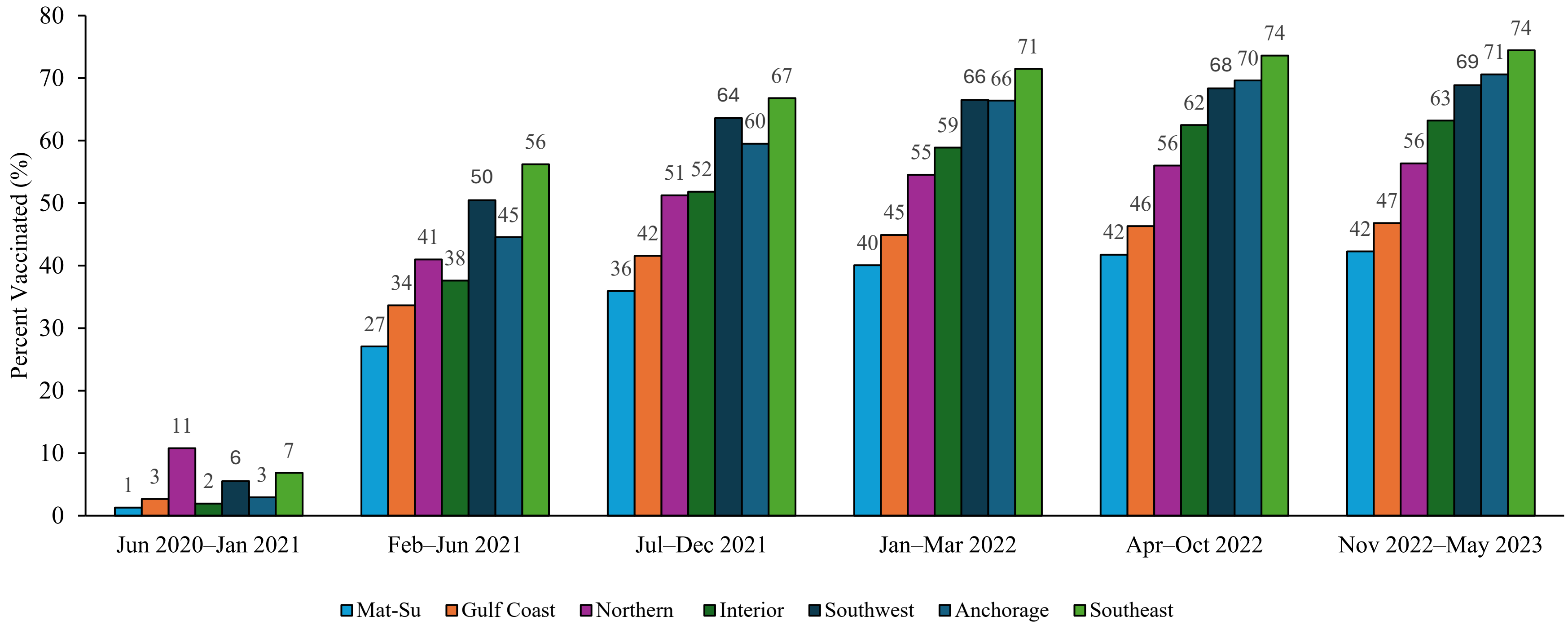


Table 5. Total Individuals Vaccinated with a Primary COVID-19 Vaccine Series by COVID-19 Era and Public Health Region — March 2020 – May 2023

Era	Dates	Anchorage	Gulf Coast	Interior	Mat-Su	Northern	Southeast	Southwest
1.	Mar–May 2020	0	0	0	0	0	0	0
2.	Jun 2020–Jan 2021	8,567	2,427	2,163	1,414	3,058	4,982	2,340
3.	Feb–Jun 2021	120,817	29,174	39,790	28,110	8,563	35,884	19,021
4.	Jul–Dec 2021	43,465	7,439	15,855	9,676	2,904	7,683	5,559
5.	Jan–Mar 2022	20,000	3,400	7,891	4,519	936	3,420	1,229
6.	Apr–Oct 2022	9,353	1,400	4,019	1,824	412	1,525	789
7.	Nov 2022–May 2023	2,841	348	802	578	98	624	213
	Total	205,043	44,188	70,520	46,121	15,971	54,118	29,151

**Excludes 12,264 people with no residence location listed.*

Figure 7. Cumulative Percentage of Alaska Residents Completing COVID-19 Vaccine Series and Receiving Boosters by Era and Public Health Region March 2020 — May 2023

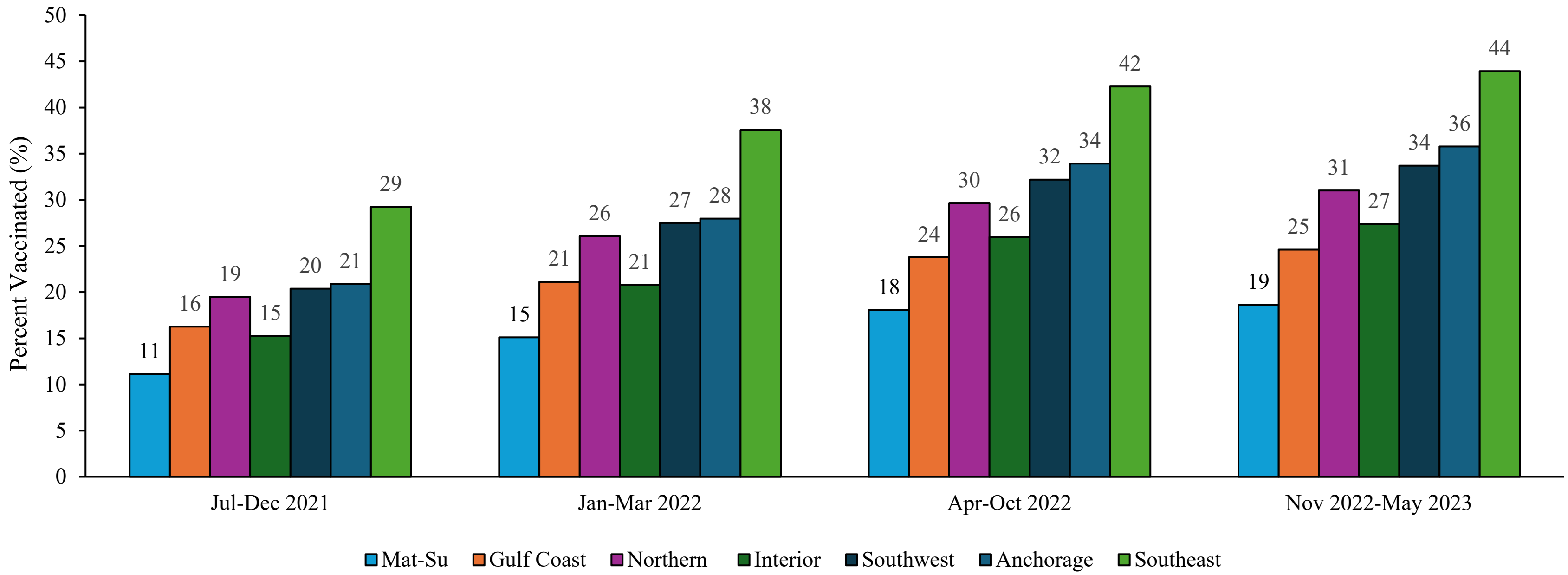


Table 6. Total People Vaccinated with a COVID-19 Booster by COVID-19 Era and Public Health Region — March 2020 – May 2023

Era	Dates	Anchorage	Gulf Coast	Interior	Mat-Su	Northern	Southeast	Southwest
1.	Mar–May 2020	0	0	0	0	0	0	0
2.	Jun 2020–Jan 2021	0	0	0	0	0	0	0
3.	Feb–Jun 2021	0	0	0	0	0	0	0
4.	Jul–Dec 2021	60,653	15,304	16,988	12,122	5,519	21,251	8,626
5.	Jan–Mar 2022	20,585	4,514	6,221	4,352	1,871	6,062	3,015
6.	Apr–Oct 2022	17,287	2,590	5,785	3,262	1,018	3,423	1,986
7.	Nov 2022–May 2023	5,399	707	1,546	597	382	1,208	638
	Total	103,924	23,115	30,540	20,333	8,790	31,944	14,265

**Excludes 4,263 people with no residence location listed.*

Table 7. Weekly Average COVID-19 Mortality Rates among Alaska Residents versus the U.S. Average by COVID-19 Era — March 2020 – May 2023

Era	Dates	Alaska	U.S. Average*
1.	Mar–May 2020	0.2	2.6
2.	Jun 2020–Jan 2021	1.1	3.3
3.	Feb–Jun 2021	0.6	1.6
4.	Jul–Dec 2021	3.6	2.7
5.	Jan–Mar 2022	2.4	3.7
6.	Apr–Oct 2022	0.7	0.7
7.	Nov 2022–May 2023	0.3	0.7

*Rates calculated per 100,000 population. * Data obtained from CDC's COVID Data Tracker* [33]

Table 8. COVID-19 Deaths and Vaccination Status by COVID-19 Era — Alaska, March 2020 – May 2023

Era	Dates	Unvaccinated Deaths§	Vaccinated Deaths¶	Age-Adjusted Unvaccinated Death Rate (95%CI)§	Age-Adjusted Vaccinated Death Rate (95%CI)¶	Rate Ratio**
1.	Mar–May 2020	12	-	NA*	NA*	NA
2.	Jun 2020–Jan 2021	291	-	NA*	NA*	NA
3.	Feb–Jun 2021	85	12	33.3 (26.6–41.6)	3.2 (1.6–10.3)	10.4 (4.9–18.5)
4.	Jul–Dec 2021	575	143	275.1 (252.8–299.4)	35.3 (29.7–41.9)	7.8 (7.1–8.1)
5.	Jan–Mar 2022	127	61	70.3 (58.5–84.1)	14.2 (10.6–18.4)	5.0 (3.9–6.1)
6.	Apr–Oct 2022	66	66	39.4 (30.4–50.3)	15.1 (11.7–19.4)	2.6 (1.8–3.2)
7.	Nov 2022–May 2023	18	37	10.7 (6.3–17.1)	8.2 (5.8–11.5)	1.3 (0.5–3.0)

**303 persons excluded who were not eligible for COVID-19 vaccination at their time of death based on Alaska COVID-19 vaccine rollout schedule among the general population.*

† Cases per 100,000 persons aged ≥12 years.

§Unvaccinated: People who had not completed an authorized primary COVID-19 vaccine series ≥ 14 days prior to death.

¶ Vaccinated: People who had completed an authorized primary COVID-19 vaccine series ≥ 14 days prior to death.

*** Calculated via Mantel-Haenszel estimation.*

Table 9. Weekly Average Mortality Rates among Alaska Residents during the Delta Variant Era — July 2021 through December 2021

Underlying Cause of Death	Rate per 100,000 population
COVID-19	3.41
Cancer	2.98
Heart Disease	2.82
Unintentional Injuries	1.74
Cerebrovascular Disease	0.76

**Underlying cause only*

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