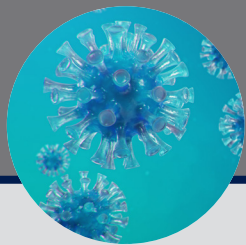


Trends in Hospitalizations and COVID-19 Alpha Variant IN COLORADO HOSPITALS

Executive Summary

COVID-19 has created unprecedented challenges to the world's health and health care system that will have long-term implications far beyond the end of the pandemic. Colorado hospitals provided critical and acute care for patients infected by COVID-19 and took on significant public health roles, including vaccination, testing, and outpatient treatment of patients with COVID-19. This report describes the results of analyzing Colorado hospitalization data on the impact of the Alpha variant of COVID-19 on hospital utilization, the types and severity of illnesses treated, and the mortality of patients. As COVID-19 hospitalizations surged during the Alpha wave, a decrease and displacement of non-COVID-19 hospitalizations and intensive care unit (ICU) cases occurred posing questions about longer term implications of deteriorated patient health due to delayed or cancelled care. Additional analyses of subsequent surges, including the Delta and Omicron variant waves, will be required to fully understand the impact on the health of Coloradans due to the continued COVID-19 pandemic as well as delayed or cancelled health care services.



Data Summary

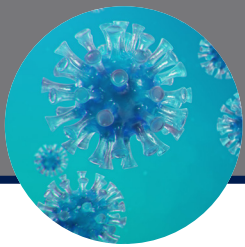
Over the course of the Alpha variant COVID-19 surge in Colorado, the number and type of hospitalizations has changed. Surges of COVID-19 hospitalizations were associated with a reduction in non-COVID cases in acute care inpatient cases, ICU cases, and across major diagnostic categories (MDCs).

March-May 2020

- During this timeframe, 4,984 patients with COVID-19 were discharged from Colorado hospitals, representing 5.3% of total hospital discharges. Total hospital discharges decreased by 17.9% compared to same timeframe in 2017-2019, as the increase in COVID-19 cases was associated with a 22% decrease in non-COVID cases.
- Hospitalizations decreased in many of the most common major diagnostic categories (MDCs) compared with the same time-period in 2019 including the following diseases and disorders. A 49.6% decrease in musculoskeletal system and connective tissue MDC, a 30.5% decrease in circulatory system MDC, a 24.6% decrease in digestive system MDC, and a 24.2% nervous system MDC.
- 1,743 of patients with COVID-19 were treated in the ICU, representing 9% of total ICU cases. Total ICU cases decreased by 21.4% compared to same timeframe in 2017-2019 as the increase in COVID-19 ICU cases was associated with a 28.8% decrease of non-COVID cases.
- Hospitalizations decreased in many of the most common major diagnostic categories compared with the same time-period in 2019. There was a 33.0% decrease in hospitalizations for diseases and disorders of the musculoskeletal system and connective tissue, a 17.1% decrease in diseases of the circulatory system, a 10.0% decrease in diseases of the digestive system, and a 10.4% decrease in diseases of the nervous system.
- 3,048 of patients with COVID-19 were treated in the ICU, representing 21% to total ICU cases. Total ICU cases decreased by 6.1% compared to the same timeframe averages from 2017-2019 as the increase in COVID-19 ICU cases was associated with a 26.2% decrease of non-COVID ICU cases compared to the average from 2017-2019.

November-December 2020

- During this timeframe, 11,316 of patients with COVID-19 were discharged from Colorado hospitals, representing 15.8% of total hospital discharges. Total hospitalizations decreased by 3.1% compared to the same timeframe in 2017-2019 as the increase in COVID-19 cases was associated with a 17.4% decrease in non-COVID hospital discharges.
- Hospitalized patients experienced longer lengths of stay and higher mortality rates compared to the prior 18 months. The average length of stay for March 2020-June 2021 was 4.8 days compared to 4.6 days in the previous 18 months, a 5% increase. The average ICU length of stay for March 2020-June 2021 was 8.0 days compared to 6.8 days in the previous 18 months, an 18% increase. The mortality rate of patients who expired between March 2020 and June 2021 was 2.3 per 100 hospitalizations, compared with 1.7 per 100 in the previous 18 months, a 35.3% increase.
- There were observed increases in patients with major and extreme all-payer refined diagnostic related groups (APRDRG) severity of illness scores, in April 2020 and November-December 2020. These increases were driven primarily by those COVID-19 patients. While hospitalizations for COVID-19 decreased in the first half of 2021, the percentage with an extreme severity of illness score increased to 68.4% between January and June 21.



Methods

To better understand and measure these changes, Colorado Hospital Association (CHA) analyzed hospital claims data submitted by Colorado hospitals. The data presented in this report describes trends in hospitalizations in Colorado over the first 16 months of the COVID-19 pandemic, representing the Alpha variant surge.

Data for this report comes from the CHA claims database, which includes data submitted to CHA using the standard 837 health care claim form from 90 acute care member hospitals. The claims data in this report are pre-adjudicated or precede the payment process of a claim.

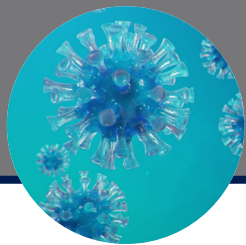
Data in this report includes claims submitted for patients hospitalized in an acute care hospital in Colorado, unless otherwise noted. Claims were included for patients discharged between January 2017 through June of 2021, with specific timeframes indicated in each analysis.

All trended data in this report is presented by month and year of discharge from the hospital; data are presented by a COVID-19 diagnosis, ICU admission, length of stay in the hospital, state of residence, county of residence type, race/ethnicity group, major diagnostic category, All-Patient Refined Diagnosis Related Group (APRDRG)¹ severity of illness scores, and patient mortality.

Patients were identified as being diagnosed with COVID-19 based on the presence of International Classifications of Diseases, 10th revision Clinical Modification (ICD-10 CM) codes U071 and B9729. Hospitalized patients whose claims did not have these selected ICD-10 CM codes are denoted as non-COVID patients in this report. Patients admitted to the ICU were identified by the presence of revenue code 020x in the claim.

The Major Diagnostic Category are summary categories of the Diagnosis Related groups (DRGs) assigned to a patient based on ICD-10 CM diagnosis codes.² The APRDRG severity of Illness score describes the extent of physiological decompensation or organ system loss of function, based on multiple sources of information about the patient.¹

Mortality data was derived from the discharge disposition section of the claim (discharge disposition='20/expired') and identified patients that died in the hospital.



Results

Hospitalization Trends, COVID-19, March 2020

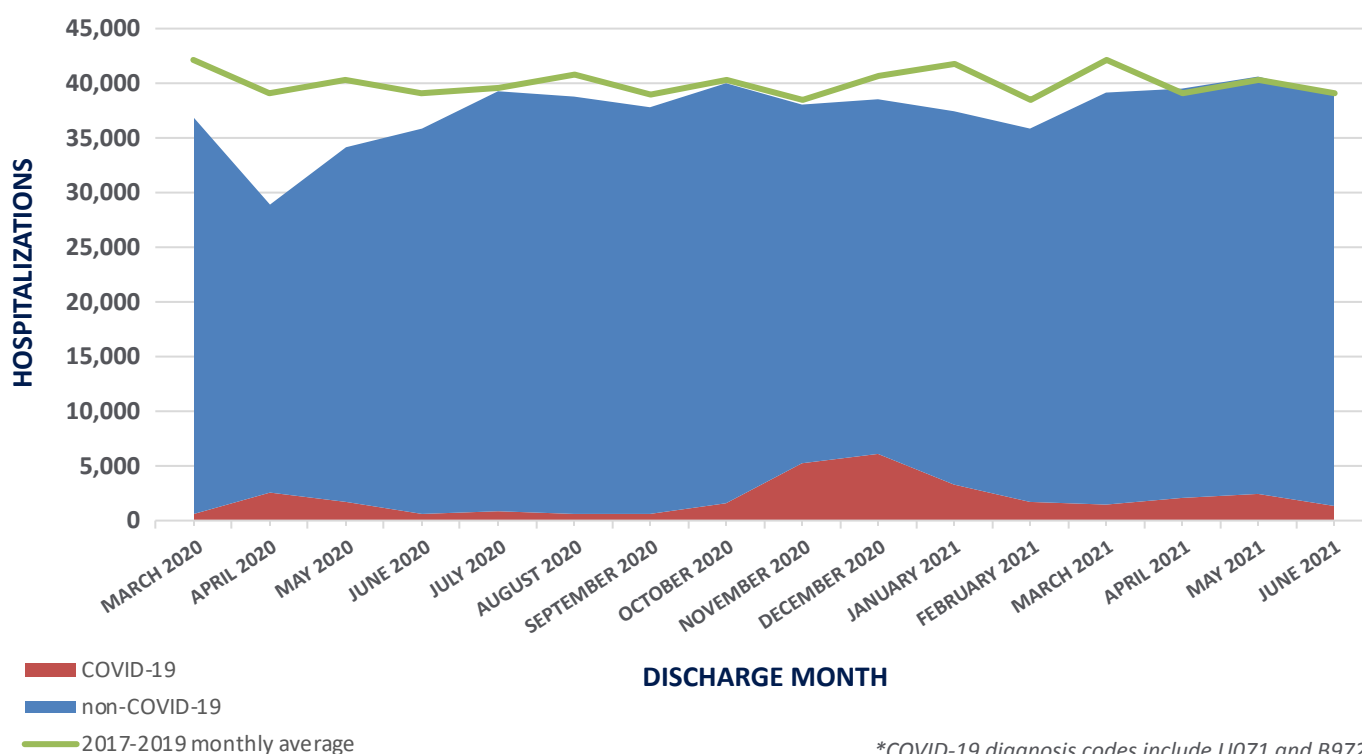
– **June 2021:** **FIGURE 1** describes the total number of inpatient hospitalizations and the presence of a COVID-19 diagnosis code by discharge month. In the first three months of the pandemic, COVID-19 hospitalizations represented 5.3% of total hospitalizations (10.0% in April 2020). For this timeframe, total hospitalizations decreased by 17.9% and non-COVID hospitalizations decreased by 22.0% compared to the same timeframe in

2017-2019. Following this sharp decline, hospitalizations returned closer to pre-COVID-19 volume levels.

When inpatient discharges with a COVID-19 diagnosis increased in November 2020 through January 2021, total inpatient discharges and non-COVID inpatient discharges decreased concurrently. For this time-period, total inpatient discharges decreased by 3.1% and non-COVID hospitalizations decreased by 17.4% compared to the same timeframe in 2017-2019.

FIGURE 1

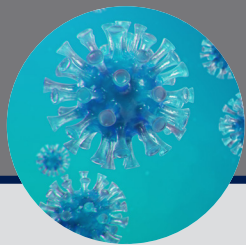
Hospitalizations by discharge month and presence of COVID-19 diagnosis codes*
MARCH 2020 - JUNE 2021



*COVID-19 diagnosis codes include U071 and B9729

For claims that included ICU treatment, there were peaks in COVID-19 cases in April 2020 and November 2020 through January 2021 (**FIGURE 2**). During December 2020, patients with a COVID-19 diagnosis made up 24.4% of the total ICU population (**FIGURE 3**) when compared with 15.8% of all inpatients (among patients discharged). Consistent with trends observed in hospital discharges, increases in COVID-19 ICU cases were largely

offset with decrease in non-COVID cases. For the period of March-May 2020, ICU cases decreased by 21.4% and non-COVID ICU cases decreased 28.8% compared to the same timeframe averages from 2017-2019. For November-December 2020, total ICU cases decreased by 6.1% and non-COVID cases decreased by 26.2% compared to the same timeframe in 2017-2019.



Results

FIGURE 2

ICU admissions by discharge month and presence of COVID-19 diagnosis codes*
MARCH 2020 - JUNE 2021

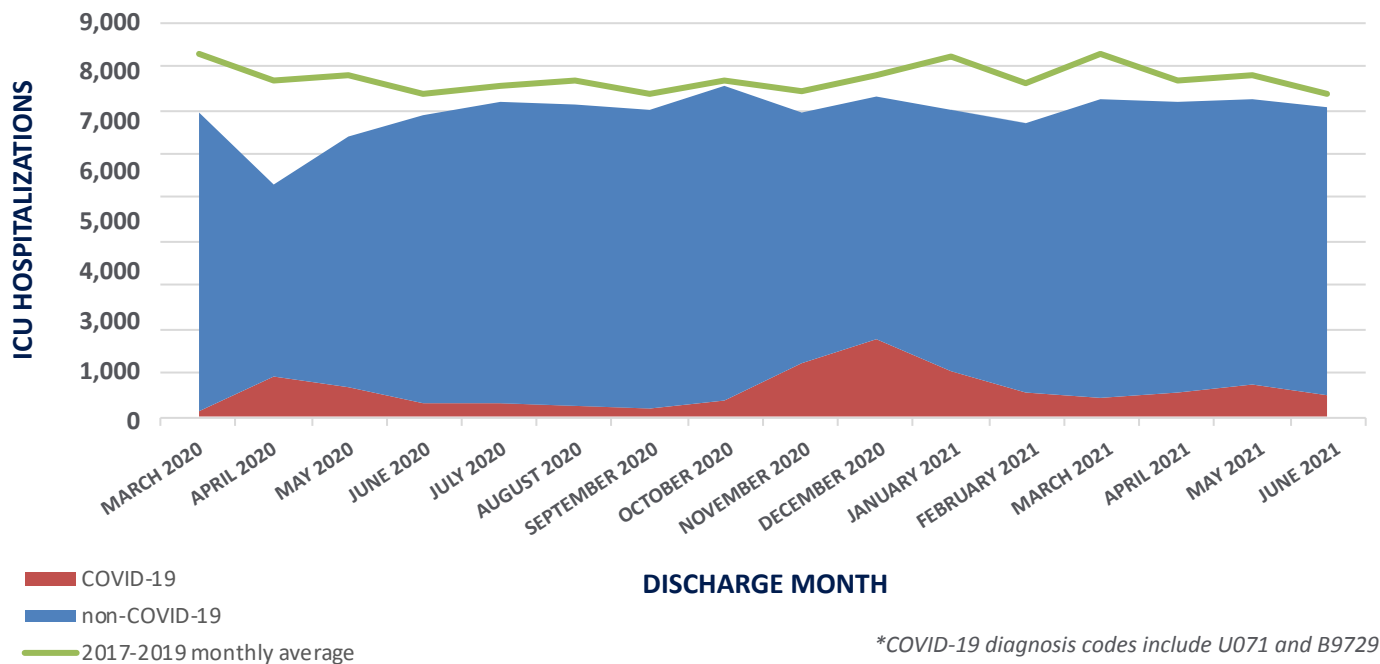
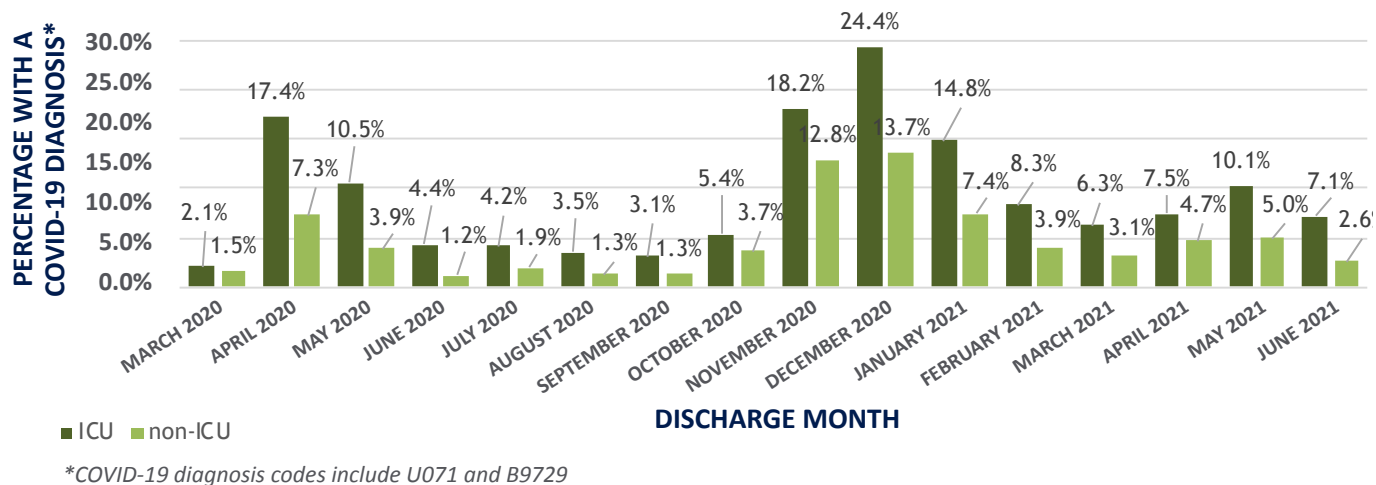
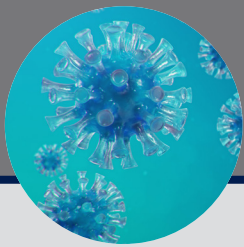


FIGURE 3

ICU and NON-ICU patients by discharge month and presence of COVID-19 diagnosis codes* **MARCH 2020 - JUNE 2021**





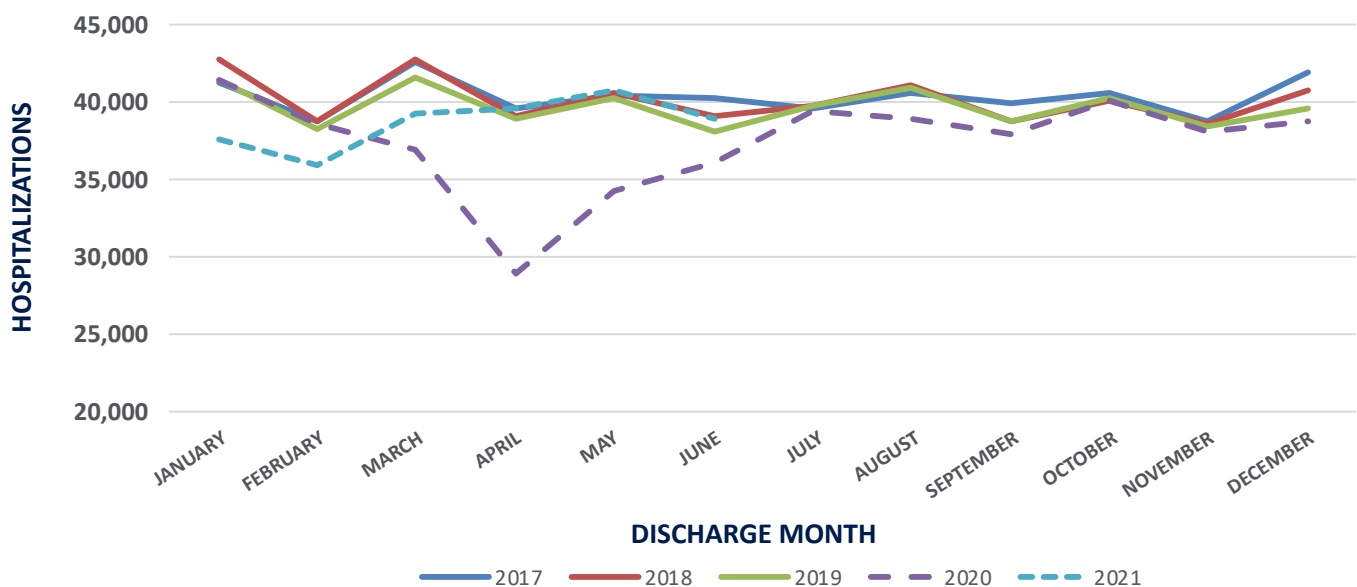
Results

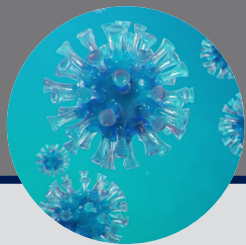
Annual Hospitalization Trends, 2017 - 2021:

FIGURE 4 describes trends of hospitalizations each year in Colorado from 2017 through June 2021. Monthly discharges from an inpatient stay ranged from 38,183 to 42,728, with an average of 40,014 (Median=39,941, Standard deviation= 1,287) between 2017 and 2019.

Fewer hospitalizations occurred in March through June 2020, with a low of 28,883 discharges in April 2020. Inpatient discharges return to pre-COVID levels between July 2020 and June 2021, except for a decrease in January and February of 2021.

FIGURE 4
Hospitalizations by discharge month 2017 – JUNE 2021



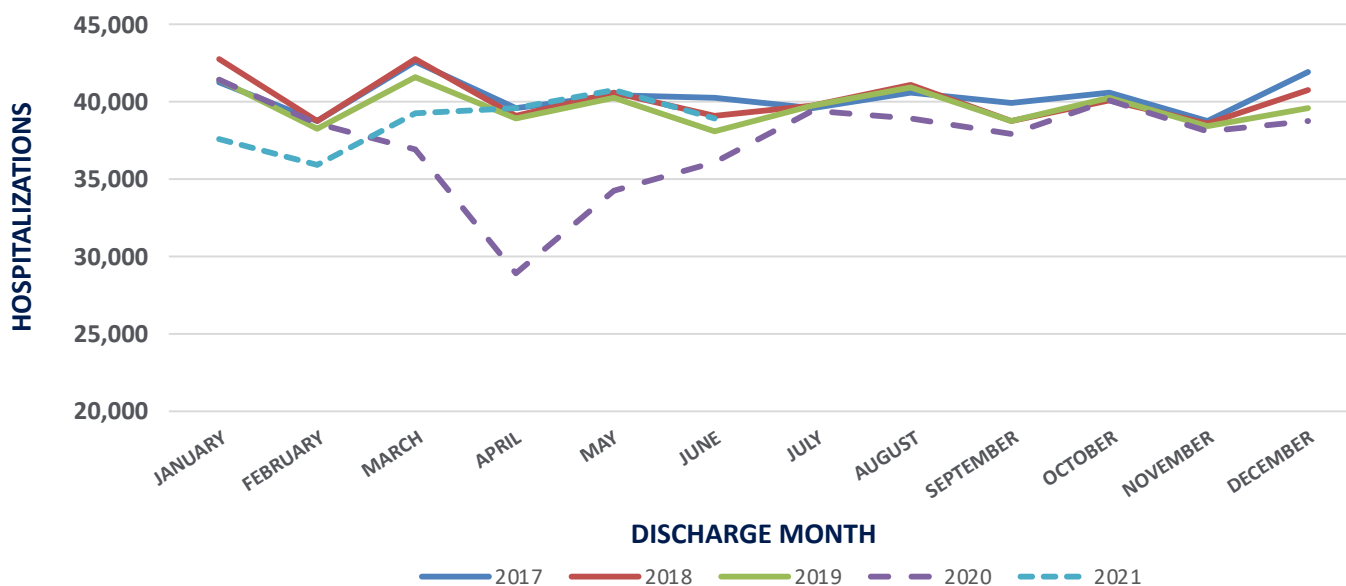


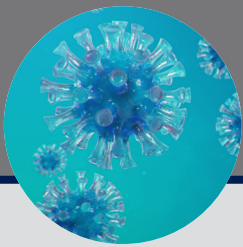
Results

The number of patients discharged from the hospital that also included treatment in the ICU ranged from 8,434 to 7,113 per month, with an average of 7,695 (median=7,655, standard deviation= 342) between 2017 and 2019 (**FIGURE 5**). Consistent with the analysis of total

inpatient discharges, there were fewer discharged patients who had an ICU stay between March and June 2020. While the number of discharged patients treated in the ICU increased in the second half of 2020, it was lower than prior years.

FIGURE 5
Hospitalizations by discharge month 2017 – JUNE 2021





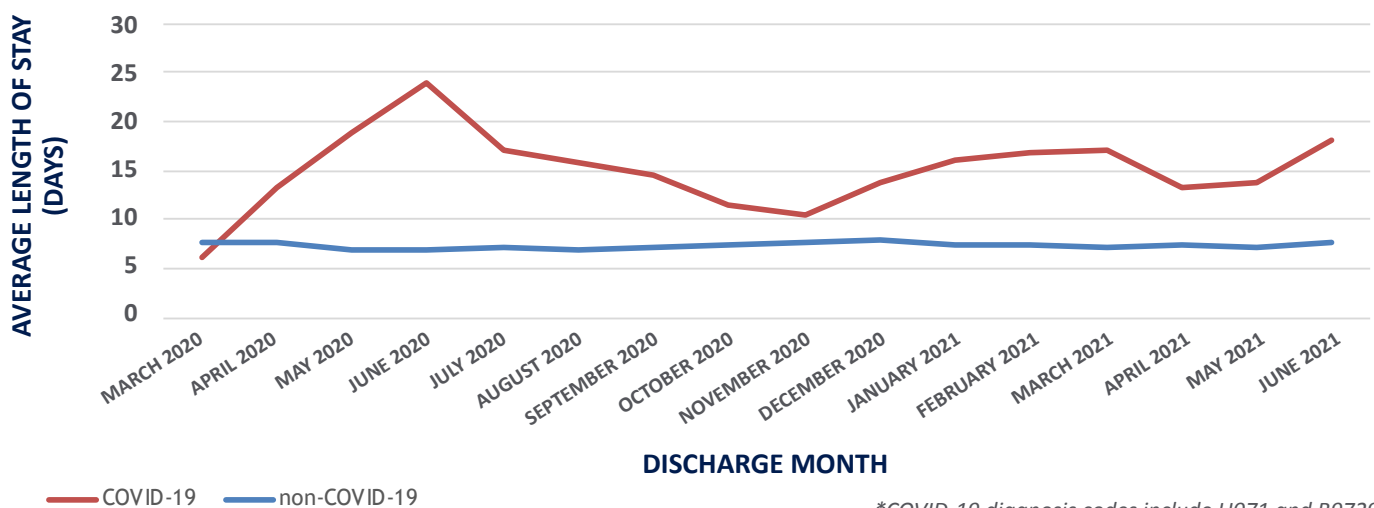
Results

Length of stay trends: The average length of stay for March 2020-June 2021 was 4.8 compared to 4.6 in the previous 18 months, a 5% increase. For ICU cases, the average for March 2020-June 2021 was 8.0 compared to 6.8 in the previous 18 months, an 18% increase. Between March 2020 and June 2021 patients with a diagnosis of COVID-19 who were admitted into the ICU had a higher average length of stay than the non-COVID patients who were admitted to the ICU (14.7 days for COVID-19 patients

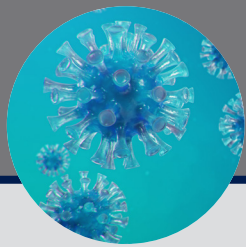
vs. 7.3 days for non-COVID-19 patients). The standard deviation for the same timeframe was 14.3 days for COVID-19 patients and 10.0 for non-COVID patients. In June 2020, the average length of stay peaked at 24 days for patients discharged with COVID-19. deviation for the same timeframe was 14.3 days for COVID-19 patients and 10.0 for non-COVID patients. In June 2020, the average length of stay peaked at 24 days for patients discharged with COVID-19.

FIGURE 6

Average length of stay (ICU) by discharge month and presence of COVID-19 diagnosis codes* **MARCH 2020 – JUNE 2021**



*COVID-19 diagnosis codes include U071 and B9729



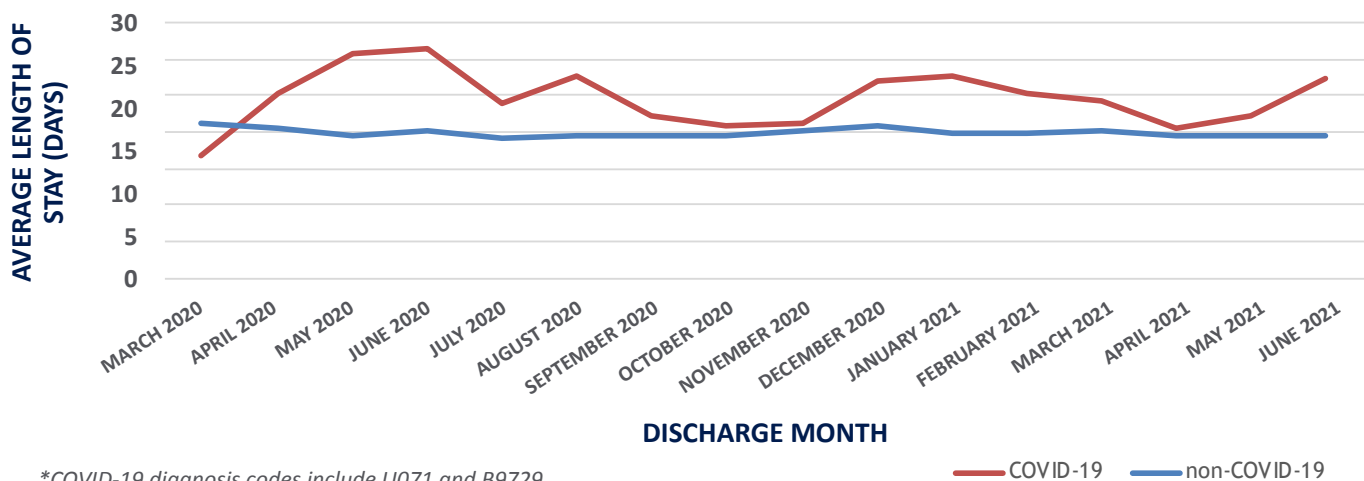
Results

Similarly, COVID-19 patients not treated in the ICU care had a longer average length of stay than those without a COVID-19 diagnosis. During this period the average length

of stay for non-COVID patients who were not seen in the ICU was relatively stable, ranging between 3.8 and 4.2 on average.

FIGURE 7

Average length of stay (NON-ICU) by discharge month and presence of COVID-19 diagnosis codes* **MARCH 2020 – JUNE 2021**



Residence data: Most patients hospitalized between March 2020 and June 2021 were Colorado residents (TABLE 1). There was a slightly higher percentage of

non-Colorado residents who were seen in the ICU compared to all inpatient hospitalizations.

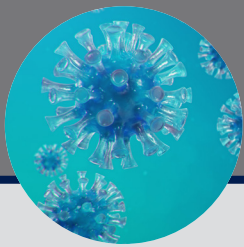
TABLE 1:

Select Hospitalizations by State of Residence
MARCH 2020 – JUNE 2021

Residence	All Inpatients		ICU Admissions		Patients with COVID-19 Diagnosis *	
	N	%	N	%	N	%
Colorado Resident	570,383	95.0%	102,828	92.6%	31,578	95.6%
Non-Colorado Resident	30,049	5.0%	8,265	7.4%	1,462	4.4%
Total	600,432		111,093		33,040	

*COVID-19 diagnosis codes include U071 and B9729

**Residence type comes from the Colorado Rural Health Center 2021 designations, <https://coruralhealth.org/resources/maps-resource>



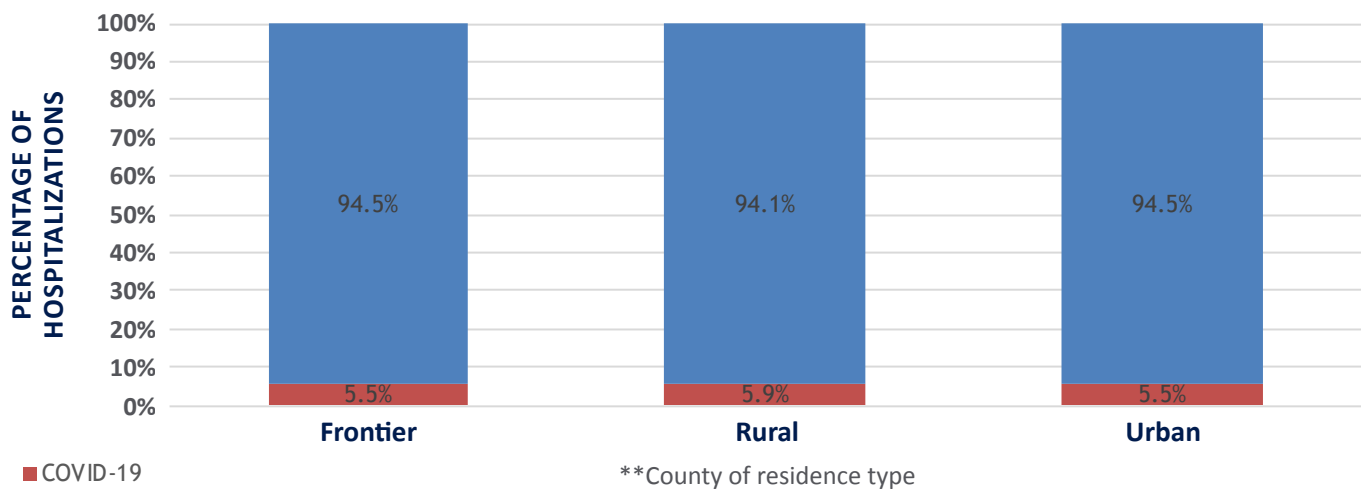
Results

As shown in **FIGURE 8**, there were not major differences among the frontier, rural, or urban county of residence for patients hospitalized with COVID-19 vs non-COVID conditions. County type designations for these data come from the Colorado Rural Health Center.** Rural is defined

as “nonmetropolitan counties with no cities over 50,000 residents,” and Frontier is defined as “a county that has a population density of 6 or fewer residents per square mile.”³

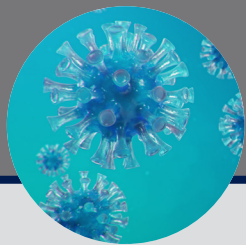
FIGURE 8

Percentage of hospitalizations with COVID-19 diagnosis* by patient county of residence type (Colorado residents) **March 2020 – JUNE 2021**



*COVID-19 diagnosis codes include U071 and B9729

**Residence type comes from the Colorado Rural Health Center 2021 designations, <https://coruralhealth.org/resources/maps-resource>

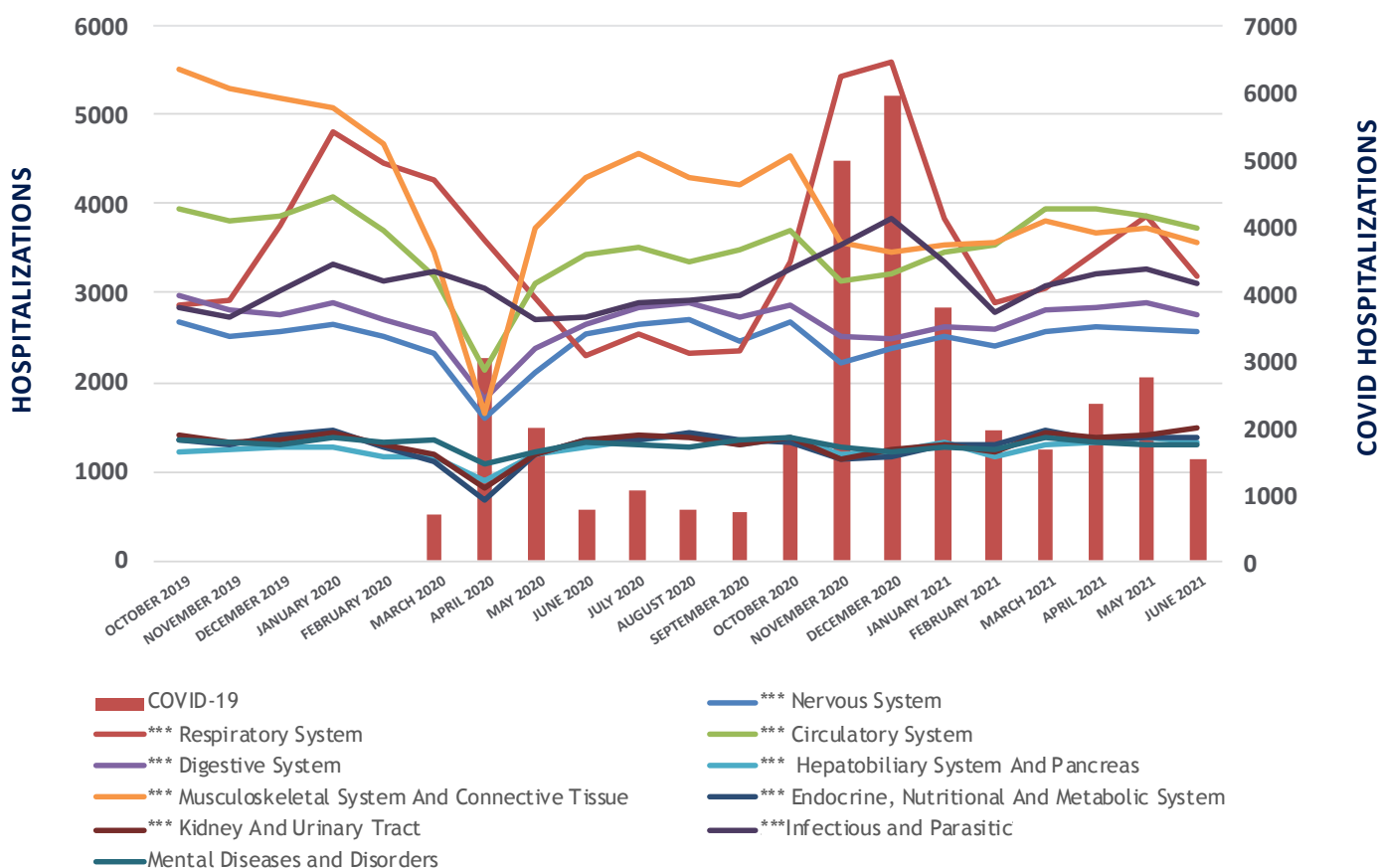


Results

Major Diagnostic Categories (MDC): During the first surge of the Alpha variant in March and April 2020, hospitalizations decreased in many of the most common Major Diagnostic Categories (MDC's) (**FIGURE 9**). This includes a 49.6% decrease in diseases and disorders of the musculoskeletal system and connective tissue, a 30.5% decrease in diseases of the circulatory system, a 24.6% decrease in diseases of the digestive system, and a 24.2% decrease in diseases of the nervous system, when compared with the same period in 2019. During the second COVID-19 surge in November and December

2020, there was a 33.0% decrease in hospitalizations for diseases and disorders of the musculoskeletal system and connective tissue, a 17.1% decrease in diseases of the circulatory system, a 10.0% decrease in diseases of the digestive system, and a 10.4% decrease in diseases of the nervous system, when compared with the same period in 2019. The secondary axis of the figure shows counts of patients with COVID-19 diagnosis and is not mutually exclusive of the MDC categories. It is worth noting that for ease of interpretation the figure does not include all MDCs.**

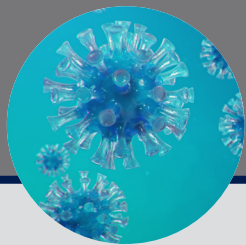
FIGURE 9
Hospitalizations by Major Disease Category, COVID-19 diagnosis* and discharge month
OCTOBER 2019 – JUNE 2021



*COVID-19 diagnosis codes include U071 and B9729

**Excludes MDC14-15 (Pregnancy and Newborn categories)

***The full title/label of MDCs is preceded by 'diseases and disorders of the' system/organ



Results

APDRG Severity of Illness Scores: The APDRG severity of illness scores range from 1=Minor, 2=Moderate, 3=Major, 4=Extreme. **FIGURES 10 AND 11** describe trends in patients whose APDRG severity of illness scores were in the Major or Extreme category, for all hospitalized patients and COVID-19 patients, respectively. When comparing COVID-19 (**FIGURE 11**) and all hospitalizations

(**FIGURE 10**) severity of illness scores, the COVID-19 patients had consistently higher percentages of extreme and major scores (35.6% of all hospitalizations compared with 95.2% of COVID-19 patients). Between March and December 2020, 39.7% of COVID-19 patients had an 'extreme' severity of illness score compared with 68.4% between January and June 2021.

FIGURE 10

Hospitalizations by Major Disease Category, COVID-19 diagnosis* and discharge month
OCTOBER 2019 – JUNE 2021

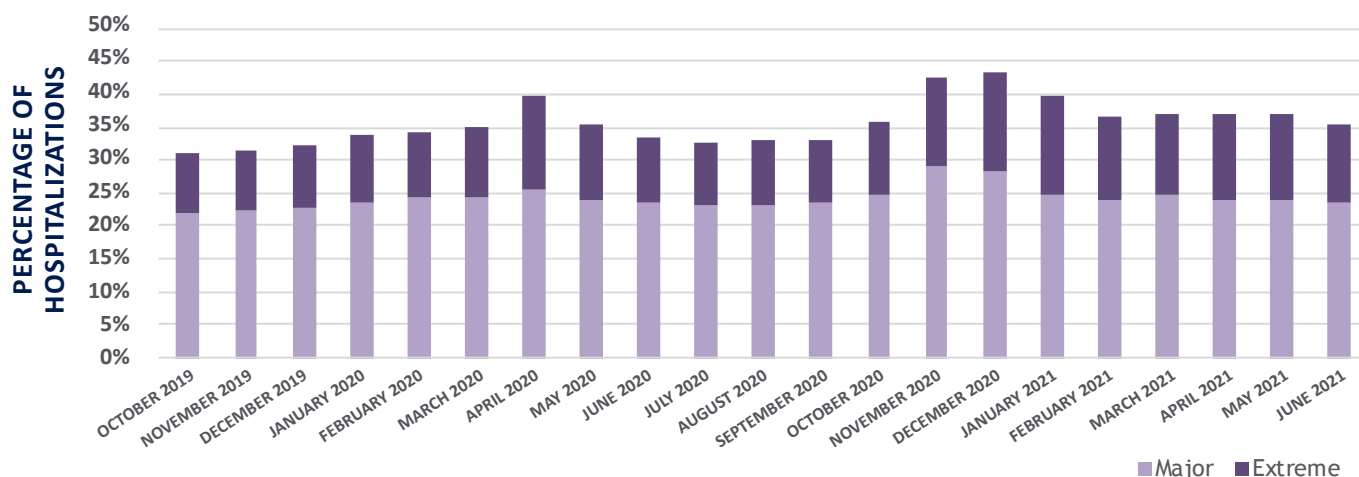
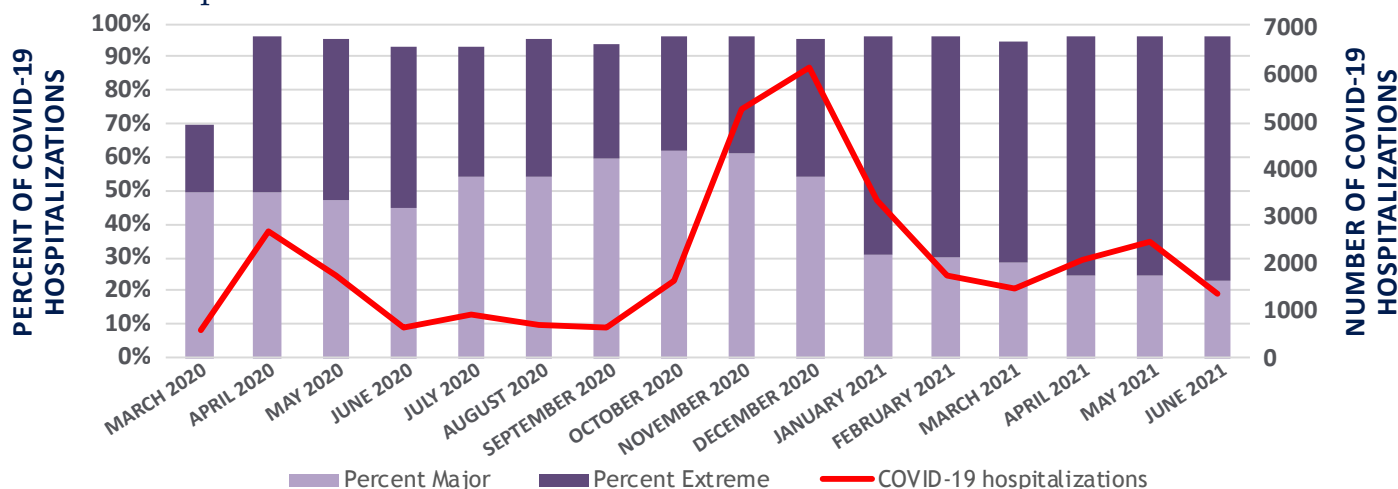
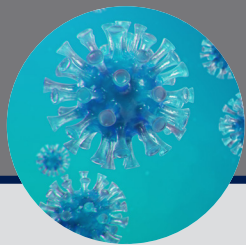


FIGURE 11

Percentage of hospitalizations by Major or Extreme APDRG SOI scores, COVID-19 patients **MARCH 2020 – JUNE 2021**



*COVID-19 diagnosis codes include U071 and B9729



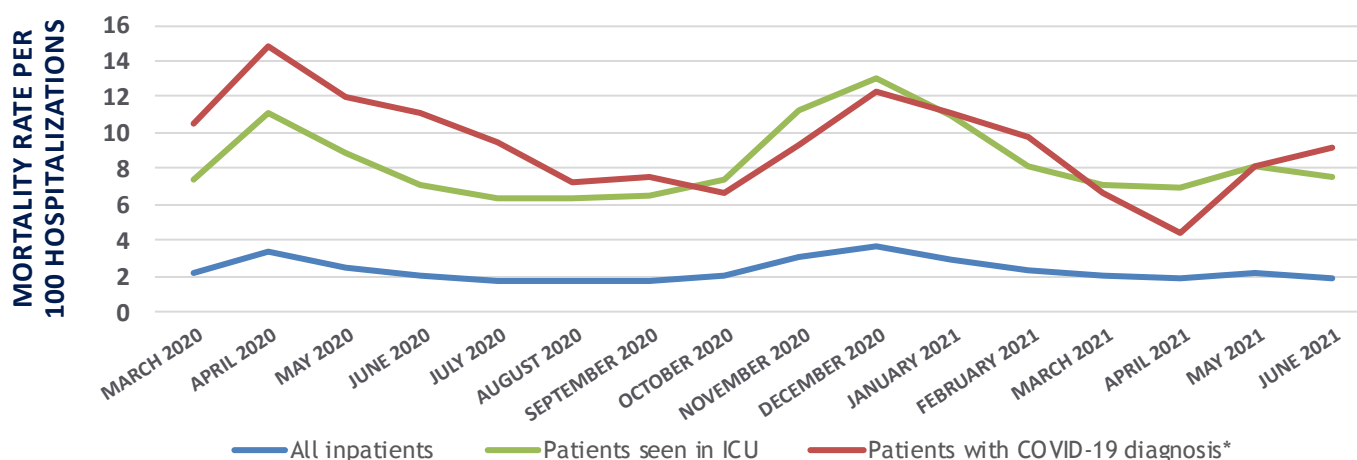
Results

Mortality: FIGURE 12 describes the population-specific mortality rate per 100 hospitalizations. There were notable increases in the mortality rate, during both April 2020 and December 2020 in all inpatients, those seen in the ICU, and those with a COVID-19 diagnosis. The mortality rate between March 2020 and June 2021 was

2.3 deaths per 100 hospitalizations, compared with 1.7 deaths per 100 hospitalizations in the previous 18 months, a 35.3% increase. FIGURE 13 demonstrates that spikes in the percentage of hospitalized patient's expiring during April and December 2020 were associated with spikes in the percentage of patients expiring from COVID-19.

FIGURE 12

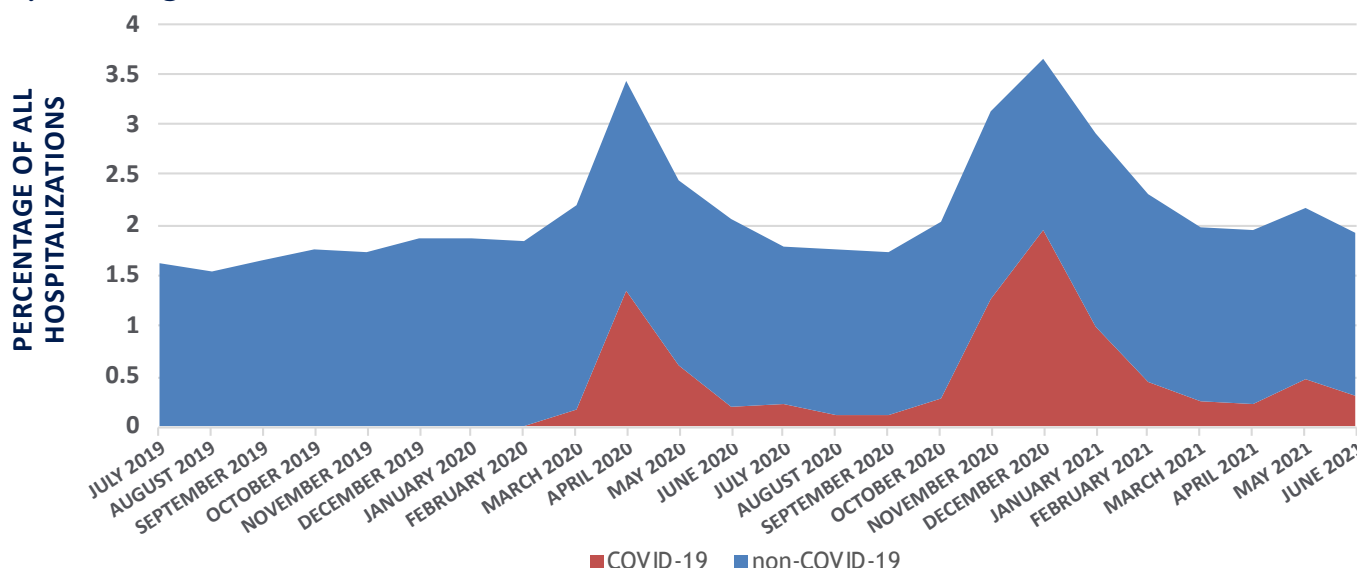
Population specific mortality rates per 100 hospitalizations, by discharge month
MARCH 2020 – JUNE 2021



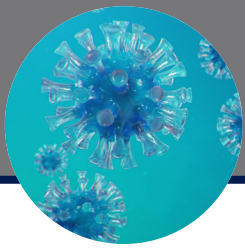
*COVID-19 diagnosis codes include U071 and B9729

FIGURE 13

Percentage of patients hospitalized that expired with and without COVID-19 diagnosis
by discharge month JULY 2019 – JUNE 2021



*COVID-19 diagnosis codes include U071 and B9729



Conclusion

When COVID-19 first arrived in Colorado, the state's hospitals and health systems worked collaboratively to provide critical and acute care for patients infected by the virus and took on significant public health roles within their communities. In this report, CHA analyzed Colorado hospitalization data to determine the impact the Alpha variant of COVID-19 had on hospital utilization, the types and severity of illnesses treated, and patient mortality. As the first waves of patients infected by the Alpha variant

hit hospitals, the data show a decrease and displacement of non-COVID-19 hospitalizations and intensive care unit (ICU) cases occurred – posing questions about the long-term impact on patient health due to postponed or foregone care. To fully understand the full impact of COVID-19 on the health of Coloradans, additional analyses of other COVID variants, including Delta and Omicron, will be necessary.

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- ¹ 3M™ All Patient Refined Diagnosis Related Groups (APR DRG). 3M Health Information Systems website. October 2021. Accessed December 13th, 2021. https://apps.3mhis.com/docs/Groupers/All_Patient_Refined_DRG/Methodology_overview_GRP041/grp041_aprdrg_meth_overviewpdf
- ² CMS.gov. ICD-10-CM/PCS MS-DRG v37.0 Definitions Manual. Accessed December 13th, 2021. https://www.cms.gov/icd10m/version37-fullcode-cms/fullcode_cms/P0001.html
- ³ Colorado Rural Health Center. 2021 County designations. Accessed December 13th, 2021. <https://coruralhealth.org/resources/maps-resource>.