The Current State of COVID-19 in Colorado

05/12/2021

Prepared by the Colorado COVID-19 Modeling Group

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Summary

- Based on data through 5/10, we estimate that overall transmission control is 59%, a 3% increase from last week.
- The effective reproductive number is 1.02 indicating flattening of infectious growth.
- Approximately 1 in every 81 people in Colorado are currently infectious, much higher than mid-March.
- Incorporating vaccination among 12-15 year-olds, if vaccination uptake is high, reaching 80% among individuals under 65, 70% immunity is attainable by mid-August in Colorado.
- The course of the epidemic curve into the summer depends on the level of transmission control that is maintained and on success in vaccinating Coloradans in the weeks ahead.
- At the current transmission control level and with high vaccination uptake, we will not reach 2020 summer lows in transmission by August.
- An immediate drop in transmission control, particularly if combined with low vaccination uptake, would keep the epidemic curve at current levels for several months to come.
- Mobility continues to slowly trend upwards with room to increase further.

Snapshot of Current SARS-CoV-2 Transmission in Colorado Based on Data Through 05/10

Effective reproduction number: 1.02. *Infections are increasing.*

Estimated prevalence of infections: Approximately 1,200 of every 100,000 Coloradans or 1 in every 81 Coloradans are currently infectious.

Estimated percent of the population immune: Approximately 48% of Coloradans are immune due to vaccination or prior infection.

Estimated percent of the population vaccinated: Approximately 47% of Coloradans have received at least one dose of a SARS-CoV-2 vaccine.

Introduction

We used our age-structured SEIRV (susceptible-exposed-infected-recovered-vaccinated) model and real-time COVID-19 hospital census, vaccination, and case data to characterize the current status of the COVID-19 epidemic in Colorado. We use estimates of the current state of the epidemic to generate projections of the potential future

course of SARS-CoV-2 in Colorado under different scenarios of vaccine roll out, spread of variants of concern and transmission control measures. These include estimates of hospital needs, infections and deaths under these different scenarios.

The model has been parameterized to Colorado-specific data whenever possible. For example, the length of time 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. Links to model details are provided in the appendix at the end of this report.

The estimates presented in this report are based on hospitalization census data through 05/10 and vaccination data through 05/09.

Model Updates

Model updates implemented this week.

1. **Variants of Concern.** The model continues to incorporate data provided by CDPHE on the distribution of variants of concern starting in early January 2021. Due to lags between sample collection, sequencing and analysis, variant data is lagged such that we must infer recent variant prevalence based on available data. In this week's model, we assume B.1.1.7 accounts for 60% of infections by mid-April with no further growth and that B.1.427/429 accounts for <1% of infections by May. These assumptions were based on data through last week. The most recent data provided by CDPHE after model fitting suggests our scenario underestimates the amount of B.1.1.7 starting in late March 2021 and that there is potential for continued growth of B.1.1.7. Because of this, our current model fit likely underestimates the impact of variants on current transmission control and the projections likely underestimate future hospital demand.
2. **Pfizer Vaccine for Ages 12-15.** This week, the FDA expanded its Emergency Use Authorization (EUA) of the Pfizer-BioNTech COVID-19 vaccine for use in 12-15 year olds. We now account for vaccination of 12-15 year-olds in our model beginning Monday, 05/10.

COVID-19 Hospitalizations

Figure 1 shows the daily number of people hospitalized with COVID-19 since March 2020, when the first case of SARS-CoV-2 was reported in Colorado. COVID-19 hospitalizations are a sensitive measure of SARS-CoV-2 transmission. While many SARS-CoV-2 infections are not captured by surveillance systems, we expect that almost all COVID-19 hospitalizations are identified.

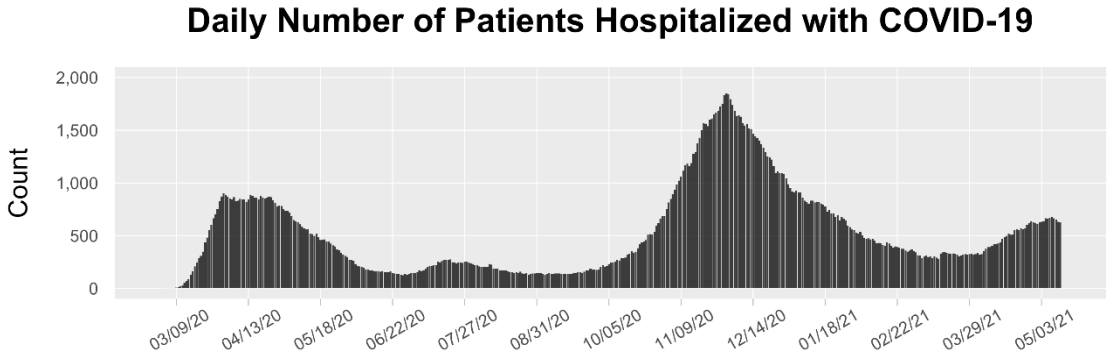

Figure 1 (above). Daily count of hospitalized COVID-19 cases through 05/10. The time series of COVID-19 hospitalizations in Colorado is based on hospitalization data provided by CDPHE through 4/07/2020 and the EMResource hospital census of COVID-19 hospitalizations starting 04/08/2020 (EMResource hospital census appeared to undercount COVID-19 hospitalizations before that date).

Transmission Control

Transmission control is an estimate of the collective impact of behaviors and policies such as mask wearing, physical distancing, case isolation, contact tracing, and moving activities outside on slowing the spread of infections from infected to susceptible individuals. When transmission control is 0%, spread of infections is uncontrolled, as in the very early days of the pandemic. When transmission control is close to 100%, the spread of the virus from an infected person to others is rare. We estimate transmission control for each two-week period since March 2020 (Figure 2). Transmission control is estimated by aligning model output to hospitalization data using model-fitting approaches. The most recent model update allows us to estimate two values of transmission control. We can estimate the level of transmission control due to policies and behaviors (TC_{pb}). This is the level of transmission were there no variants of concern in Colorado. We estimate TC_{pb} as 68%. We can also estimate transmission control that accounts for policies, behaviors, and variants (TC); TC corresponds to the estimates made previously. This value accounts for the proportion of total infections presumed to be caused by B.1.1.7 and B.1.427/429 variants. The difference between TC_{pb} and TC represents the consequences of the more transmissible variants versus the previously circulating strains.

Our current estimate of effective transmission control due to policy, behaviors, and variants is 59%. This estimate is for the period 04/17 to 04/27, given the lag between infection and hospitalization.

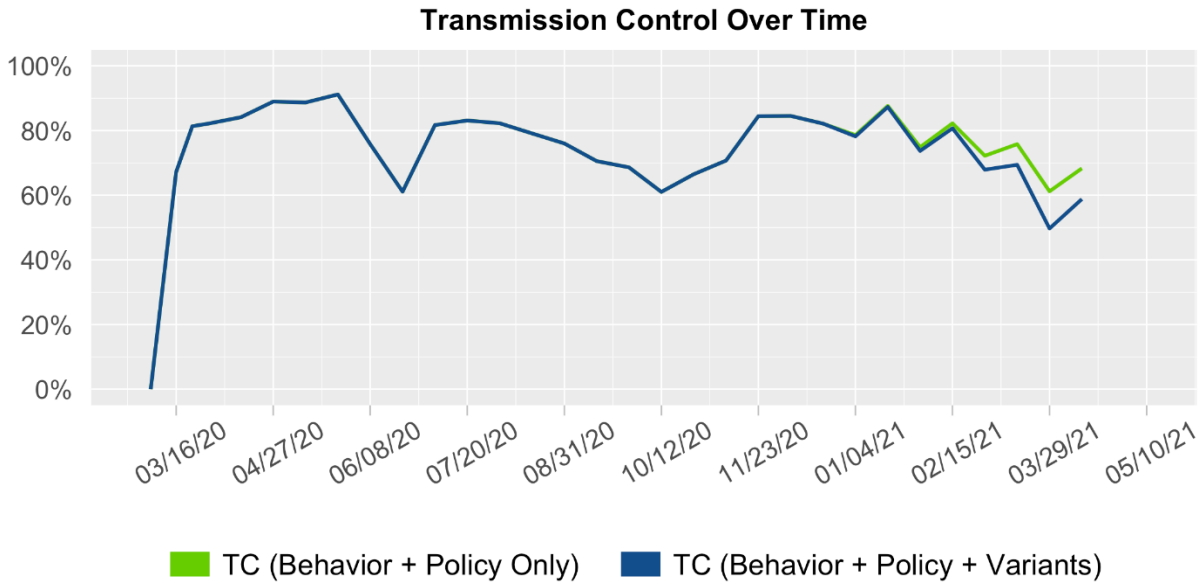

Figure 2 (above). The estimated transmission control value for each two-week period since the beginning of the epidemic due to behavior and policy only (green line) and the estimated transmission control accounting for behavior, policy, and variants (blue line). On the graph, the value is shown for the mid-point of each two-week period. Transmission control is estimated using model fitting approaches to align model output with COVID-19 hospitalizations.

Model Fit

We assess model fit by comparing the model-estimated number of hospitalizations to actual hospitalizations. Figure 3 shows the current estimated trajectory of hospitalizations, based on the most recent model-fit, compared to the daily reported number of people hospitalized with COVID-19. For reference, a line showing the estimated trajectory one-week prior is also shown. A figure showing model fit since the beginning of the pandemic is provided in the appendix.

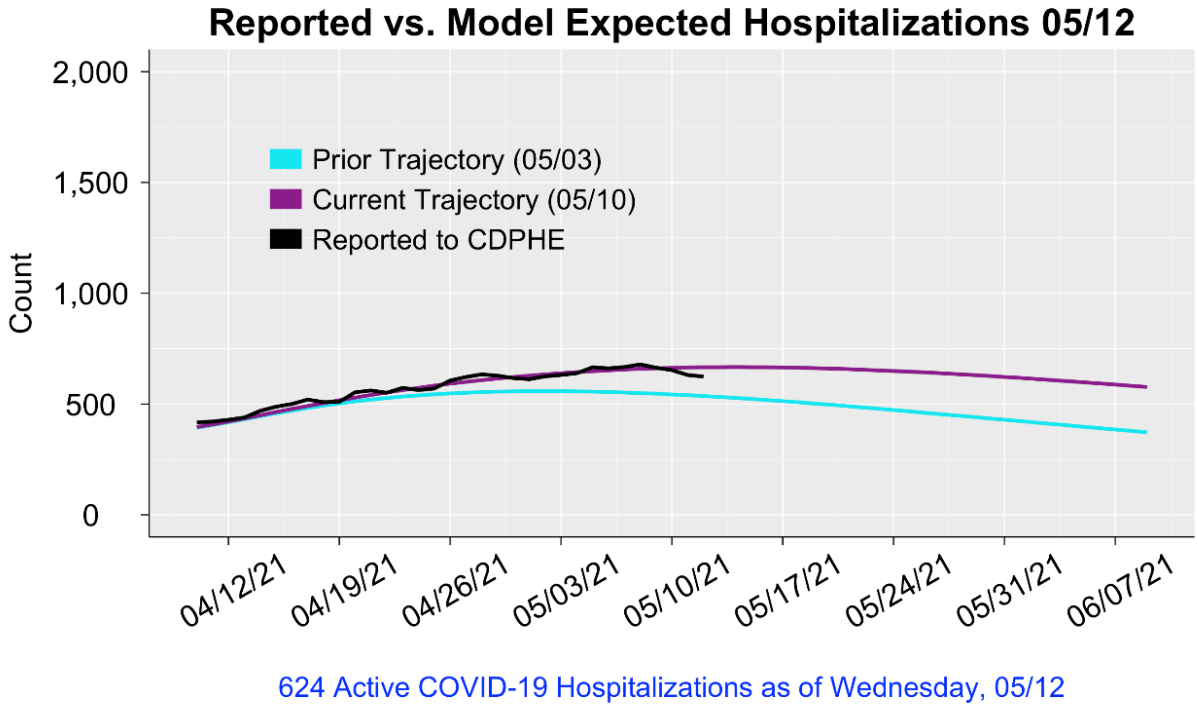

Figure 3 (above). The projected course of COVID-19 hospitalizations if Colorado were to remain on the current estimated trajectory (purple line) or on the trajectory estimated one week prior (turquoise line). Each trajectory is generated assuming Colorado rolls out vaccines on schedule, as described in the long-term projections.

The Effective Reproduction Number

The effective reproduction number (Re) is a measure of how rapidly infections are spreading or declining. When the effective reproduction number is below one, infections are decreasing. When the effective reproduction number is above one, infections are increasing. The effective reproduction number is estimated using our age-structured SEIRV model fit to hospitalization data.

Our current estimate of Re is 1.02. Due to the lag between infections and hospitalizations, this estimate of Re reflects the spread of infections occurring on approximately 04/27. The estimated values of the reproduction number since March 2020 are shown in Figure 4.

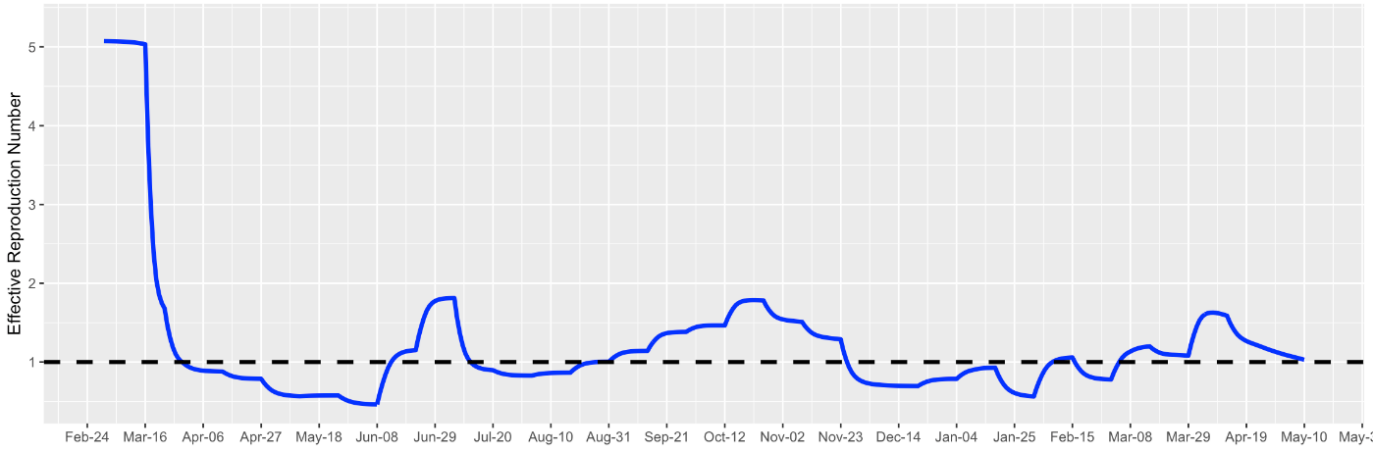

Figure 4 (above). Estimates of the effective reproduction number over time.

Infection Prevalence

Infection prevalence provides an estimate of the proportion of the population that is currently infected with SARS-CoV-2 and capable of spreading infections. At higher levels of infection prevalence, susceptible individuals are more likely to encounter infectious individuals among their contacts. Because many people experience no symptoms or mild symptoms of COVID-19, many infections are not identified by surveillance systems. The estimates we present here are intended to provide an approximation of all infections, including those not detected by the Colorado Electronic Disease Reporting System (CEDRS).

These estimates are generated using the model by assuming the most recent transmission control parameter (estimated for the period 04/17 to 04/27) remains at the estimated value through 05/10. These estimates are sensitive to the model assumptions, including assumptions about the probability an infected individual will be symptomatic and require hospital care, and assumptions about length of hospital stay, which vary by age.

We estimate that there are approximately 71,400 infectious individuals in Colorado at present (05/10): approximately 1,200 of every 100,000 Coloradoans or 1 in every 81 people. The estimated infection prevalence since March 2020 is shown in Figure 5.

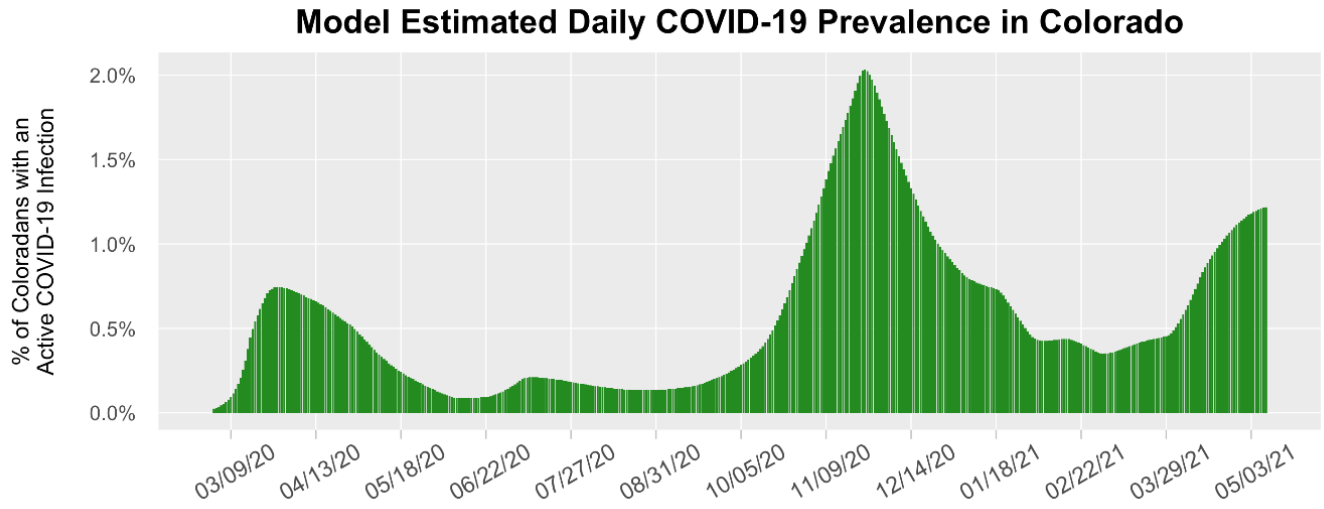

Figure 5 (above). Estimated daily number of people who are infectious and infected with SARS-CoV-2 (point prevalence). Estimate is shown per 100,000 population. The number of infectious individuals is inferred using the model and based on hospitalizations.

Case Detection

Comparing observed to model-estimated infections, **we estimate that approximately 21% of infections were detected by state surveillance systems, including both asymptomatic and symptomatic infections in the two-week period from 04/17 to 04/30** (Figure 6).

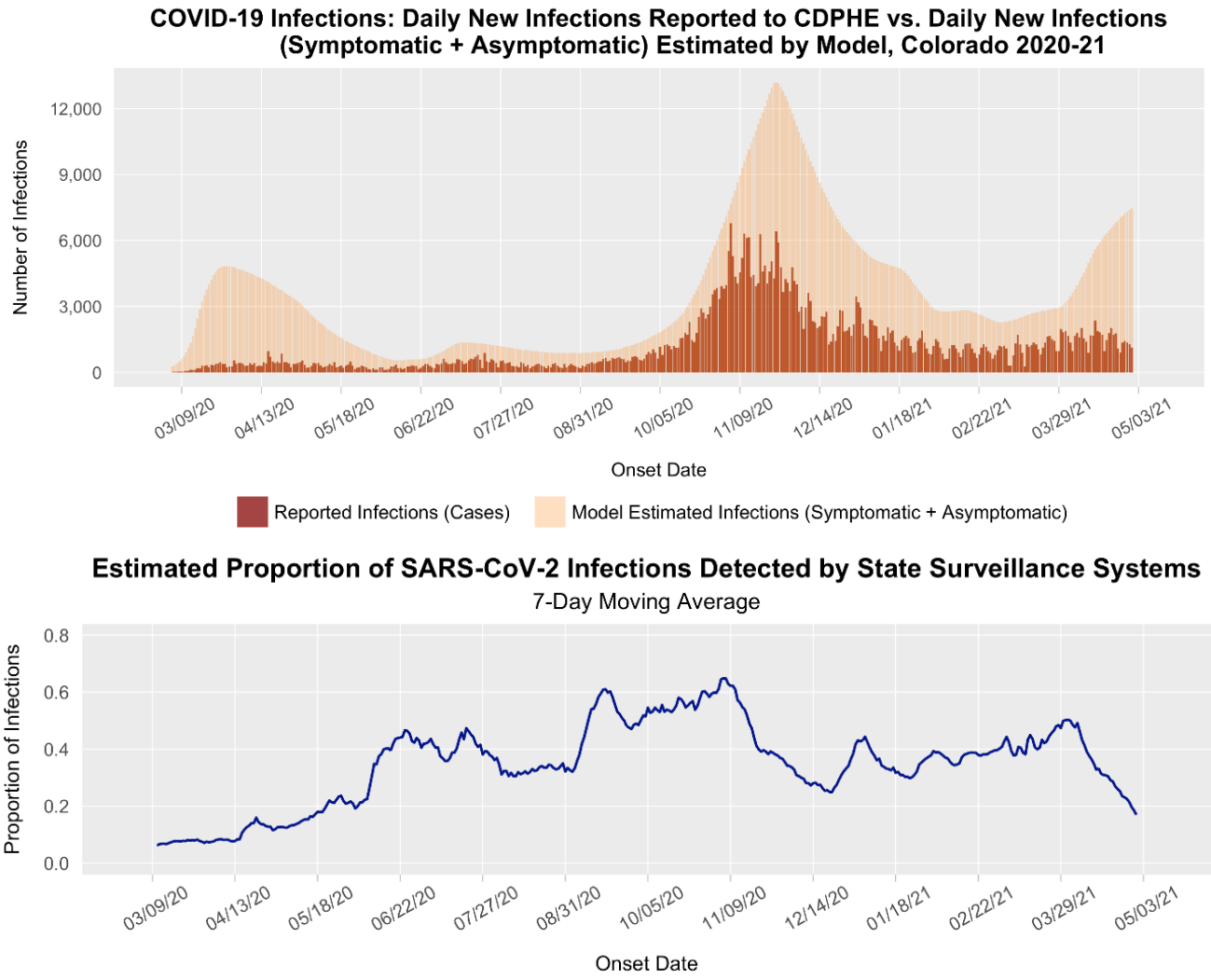

Figure 6 (above). Estimated daily number of new (incident) SARS-CoV-2 infections based on the total estimated by the SEIR model (light orange graph) and reported cases (dark orange graph) over time shown in the top panel. Lower panel shows the 7-day moving average of the estimated proportion of SARS-COV2 infections that are being captured by Colorado state surveillance systems, over time. The proportion detected is estimated by dividing the total number of new cases captured by state surveillance systems by the model-estimated number of new infections each day. The number of cases captured by the state surveillance systems is the number of cases reported by CDPHE, using the onset date of symptoms (if onset date is not available, onset date is imputed by CDPHE using a proxy distribution of recent onset dates). Data are shown through 04/30 to account for typical lags between symptom onset and case report.

Cases and Hospitalizations by Age

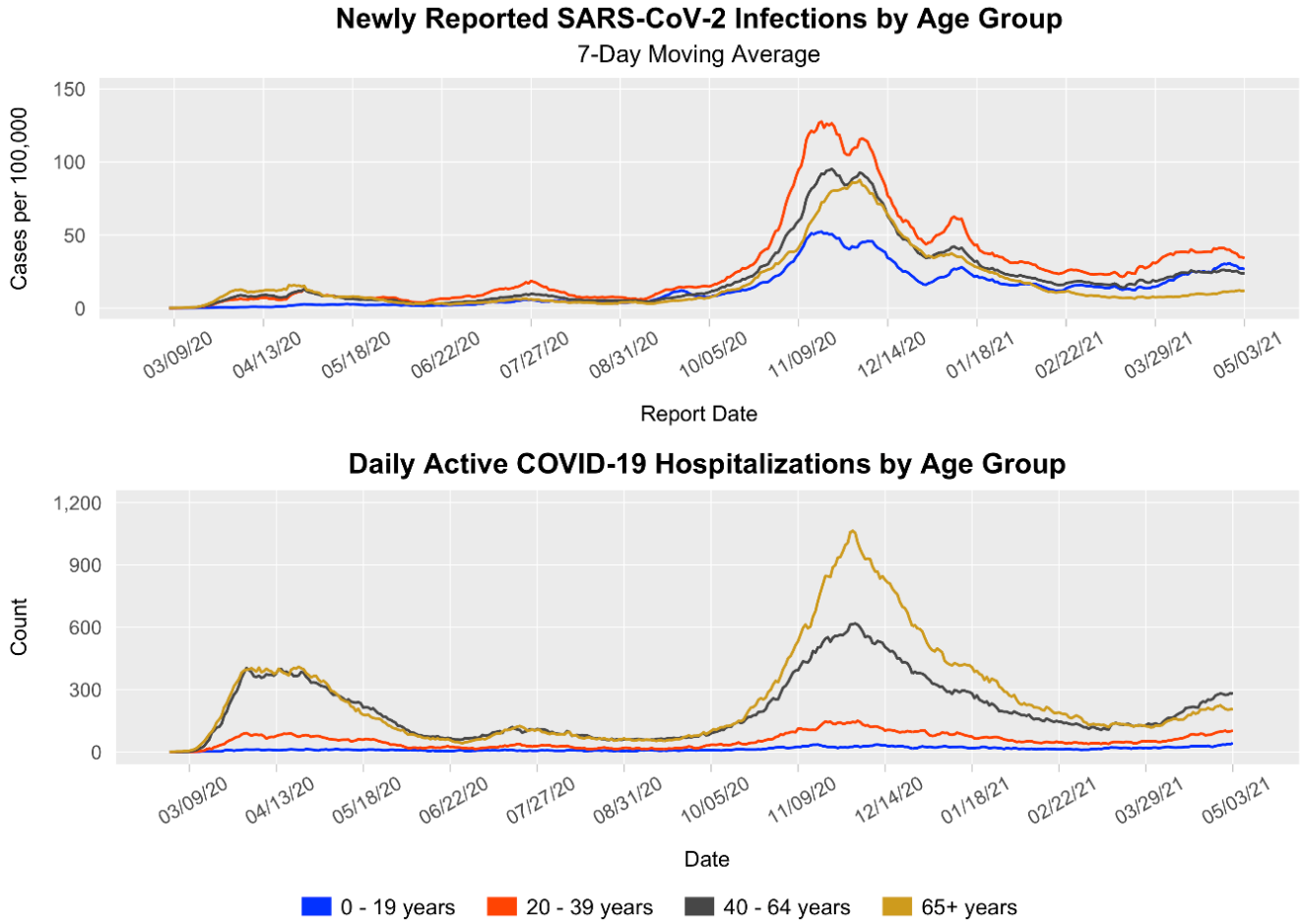

Figure 7 (above). 7-day moving average of newly reported SARS-CoV-2 infections by age group (top panel) since March 2020, obtained from the Colorado Electronic Disease Reporting (CEDRS) line list provided by CDPHE, and count of active COVID-19 hospitalizations by age group (bottom panel) since March 2020, obtained from the COvid Patient Hospitalization Surveillance (COPHS) database at CDPHE. Data on cases is shown through 05/03 and data on hospitalizations is shown through 05/03 to account for typical lags in reporting.

Population Immunity

People can develop immunity to SARS-CoV-2 by vaccination and by prior infection. The proportion of the population immune is an important measure because as more people develop immunity, the spread of infections slows. When many people are immune, infectious individuals are less likely to encounter individuals who are still susceptible to infection (not immune).

Figure 8 shows the proportion of the population immune from March 2020 through the present, estimated using our age-structured SEIRV model and data on vaccinations in Colorado provided by CDPHE. Figure 9 shows the proportions of this immunity by age group. This estimate of population immunity has two components. It accounts for the proportion of people estimated to be immune due to vaccination (yellow line), and the proportion of people estimated to be immune due to either vaccination or prior infection (blue line). In the model, the two-dose vaccines are assumed be 80% effective at preventing infections 14 days after the first dose, and 90% effective one week after the second dose. Vaccination data by age are provided by CDPHE and we assume all individuals who receive first doses also received second doses on schedule. This estimate also accounts for the number of people estimated to have immunity due to prior infection. In our model, immunity from symptomatic infection is assumed to last

approximately one year, and immunity from asymptomatic infection is assumed to last approximately six months. This means people who were infected early in the pandemic may no longer be immune to infection unless they have been vaccinated. We include both detected and undetected infections. Our estimates account for overlap between the vaccinated population and those with immunity due to prior infection. We note that recent studies suggest vaccinations boost immunity in those previously infected.

We estimate that approximately 2,802,000 people in Colorado, or 48% of the Colorado population, are immune to SARS-CoV-2 as of 05/10.

In addition, we provide an estimate of the cumulative number of infections, noting that some people who were infected early in the pandemic may no longer be immune to infection unless they have been vaccinated. **We estimate that approximately 1,673,000 people in Colorado, or 28% of the population, have been infected to date (05/10).**

Projecting forward, Figure 10 shows the timing of reaching various levels of immunity through vaccination and naturally acquired infection, highlighting the higher levels of 70, 80, and 90% and the potential to reach these levels on the current trajectory through August 2021.

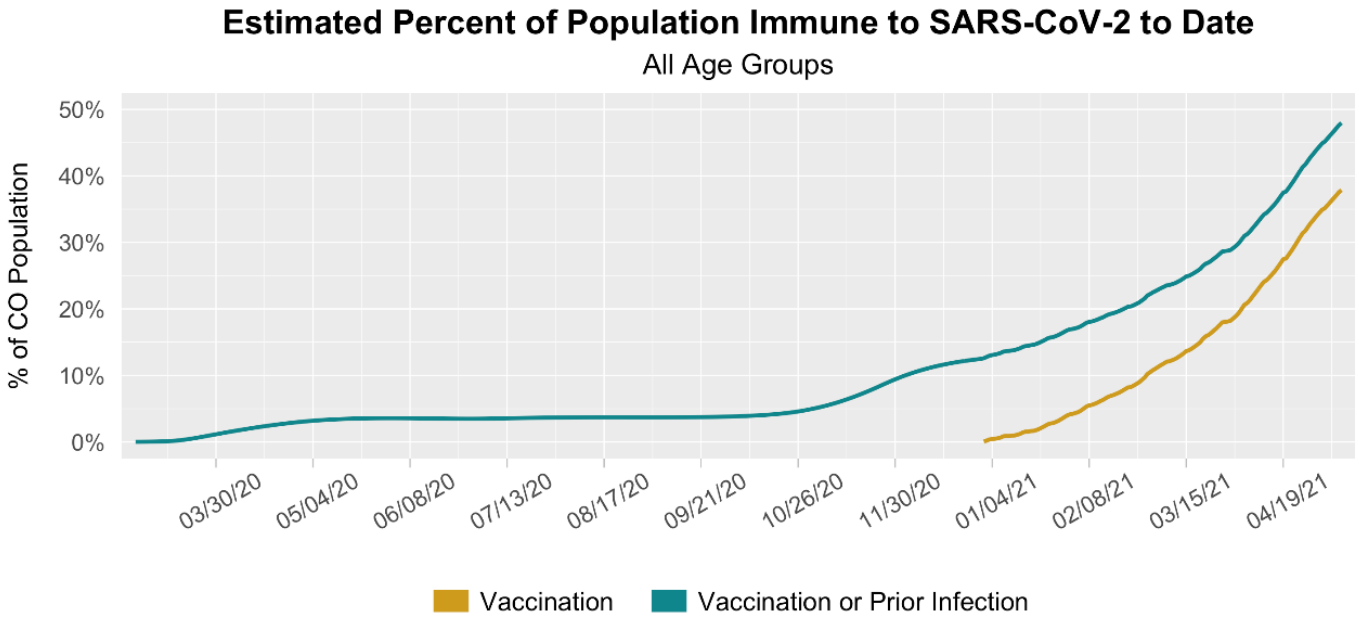

Figure 8 (above). Estimated percent of the population in Colorado assumed to be immune to SARS-CoV-2 due to infection and/or vaccination through 05/10.

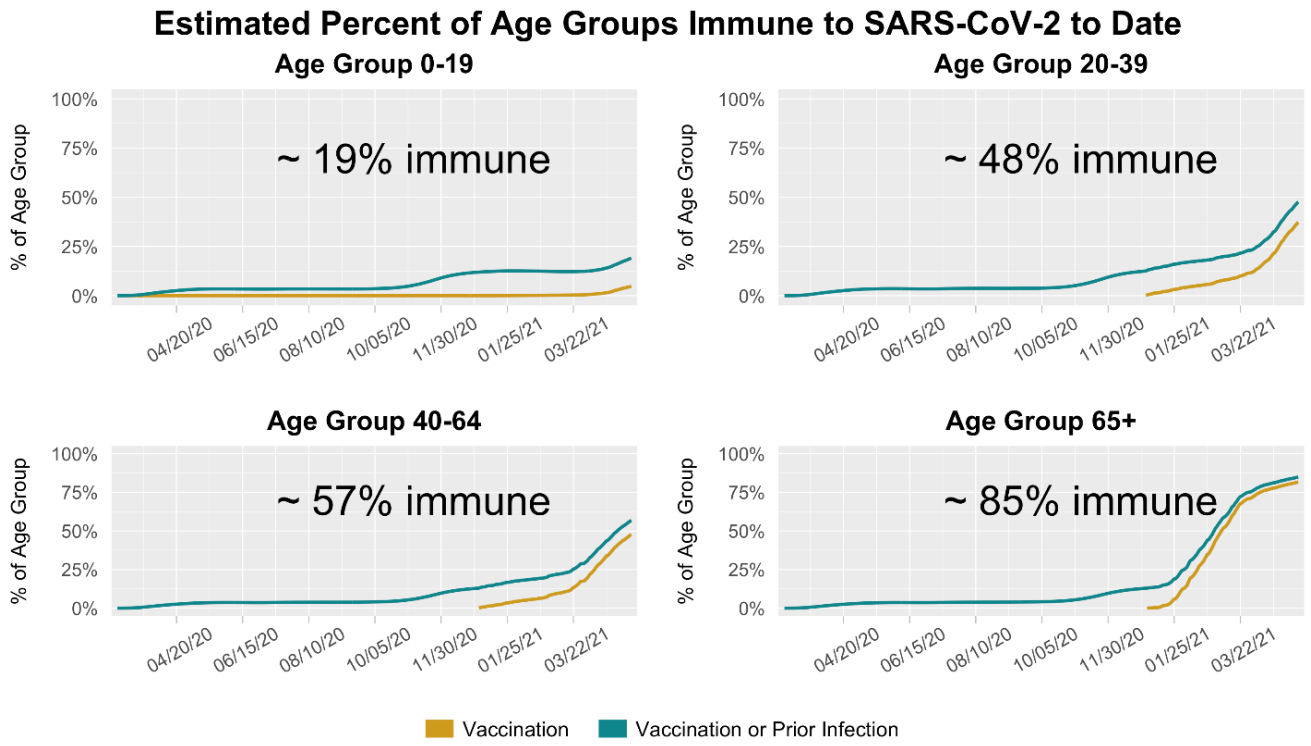

Figure 9 (above). Estimated percent of each age group in Colorado assumed to be immune to SARS-CoV-2 due to infection and/or vaccination through 05/10.

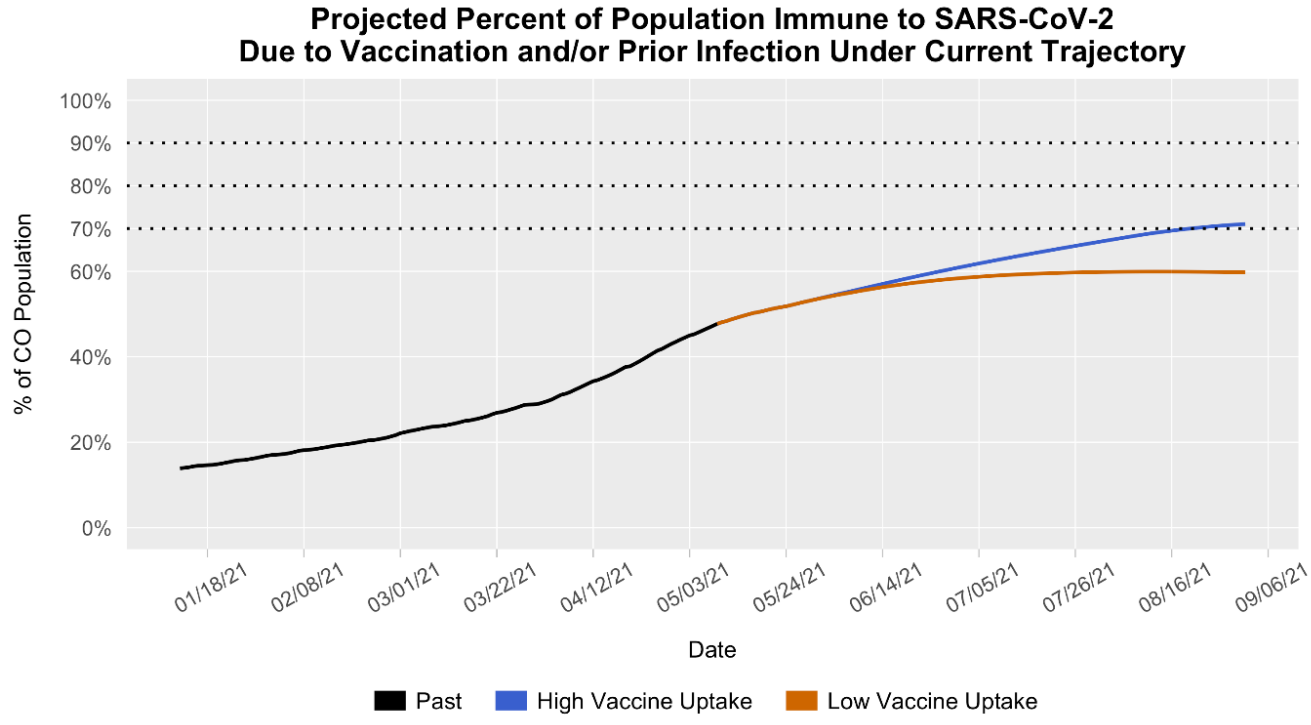

Figure 10 (above). Estimated percent of the population immune due to vaccination and/or prior infection, assuming Colorado remains on its current trajectory and continues either a high vaccine uptake or low vaccine uptake trends under current trends in variant growth. Dashed lines highlight immunity levels of 70%, 80%, and 90%.

Mobility

To investigate the impact of mobility on COVID-19 transmission, we analyze time spent away from home using aggregated mobile device data. Figure 10 displays daily % of time spent away from home from November 1, 2019, to the present for Colorado, as well as the average number of daily contacts per device. The time away from home and daily contacts are the highest they have been since March 2020; however, daily contacts remain well below pre-pandemic levels.

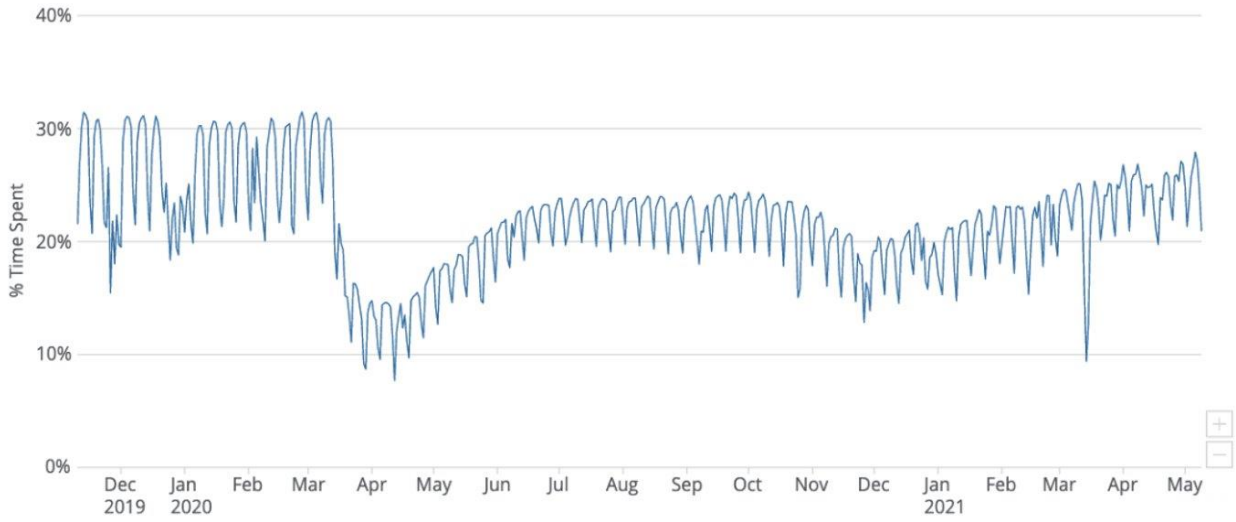

Figure 11 (above). Daily % of time spent not at home from November 2019 to present.

Long-Term Projections

We generated projections of future hospital demand and cumulative mortality under a range of scenarios that assess the potential impact of further reductions in transmission control, the timing of those reductions and low and high vaccine uptake.

Vaccination. We modelled two vaccine rollout scenarios (Figure 12). These scenarios have now been updated to account for the recent approval of Pfizer-BioNTech COVID-19 vaccine for use in 12-15 year olds. In both scenarios, we assume a maximum of 94% uptake in individuals over 65 based on recent vaccination data for this age group. For the high vaccine uptake scenario, we assume there will be 80% uptake in all individuals aged 12 - 64. For the low vaccine uptake scenario, we assume 62% vaccine uptake in the 40 - 64 age group and 50% uptake among individuals 12 - 39. These values come from surveys on vaccine hesitancy rates in Colorado provided by CDPHE. In both scenarios, vaccination rates are assumed to occur at current age-specific rates which remains highest in older age groups. Once the oldest age groups are vaccinated up to the threshold, vaccine is then allocated to the next oldest age group. We assume all individuals who receive a first dose of a two-dose vaccine (Pfizer or Moderna) receive a second dose on schedule. Vaccinations for 12-15 year olds are assumed to begin the week of 05/10. Details of the vaccination rates to date and key assumptions are provided in the appendix.

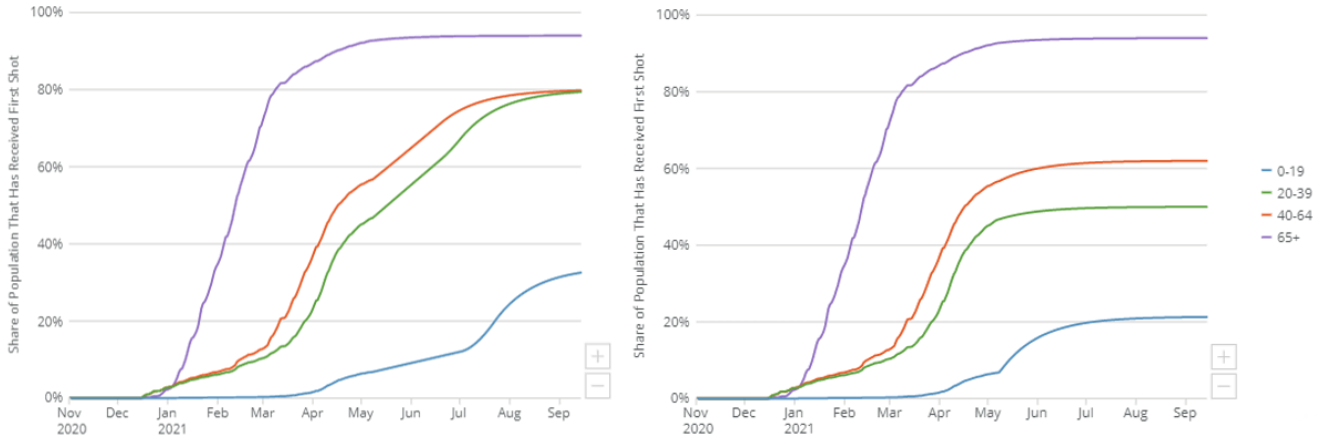

Figure 12 (above). Cumulative number of people vaccinated by age group under the high (left panel) and low (right panel) vaccine uptake scenarios. In the high vaccine uptake scenario, there is 94% uptake among those 65+ and 80% uptake among individuals 12 – 64. Under this scenario, 70% of the total population receives vaccines. In the low vaccine uptake scenario, there is 94% uptake among those 65+, 62% uptake among individuals 40 – 64, and 50% uptake among individuals 12 – 39. Under this scenario, 53% of the total population receives vaccines.

Variants of Concern. Since late 2020, several variants of concern (VOC) emerged in the United States. Based on recent Colorado data, we focus on the two VOCs that appear to be the major VOCs in Colorado: B.1.1.7, which emerged in the United Kingdom and was first reported in the United States in Colorado, and B.1.427/429, first reported in California. The current scientific evidence indicates that both variants are more infectious than other currently circulating variants. Additionally, infection with B.1.1.7 has been shown to increase the risk of hospitalization and death (e.g. NERVTAG 02/11/2021; Davies et. al, 2021). In the projections, we assume B.1.1.7 is 1.5 times more infectious than current circulating variants, and B.1.427/429 is 1.2 times more infectious than currently circulating variants (US CDC, Deng et al 2021). We assume infection with the B.1.1.7 variant confers a 1.4-fold increased risk of hospitalization, a 1.4-fold increased risk of death among those hospitalized, and a 1.7-fold increased risk of death among those not hospitalized for those age 40+ (NERVTAG 02/11/2021; Davies et. al, 2021). We assume infection with the B.1.427/429 variant confers no additional risk of hospitalization or death.

We model the historical distribution of B.1.1.7 and B.1.427/429 since January 2021 using data provided by CDPHE. We then project future growth based on recent trends (Figure A2). In our current scenario, we assume B.1.1.7 accounts for 60% of SARS-CoV-2 infections by mid-April with no further growth and that B.1.427/B.1.429 accounts for <1% of infections by May. More recent data provided by CDPHE and CDC suggests our scenario underestimates the amount of B.1.1.7 starting in April 2021 and that there is potential for continued growth of B.1.1.7. Because of this, the projections below likely underestimate future hospital demand.

Projected COVID-19 Hospital Demand and Deaths Under Different Scenarios.

We considered the following scenarios involving transmission control and vaccine uptake.

1. ***Current trajectory.*** Remain on the current trajectory indefinitely.
2. ***Reduction in transmission control.*** Based on the 7% decline in TC_{pb} over the first two weeks in April, we model a further 7% drop in TC_{pb} now, in two weeks or in four weeks. This is modeled as a 7% drop occurring on Friday, 05/14, 05/28 or 6/11. For each of these scenarios, we assumes TC_{pb} remains at current levels until the date indicated.
3. ***High vs. low vaccine uptake.*** Each of the above scenarios is modeled using a high vaccine uptake scenario and a low vaccine uptake scenario as described above.

Figure 13 shows the projected daily number of people hospitalized with COVID-19 and COVID-19 deaths through late July 2021, if Colorado remains on the current trajectory, for the high and low vaccine uptake scenarios. Figure 14 shows the projected daily number of people hospitalized with COVID-19 and COVID-19 deaths through late July 2021 if Colorado remains on its current trajectory or experiences further declines in transmission control due to changes in policies and behaviors now, in two weeks or in four weeks under high and low vaccine uptake scenarios. Table 1 and Table A3 show the projected cumulative and additional deaths under these scenarios from 05/10 to 07/31.

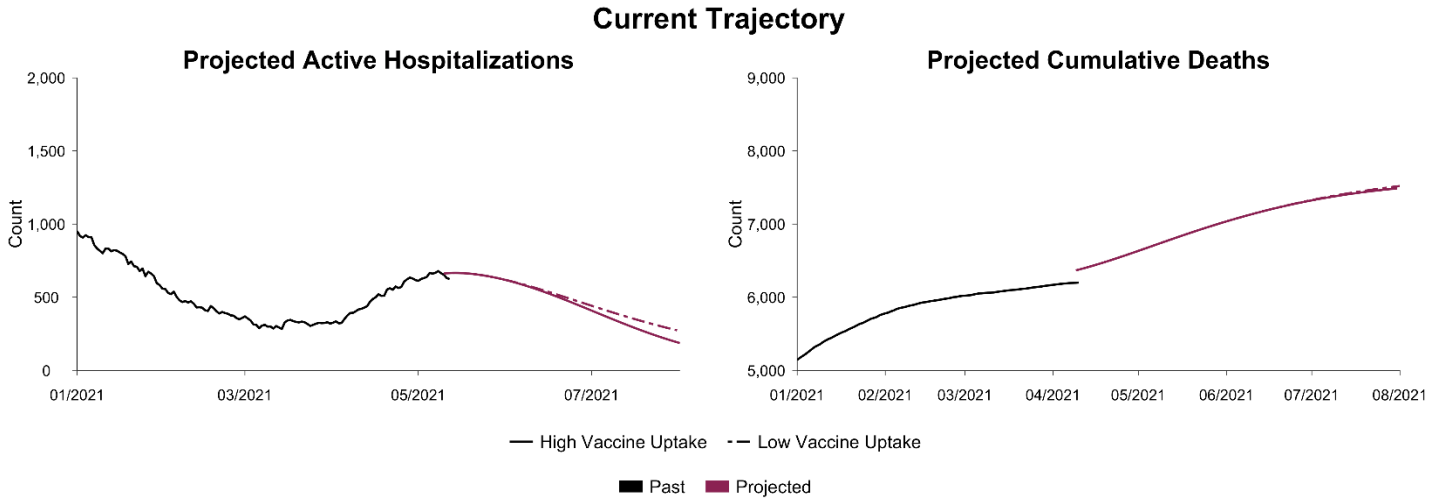

Figure 13 (above). Projected daily number of patients hospitalized with COVID-19 through late July 2021 assuming transmission control (TCpb) remains at the current level indefinitely if there is high vaccine uptake (solid lines) or low vaccine uptake (dashed lines). Black lines indicating historical data reflect observed hospitalizations reported in EMResources and observed cumulative deaths gathered from the CEDRS line list provided by CDPHE. Observed deaths are shown through 04/10 to account for lags in reporting. In these scenarios, we assume B.1.1.7 accounts for 60% of infections as of mid-April, which may be an underestimate.

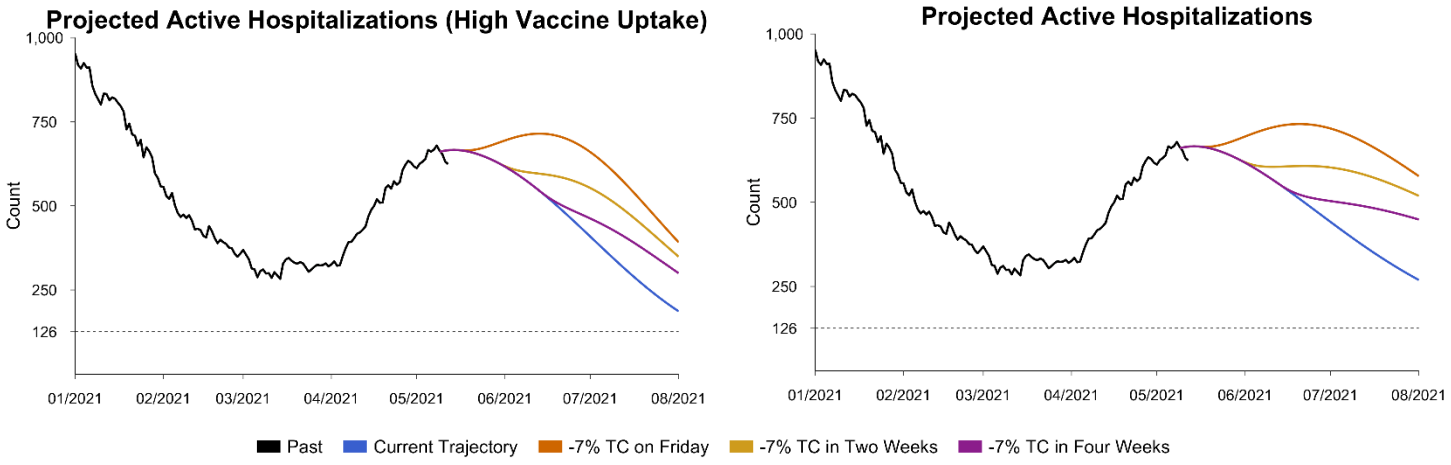

Figure 14 (above). Projected daily number of patients hospitalized with COVID-19 through late July 2021 assuming high (left panel) vs. low (right panel) vaccine uptake. These scenarios show projected hospitalizations if Colorado remains on its current estimated trajectory (blue lines), experiences a 7% reduction in transmission control due to policies and behaviors (TCpb) on Friday, 05/14 (orange lines), in two weeks on Friday, 05/28 (yellow lines), or in four weeks on Friday, 06/11 (purple lines). For each of these scenarios, we assumes TC_{pb} remains at current levels until the date indicated. The horizontal dashed line indicates the low point in hospitalizations during the summer of 2020. Black lines indicating historical data reflect observed hospitalizations

reported in EMResources. In these scenarios, we assume B.1.1.7 accounts for 60% of infections as of mid-April, which may be an underestimate.

Table 1 (below). Projected deaths from 05/10 to 07/31 for the different scenarios. We define additional deaths as the difference between the projected number of deaths under scenarios with additional decay in transmission control, minus the number of deaths projected on the current trajectory.

	Cumulative COVID-19 deaths 5/10 to 7/31	**Additional deaths compared to current, high-vaccine trajectory**
High Vaccine Uptake		
Current trajectory (reference)	731	--
7% decline on 06/11	804	73
7% decline on 05/28	883	152
7% decline on 05/14	1,004	273
Low Vaccine Uptake		
Current trajectory	759	28
7% decline on 06/11	848	117
7% decline on 05/28	935	204
7% decline on 05/14	1,061	330

Appendix

Code, Documentation, and Prior Reports

Code for our model is available on GitHub: https://github.com/agb85/covid-19

Documentation for the model can be found at: https://agb85.github.io/covid-19/SEIR%20Documentation.pdf

Prior modeling reports and documentation can be found at: https://agb85.github.io/covid-19/

Regional modeling results can be found at: https://www.colorado-data.org/regional-epidemic-models

Model Fit

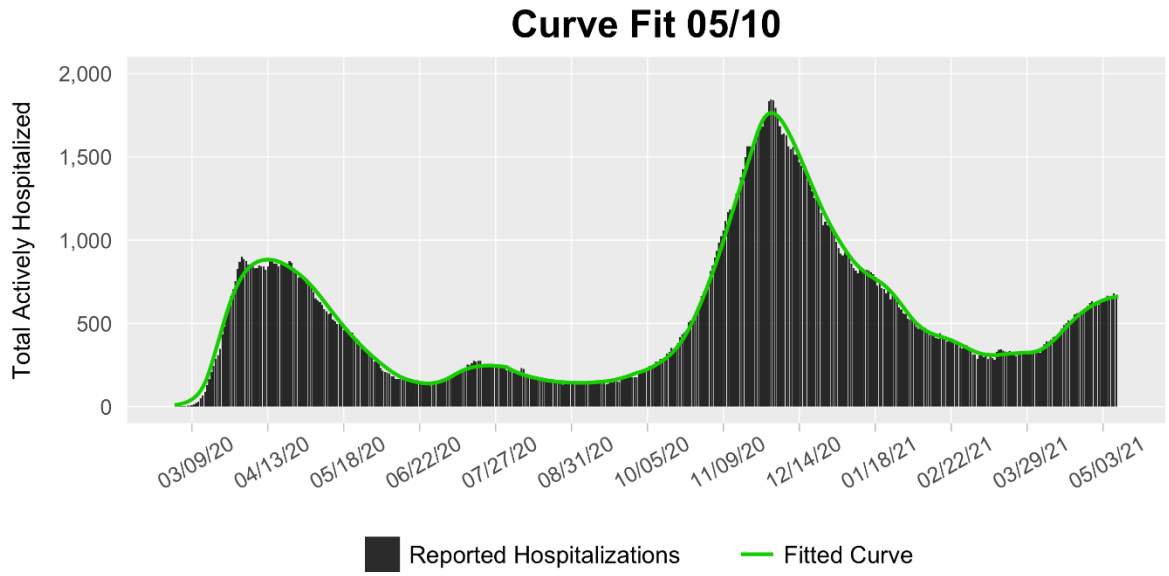

Figure A1 (above). Current model fit (green line) to the count of hospitalized COVID-19 cases (black lines) through 05/10 using the age-structured SEIR model. Hospitalized COVID-19 cases are from CDPHE reported COVID-19 hospitalizations and EMResource (EMR) hospital census data provided by CDPHE.

Data Sources

Table A1 (below). Data used for this model is collected from a variety of sources. Potential lags in reporting can often result in an artificial decline during the most recent days in a dataset, such as with reported cases. To reconcile this, we have cleaved the source data by a set number of days depending on the degree of lag and the metric used. For example, data measured by onset date is cleaved more aggressively than data measured by report date because reported cases tend to be more up to date than the former.

Data	Description	Source	Download Date	Cleave Date	Additional Notes
Hospitalizations (whole state)	Daily COVID-19 hospitalization census (i.e. snapshot of number of patients in the state currently hospitalized with COVID-19 on a given day)	EMR (CDPHE Emergency Management Resource) Dashboard	05/10	05/10	Data is collected in real time (updated 10am MST daily) and is not cleaved.

Data	Description	Source	Download Date	Cleave Date	Additional Notes
Hospitalizations (by age group)	Daily COVID-19 hospitalization census (i.e. snapshot of number of patients in the state currently hospitalized with COVID-19 on a given day) for each age group	COPHS (Covid Patient Hospitalization Surveillance) Resource Utilization Data Output	05/07	05/03	Age groups are 0-19, 20-39, 40-64, and 65+.
Cases detected by state surveillance systems	Daily count of new COVID-19 cases (using onset date)	CEDRS (Colorado Electronic Disease Reporting System) Line List	05/10	04/30	If onset date is missing, an imputed onset date is provided by CDPHE, which is based on true onset dates for the previous two weeks, compiled into a proxy distribution and recalculated weekly.
Reported cases by age and race/ethnicity	Daily count of new COVID-19 cases by age or race/ethnicity (using report date)	CEDRS (Colorado Electronic Disease Reporting System) Line List	05/10	05/03	Age groups are 0-19, 20-39, 40-64, and 65+. Race/ethnicity categories derived from this line list are American Indian/Alaska Native, Asian/Pacific Islander, Black/African American, Hispanic (All Races), Multiple Races (Non-Hispanic), White (Non-Hispanic), and Other/Unknown.
Detected cases by age	Daily count of new COVID-19 cases by age group (using onset date)	CEDRS (Colorado Electronic Disease Reporting System) Line List	05/10	04/26	Used for fitting and estimating age-specific transmission control parameters.
Cumulative deaths	Total deaths among COVID-19 cases to date	CEDRS (Colorado Electronic Disease Reporting System) Line List	05/10	04/10	Used for generating historical and projected estimates of cumulative mortality.

Vaccination

COVID-19 vaccines became available in Colorado on December 16, 2020. We use data provided by CDPHE to estimate the number of people vaccinated by age group over time, and to project the allocation of future vaccinations.

We use known vaccination rates along with assumptions about the level of transmission control moving forward, to generate projections of the percent of the population immune due to vaccination and/or prior infection.

In regards to vaccination, we take into consideration the following:

- We assume all individuals who receive a first dose of a two-dose vaccine (Pfizer or Moderna) receive a second dose on schedule.
- In the model, we represent the efficacy of single and double doses by assuming that among individuals who receive any two-dose vaccine (Pfizer or Moderna), 80% of individuals enter the vaccinated compartment 14 days after the first dose, and an additional 10% of individuals enter the vaccinated compartment 32 days after the first dose, indicating a collective 90% of individuals achieving complete immunity through vaccination.

- In the model, we represent the efficacy of the Johnson & Johnson vaccine by assuming that 66% of individuals receiving this vaccine enter the vaccinated compartment 14 days after vaccination, and an additional 6% enter the vaccinated compartment after 28 days, indicating a collective 72% of individuals in the vaccinated compartment by 28 days after dosing.
- We assume that individuals will be vaccinated regardless of prior infection history. Any individual can receive a vaccine, although vaccination is assumed to have no effect on individuals currently infected.

Table A2 (below). Vaccination rates by age to date included in the model. These are based on data from CDPHE on vaccinations to date by age.

Dates of First Vaccine Dose Administration	0-19 Daily Vaccination Rate*	20-39 Daily Vaccination Rate*	40-64 Daily Vaccination Rate*	65+ Daily Vaccination Rate*
Pfizer/Moderna				
12/15 - 02/01	43	2,089	2,576	4,976
02/01 - 03/08	79	2,516	4,406	9,469
03/08 - 03/29	533	5,999	13,817	2,839
03/29 - 04/12	1,739	12,268	15,131	1,459
04/12 - 04/26	2,784	13,224	11,944	1,436
04/26 - 05/10	1,536	6,295	5,567	933
Johnson & Johnson				
03/01 - 03/15	24	497	1,778	456
03/15 - 03/29	165	459	707	132
03/29 - 04/12	162	2,042	1,924	221
04/12 - 04/26	64	698	647	87
04/26 - 05/10	33	337	387	98

*First doses administered per day for Pfizer and Moderna (assuming all people receiving first doses receive second doses on schedule).

Variants of Concern

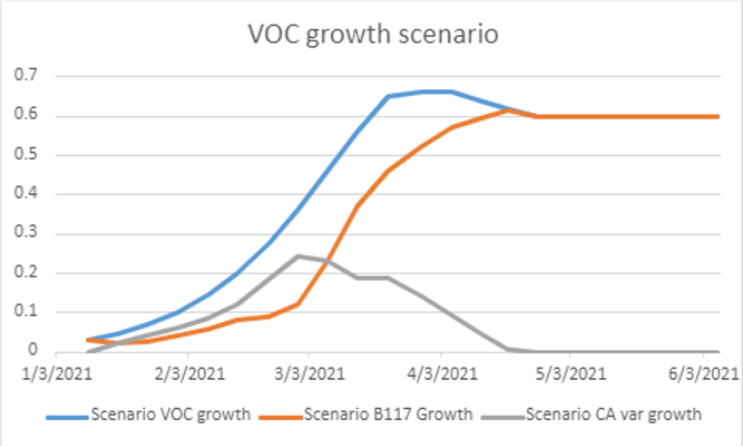

Figure A2 (above). Historical and projected growth of variants of concern in Colorado. Historical variant distribution is based on data provided by CDPHE. Projected growth is based on recent trends. We note that more recent data from the CDC and CDPHE indicate potential for continued variant of concern growth, primarily due to growth of B.1.1.7.

Hospital Demand and Cumulative Mortality

Table A3 (below). Comparison of active COVID-19 hospitalizations and cumulative COVID-19 deaths between 05/10 and 07/31 under the scenarios investigated.

	Date of Peak in Active Hospitalizations	Peak Number of Active Hospitalizations Between 05/10 and 07/31*	Cumulative Infections Between 05/10 and 07/31*	Cumulative Deaths Between 05/10 and 07/31*	Deaths 0-39	Deaths 40-64	Deaths 65+
High Vaccine Uptake							
Maintain Current Trajectory	05/14/2021	666	412,000	731	22	261	447
-7% TC on Fri 05/14	06/13/2021	715	650,000	1,004	31	350	623
-7% TC on Fri 05/28	05/14/2021	666	558,000	883	27	309	548
-7% TC on Fri 06/11	05/14/2021	666	491,000	804	24	283	497
Low Vaccine Uptake							
Maintain Current Trajectory	05/14/2021	666	436,000	759	24	282	453
-7% TC on Fri 05/14	06/20/2021	732	705,000	1,061	34	391	636
-7% TC on Fri 05/28	05/14/2021	666	607,000	935	30	345	560
-7% TC on Fri 06/11	05/14/2021	666	534,000	848	27	313	508

*Deaths estimated from the model include deaths both inside the hospital (ICU and non-ICU) and outside the hospital. Due to lags in reporting that can take up to 28 days, the model may overestimate the number of actual deaths reported by this date.