COVID-19 in Colorado, 8/25/2022

Prepared by the Colorado COVID-19 Modeling Group

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Key Messages

- SARS-CoV-2 infections have now been declining for 3+ weeks as documented by recent data on percent positivity, wastewater concentration, and hospital count.
- BA.5 accounts for most cases in the US and in Colorado. The latest science indicates BA.5 has a growth advantage over BA.2, primarily due to greater immune escape.
- The prevalence of SARS-CoV-2 infection in Colorado is declining. We estimate approximately 1 in 162 people are infected as of August 16, 2022.
- Simulations incorporating BA.5 and an increase in contact rates among people corresponding with schools opening shows that the epidemic curve will continue to decline over the next 6-8 weeks. Nonetheless the findings concerning a decline in the epidemic curve through early October are robust to other model assumptions.
- We are closely monitoring BA.2.75 and watching for other variants and have not yet included any emerging variants in model simulations.
- The course of the COVID-19 pandemic after October in Colorado is unknown at present and will be determined by the next variant(s) that drive the pandemic. At present, there is not a clear variant of concern, although there are several emerging Omicron subvariants that we are monitoring closely.

Introduction

Hospital bed demand for COVID-19 patients began to decline in July 2022, following a peak in infections in June 2022. At the time, COVID-19 hospitalization count reached 323 patients. In the modeling report released on June 23, 2022, we estimated that SARS-CoV-2 infections and COVID-19 hospital demand would begin to decline in the weeks following the report. That has largely played out, except that COVID-19 hospital demand plateaued for several weeks in July before declining to the most recent low of 236 for the week of August 16. In this report, we consider what might happen over the next eight weeks, now that the Omicron subvariant, BA.5, has become the dominant variant in Colorado. We consider the impact of increased population mixing as schools open.

To make our projections, we used COVID-19 hospital, vaccination, and case data and a mathematical model of the SARS-CoV-2 epidemic tailored to Colorado. We conducted a review of the emerging literature on BA.5, to assess what is known about the infectiousness, immune escape and virulence of this Omicron subvariant, and incorporated that information into model simulations. Details on the model and updates are provided in the Appendix.

The omicron subvariant, BA.5, now accounts for almost all SARS-CoV-2 infections in Colorado and throughout the United States.

The Omicron subvariant BA.5 accounts for approximately 90% of SARS-CoV-2 infections nationwide, and likely accounts for a similarly high proportion of infections in Colorado based on recent growth trends

(CDC Variant Tracker August 2022; CDPHE COVID-19 data). BA.5 has displaced BA.2 and BA.4 in the United States and elsewhere and is now the dominant strain.

The current scientific evidence indicates BA.5's growth advantage is primarily due to increased immune escape (e.g., Tegally et al, 2022; Cao et al, 2022; Chemaitelly et al, 2022; Aggarwal et al, 2022). This means that BA.5 is more likely than other extant Omicron subvariants to cause infections in people who have been infected previously, as well as those who have been vaccinated and boosted (Hachmann et al, 2022; Tuekprakhon et al, 2022; Wang et al, 2022. BA.5 even demonstrates immune escape to early Omicron variants, including BA.1, which drove the large wave of infections last winter. There is some evidence that BA.4/5 suppresses the innate immune system, which may increase infection risk and potentially reduce protection from severe disease (Reuschl et al, 2022). The combination of waning immunity over time and immune escape led to a substantial population at risk of infection by summer 2022, including some of those who had been infected with Omicron in January/February 2022. While one study suggests increased infectiousness (Aggarwal et al, 2022), it remains unclear whether BA.5 is more infectious than other variants.

At present, there is no evidence that BA.5 causes more severe disease than other Omicron variants. Disease severity was similar amongst diagnosed COVID-19 cases in the BA.4/BA.5 and BA.1 periods in the context of growing immunity and decreasing severe/fatal reinfections of SARS-CoV-2 in South Africa (Davies et al, 2022) and Qatar (Chemaitelly et al, 2022).

SARS-CoV-2 Infections are declining in Colorado

Statewide, SARS-CoV-2 wastewater concentrations are trending down (Figure 1). This is consistent with trends of percent positivity, reported SARS-CoV-2 cases and COVID-19 hospitalizations, which have all been declining over the past several weeks. This constellation of evidence indicates a decline in infections. See figure A1 in the appendix for trends in % positivity and hospitalized patients.

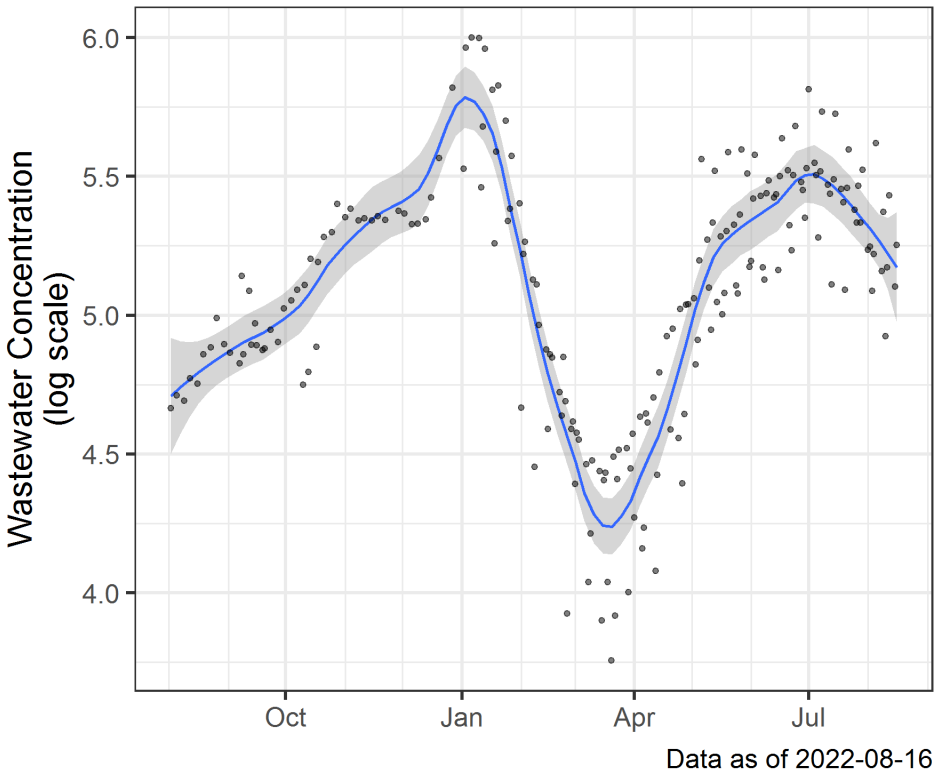

Figure 1. Population-weighted average wastewater concentrations from 53 sites Aug 2021 to present. Bayesian Structural Time Series model is fit to logged measurements from each utility. Population-weighted average is calculated each day. Blue line is a localized regression fitted to a sliding 3-month window. Data source: https://cdphe.maps.arcgis.com/apps/dashboards/d79cf93c3938470ca4bcc4823328946b

We estimate that the number of people infected with SARS-CoV-2 in Colorado has been declining over the last 4 weeks (Figure 2). We estimated approximately 1 in every 162 Coloradans are infectious as of 8/16/2022 and the number infected should continue to decline. These estimates are sensitive to model assumptions, including assumptions about the probability that an infected individual will be symptomatic and require hospital care, assumed to vary by age.

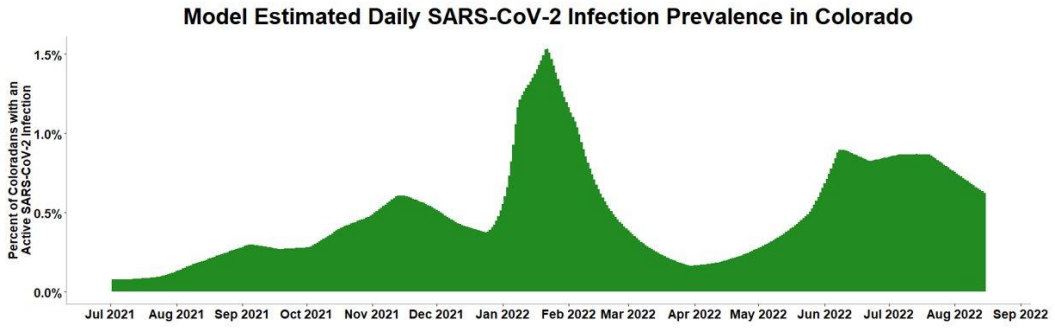

Figure 2. Estimated prevalence of SARS-CoV-2 infection in Colorado from July 2021 to August 16, 2022. The number of infectious individuals is inferred using mathematical model fit to COVID-19 hospitalizations in Colorado.

We estimate that there are high levels of immunity against severe COVID-19 disease and infection in Colorado (Figure 3). Due to the immune escape of BA.5, estimated immunity to infection is lower than immunity to severe disease. Vaccination and prior infection provide protection against developing more severe disease and death. Due to the recent wave of BA.5 infections, we estimate immunity has increased over the past two months.

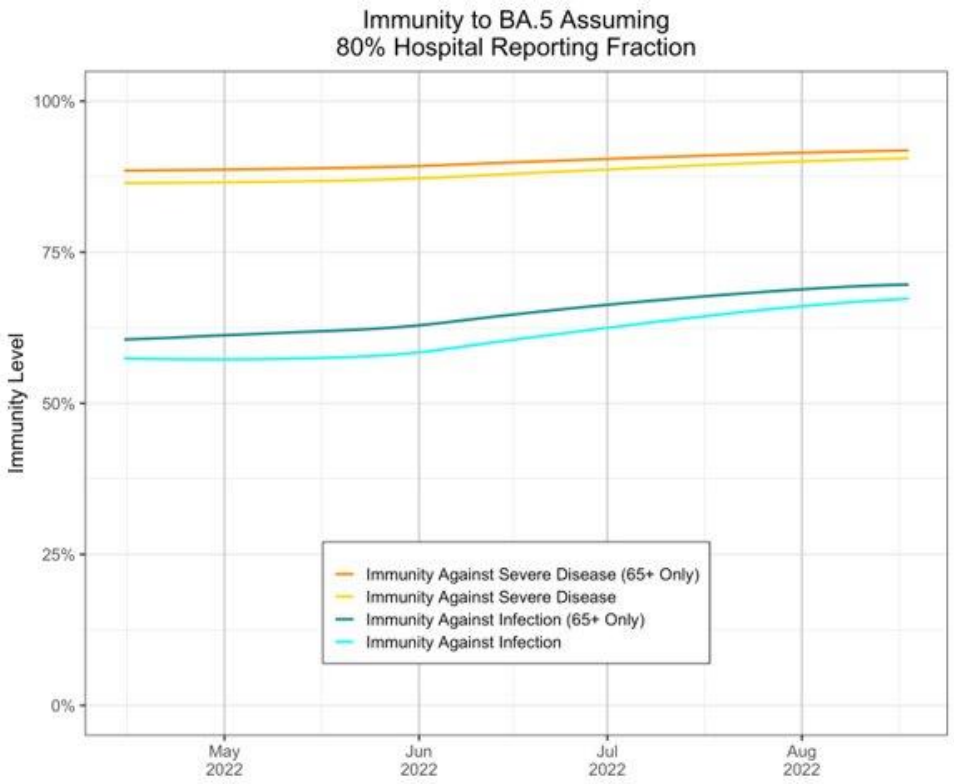

Figure 3. Estimated immunity to BA.5 in Colorado against severe disease and infection among the full population and those 65+. The estimates shown are based on the assumption that BA.5 is equally as infectious as BA.4 and BA.2.12.1 and that approximately 80% of people with COVID-19 in Colorado hospitals are identified and reported to state surveillance systems.

We estimate that SARS-CoV-2 infections and hospital demand will continue to decrease over the next 6-8 weeks.

Figure 4 shows projections of the course of Colorado's epidemic curve into mid-October. The vertical lines summarize a set of 27 projections that reflect differing assumptions in the model, including the increased contacts that will come with the opening of schools. Other assumptions relate to shifting patterns of testing and reporting related to COVID-19 in hospitals and the degree of infectiousness of BA.5. The bars cover the range of the 27 curves. Importantly, all curves indicate a decline in COVID-19 hospital demand for the next two months, heading towards hospitalization counts around 100, close to recent low values achieved in April of this year. The projections are not extended further because of uncertainty regarding the emergence of future variants. Our projections are consistent with estimates from others, which forecast a decline in COVID-19 hospital demand in Colorado (COVID-19 Forecast Hub; IHME). A detailed description of the modeling scenario assumptions is provided in the appendix.

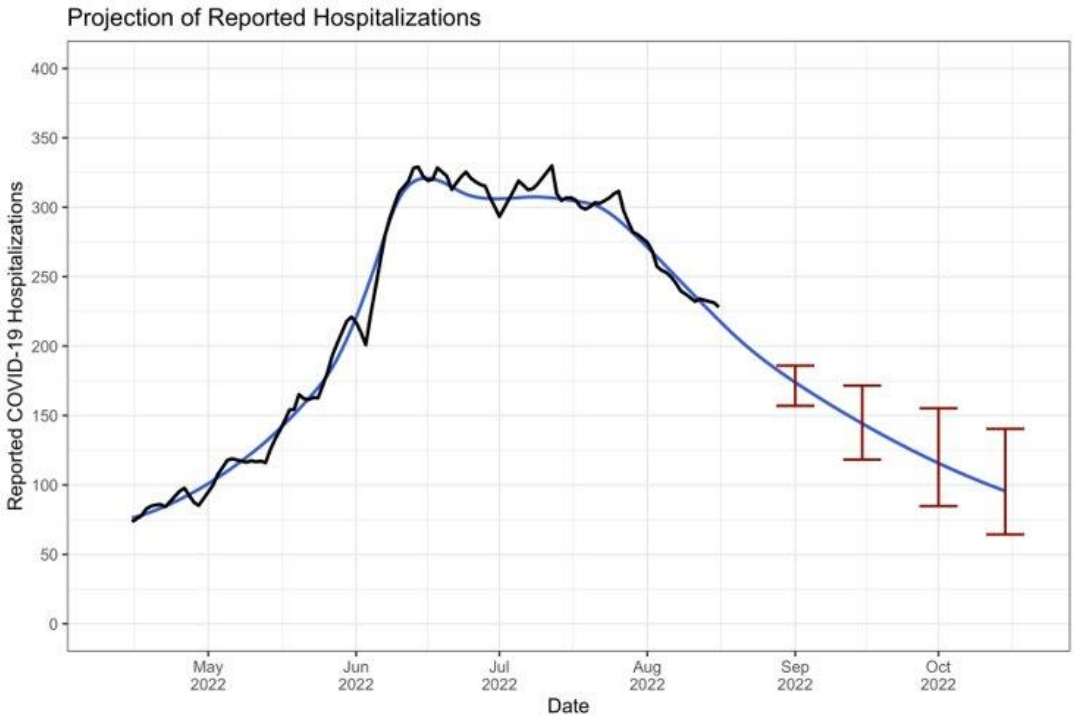

Figure 4. Projected COVID-19 hospital demand in Colorado over the next 8 weeks (blue line). The red bars indicate the range of our projections for 27 different simulations. These projections account for increases in contact rates at the start of school, changes in hospital-based COVID-19 surveillance, and uncertainties about BA.5. They do not account for the emergence of new variants, which is expected in the months ahead.

The course of the COVID-19 pandemic after October in Colorado is unknown at present and will be determined by the next variant(s) that drive the pandemic.

We continue to monitor emerging variants. At present, we are monitoring two Omicron subvariants:

- BA.2.75, a subvariant with currently limited geographical spread, has a 13% higher effective reproductive number compared to BA.5 (Saito et al, 2022) and may have as much immune escape as BA.5 (Sheward et al, 2022) or more (Cao et al, 2022; Yamasoba et al, 2022).
- BA.4.6 accounts for a small (<10%) but growing proportion of SARS-CoV-2 infections in the United States (CDC variant tracker). It has mutations that are estimated to increase immune escape, and it may have a growth advantage over BA.5 (Jian et al, 2022). Data on this sub-variant is limited at present.

It is unclear whether either of these variants will displace BA.5.

Historically, new Omicron subvariants spread geographically for 7-14 weeks before they become dominant strains in the United States. We evaluated the time from the first detection to the time the variant accounted for most infections. The most rapid growth occurred for BA.1.1, first reported on November 20, 2021, and accounting for 50% of infections by early January 2022, 7 weeks later. Growth was slower for BA.2.12.1 (13 weeks) and BA.5 (14 weeks). These temporal patterns for prior variants suggest that we are unlikely to see a sudden change in the trajectory of infections over the next few

weeks due to a new Omicron subvariant. Over the fall, the course of COVID-19 will be determined by the next variant of concern to displace BA.5. We could see rapid growth of infections akin to what occurred following the emergence of BA.1.1 if a new variant emerges that is distinct from prior variants of concern.

Appendix

The model is an age-structured SEIRV (susceptible-exposed-infected-recovered-vaccinated) infectious disease transmission model that has been calibrated to Colorado-specific data whenever possible. For example, the length of time that a COVID-19 patient is assumed to spend in the hospital varies by age and over time and is based on data provided by Colorado hospitals. Code is available on GitHub at https://github.com/CSPH-COVID/covid-models.

This report is based on model simulations using COVID-19 hospitalization data through 8/16/2022 and vaccination data through 8/15/2022.

Recent model updates

The model has been updated to reflect our latest understanding of the Omicron subvariants and recent changes in SARS-CoV-2 testing at Colorado hospitals. This includes the following updates:

- We continue to assume a drop in detection and reporting of "with-COVID" hospitalizations after mid-March 2022. This corresponds with a change in SARS-CoV-2 testing protocols at major Colorado hospitals such that all patients are not presumptively screened. Model fitting and projections account for this change. We define the hospital reporting percentage as the number of COVID-19 hospitalizations reported vs. what would have been detected if universal testing on admission still occurred. We estimate hospital reporting to be 80% based on a recent data analysis. This is phased in incrementally over March 2022. We ran sensitivity analyses examining the impact of assuming 70% and 90%.
- Owing to the low prevalence of BA.4 and the dominance of BA.5, we now focus the latest variant simulations on BA.5. We had previously modeled BA.4/5 as a combined variant. We now refer to BA.5 exclusively in our estimates and projections.
- Based on the latest science, we continue to assume BA.5 has greater immune escape than BA.2.12.1. We now assume BA.5 is equally transmissible as BA.2.12.1. We conducted sensitivity analyses simulating 5% increased and decreased transmissibility to account for our uncertainties about BA.5.

Model simulations

In our model simulations, we accounted for three key sources of uncertainty in our scenarios.

1. Uncertainties in how contact rates will change with the start of the school year. We simulated 0, 10 and 20% increased transmission-relevant contact among the 0-19 age group beginning August 15th.
2. Uncertainties in how changes in hospital testing protocols have impacted COVID-19 hospitalization numbers. This is the biggest source of uncertainty. We ran simulations assuming 70, 80 and 90% of people in the hospital with or for COVID-19 are being identified and reported to state surveillance systems. This range is based on a recent analysis of changes in the proportion of hospitalized patients with versus for COVID-19 following the March 2022 shift in hospital testing protocols.
3. Uncertainties in the transmissibility of BA.5 due to gaps in the science. Based on the latest science, we continue to assume BA.5 has greater immune escape than BA.2.12.1. We now assume BA.5 is equally transmissible as BA.2.12.1. We conducted sensitivity analyses simulating 5% increased and decreased transmissibility to account for our uncertainties about BA.5.

The combination of these assumptions leads to 27 scenarios which we ran to assess the range of our projections.

Wastewater, percent positivity and COVID-19 hospitalizations

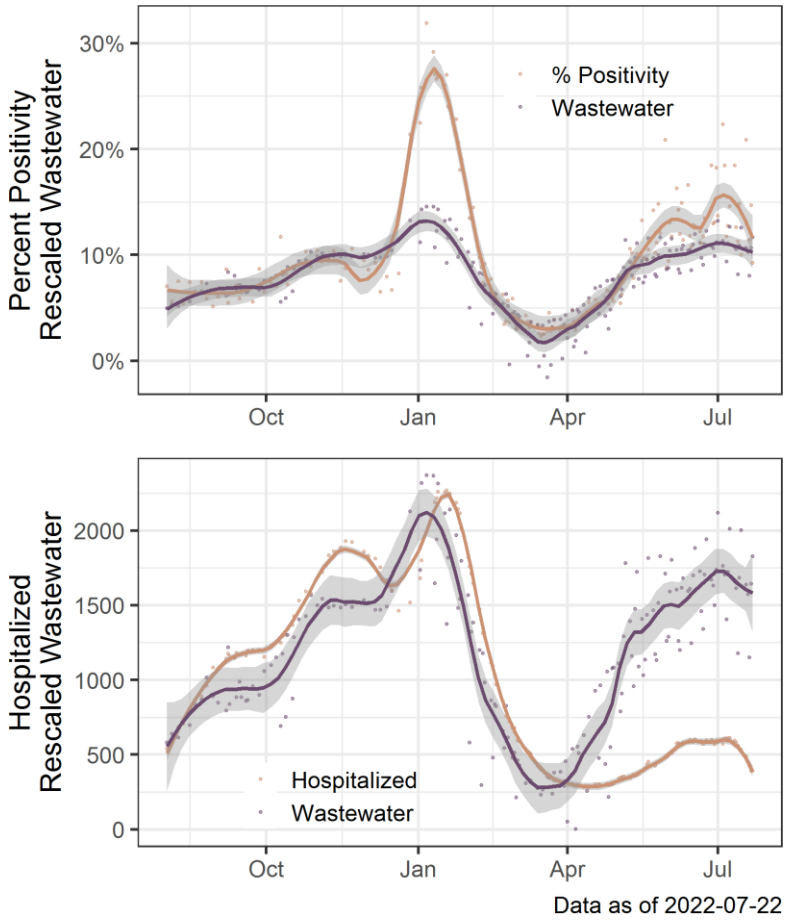

Figure A1. Recent trends in wastewater rescaled to units comparable to testing % positivity and number hospitalized. Wastewater samples measure the number of SARS-CoV-2 copies per liter in a wastewater sample at various sites across the state. We calculate a population-weighted average daily measurement (logged) of sites in Colorado. The wastewater data is then rescaled to units comparable to percent positivity, 7-day case rate, and hospitalized based on the pre-vaccine period: August 2020 – March 2021.

Source: https://cdphe.maps.arcgis.com/apps/dashboards/d79cf93c3938470ca4bcc4823328946b

Figure A1 shows that % positivity still largely agrees with trends in wastewater data. The figure also shows that during the most recent wave of infections, fewer people were hospitalized. The divergent trends are likely due to increased vaccination rates and efficacy against current variants, changes in reporting, and possible reduced severity of disease resulting from current variants.