

Progress Report: Development of Resources for Colorado's SARS-CoV-2 Epidemic

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Introduction

With generous support from several sources, the Colorado School of Public Health (ColoradoSPH) has developed two key resources for the State of Colorado, addressing needs of some of the most critical stakeholders involved in epidemic control. The first is an elaboration of the epidemic model used for the statewide modeling to provide estimates for the course of the epidemic in the state's 11 local public health agency (LPHA) regions and in the counties of the Denver Metro Area. The second is the development and implementation of a website (www.colorado-data.org) that provides a picture at the county-level of the epidemic, covering indicators of the status of the epidemic, the demographics and risk profile of the county population, indicators of economic impact, and patterns of mobility relevant to transmission control. The website also provides access to the modeling at the LPHA- and county-levels.

COVID-19 Regional- and County-Modeling

In March, 2020, the Colorado COVID-19 Modeling Group was formed and since then has used an increasingly refined SEIR (Susceptible, Exposed, Infected, Recovered) model to track the pandemic in Colorado. The model estimates are used to characterize the status of the epidemic, i.e., how rapidly is the epidemic spreading, and to make projections of what could happen under different scenarios of transmission control. The model results are used by the Colorado Department of Public Health and Environment and the Governor's Office in decision-making. Some of the key measures provided by the model are:

1. The effective reproduction number (R_e), which describes the rate of transmission. If above 1, the epidemic curve is rising and if below 1, it is falling.
2. Transmission control, which describes the degree to which transmission of infection is being controlled. It ranges from 0 to 100%.
3. Infection prevalence characterizes how many people are infected in a population. It is expressed as 1 in xx, e.g., 1 in 100 Coloradans, are infected
4. Percent of population recovered from infection to date describes the percentage of the population that has been infected with the SARS-CoV-2 virus.

The regional- and county-level models were developed following requests from some critical stakeholders particularly the directors of the LPHAs. The state-level modeling proved to be too general for use by the LPHAs, as the model results did not address the specific characteristics of the populations of the state nor the variation in the epidemic by county and geographic region. The regional- and county-level reports are now posted regularly on the website for the Colorado School of Public Health and can also be accessed

through the new website. The most recent report (12/15/20) can be found here: https://agb85.github.io/covid-19/Regional%20Report_20201216.html

The development of these models to complement the statewide model involved substantial effort to accommodate the more limited quantity of data available for these subpopulations of the state. New approaches were developed and tested that pulled in case data as well as hospitalization data, which can be sparse for smaller regions and counties. Additionally, the team developed data displays that provided a comprehensive picture over time for each geographic unit. The Appendix provides examples of the data included in the regional- and county-level reports.

Colorado Population Data Dashboard (www.colorado-data.org)

The Colorado School of Public Health and the COVID-19 Modeling Group developed the Colorado Population Data Dashboard website to disseminate key information and population-level data related to the ongoing SARS-CoV-2 (COVID-19) pandemic. It was developed for decision-makers in Colorado, from the state to the local levels, and for private citizens who may find the information and models useful. It is designed to complement existing information available on the COVID-19 pandemic and provide a comprehensive picture of community-level characteristics to assist local decision-makers in both the short- and long-term recovery post-pandemic.

It brings together data from state and federal public resources on health and economics, epidemic models for the state, local public health regions and counties, a description of how people move within and across their counties, and unemployment activity at the county level.

In developing this website, we have had input from many sectors, including state and local public health agencies, county commissioners, Colorado Human Services Directors Association and other local stakeholders.

Data used on our website and disease models

All the datasets and indicators were carefully selected for inclusion in the website with input from our stakeholders. The website provides access to both static (updated on a yearly basis) and real-time (updated on a daily or weekly basis) data. We make the data available to all who may choose to use it in their own analyses through the website.

We coordinated with various agencies in Colorado to ensure the accuracy and interpretation of the data including: Colorado Department of Public Health and Environment, Colorado State Demography Office, Colorado Department of Labor and Employment, Colorado Department of Health Care Policy and Financing, and Colorado Office of Economic Security.

The website dedicates a series of pages for estimates (e.g., effective reproduction number and infection prevalence) from the [state](#) and [regional epidemic models](#), as described above.

The first released version of the county-level dashboards includes the following categories of indicators:

- COVID-19 surveillance indicators (e.g., past 14-day case rates and positivity rates)
- Demographics (e.g., age and race)
- Social and economic factors (e.g., education and insurance)
- Health risks (e.g., diabetes, asthma and heart disease)
- Mental health (e.g., suicide and alcohol consumption)
- Economic activity (e.g., weekly filings for unemployment insurance benefits, Supplemental Nutrition Assistance Program monthly claims and monthly Medicaid enrollment)
- Mobility patterns (real-time)
- Other factors that may increase a person's and a population's risk for contracting SARS-CoV-2 infection and the disease it causes—COVID-19 (e.g., working in essential jobs)

Stakeholder Advisory Group

To assure that this website is as informative as possible, we assembled a diverse [stakeholder advisory committee](#) to provide insight as the website is developed, implemented, and revised over time.

Prior to public launch, we held several meetings with our stakeholders (listed below). The report from these meetings can be found here: [View the stakeholder feedback report from the first meeting.](#)

Local Public Health Agencies

- Bill Burman, MD: Director of Denver Public Health
- John Douglas, MD: Director of Tri-County Health Department
- Grace Franklin, MPH: Director of San Miguel Department of Public Health
- Tom Gonzales, MPH: Director Larimer County Department of Health and Environment
- Hayden Hedman, PhD: Lead COVID-19 Epidemiologist for Summit County
- Joni Reynolds, RN/CNS, MSN: Director Gunnison County Department of Health and Human Services
- Suzuho Shimasaki, DrPH, MPH: Deputy Director Pitkin County Public Health
- Jason Vahling, MPH: Director Broomfield Department of Public Health and Environment

County Commissioners and Appointees

- Sandra Cinor, PhD: Regional Epidemiologist for the West Central Public Health Partnership (appointed by Ben Tisdell/Ouray)
- Megan Davisson, MPP: Senior Analyst for Douglas County (appointed)
- Beth Melton, BA: Routt County Commissioner

Colorado Hospital Association

- Darlene Tad-y, MD: Vice President of Clinical Affairs
- Essey Yirdaw, MPH: Director of Data Analytics

Organizations

- Colorado Association of Local Public Health Officials: Tracy Anselmo, MPH (Executive Director)

- Colorado Human Services Directors Association: Alexis Kuznick, JD (Director)
- Colorado Counties, Inc: Gini Pingenot, MS (Director of External Affairs)
- Colorado Counties, Inc: Daphne Gervais, BS (Legislative and Policy Advocate)

Anticipated Additions

The intent is to continue to enrich the data available on the website. Planned additions include mental health indicators and we anticipate further expansions as we hear from users.

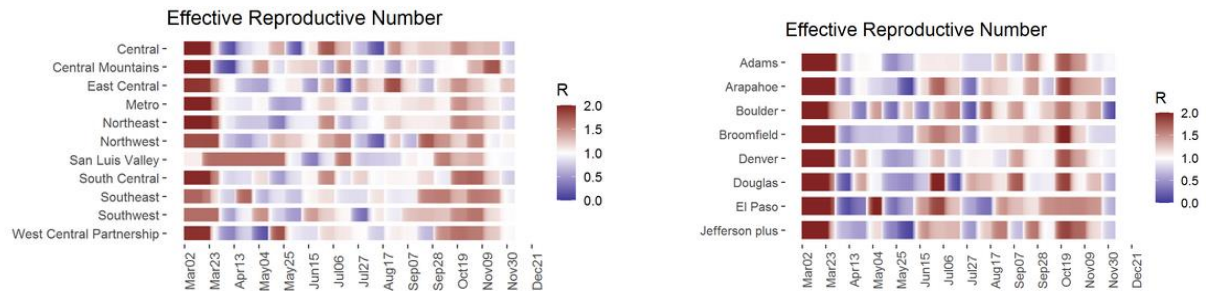
APPENDIX

Epidemic-Related Measures Generated for the Regional Modeling Reports

Effective Reproduction Number

The effective reproduction number (R_e) measures how quickly COVID-19 infections are spreading in a region at that time. When R_e is above 1, infections are increasing. When R_e is below 1, infections are decreasing. When R_e equals 1, infections are stable. R_e is estimated using the regions' hospitalization data. As hospitalizations generally occur 2 weeks after infection, the hospitalizations and R_e estimate provided represents infections from 13 days prior. For example, an R_e reported on 11/24/2020 reflects the spread of infections occurring on approximately 11/03/2020.

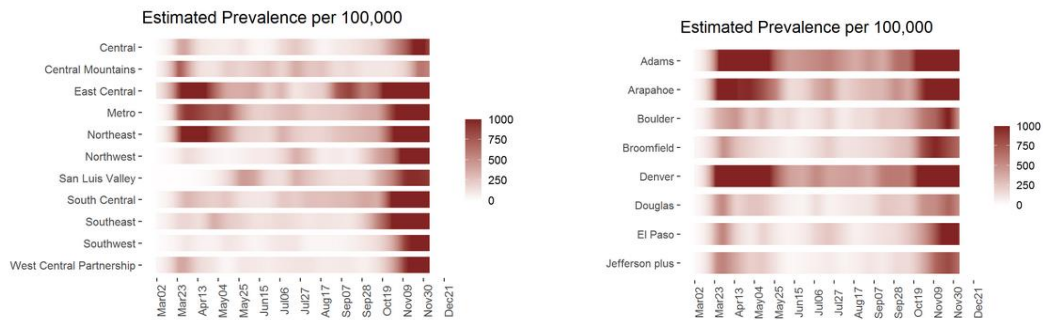
Figure 1 in the report shows the estimated R_e over time in the individual regions formatted in a "heat map" with purple representing R_e below 1 (decreasing infections), white representing R_e at 1 (stable infections), and red representing R_e above 1 (increasing infections).



Infection Prevalence

Infection prevalence provides an estimate of the proportion of the region's population that is currently infected with COVID-19 and capable of spreading it to others. When infection prevalence levels are higher, uninfected people are more likely to come in contact with an infectious person. As this is a prevalence measure, it is reported per 100,000 people in the same region, rather than as a total count of infectious people.

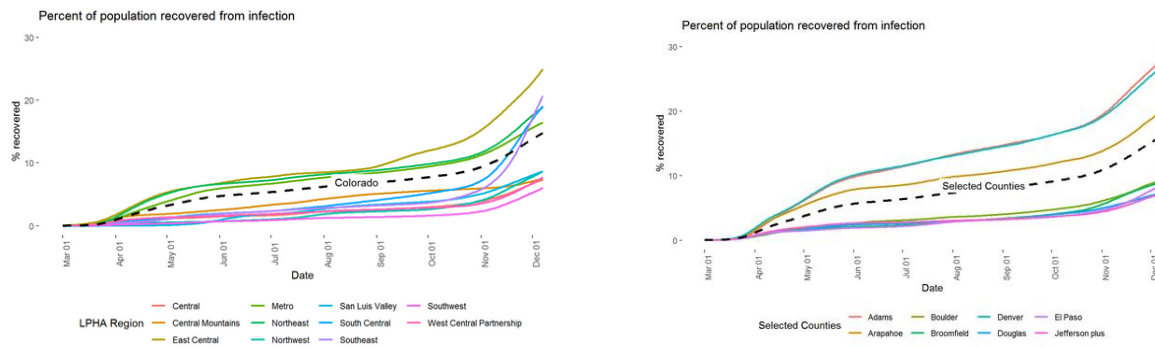
Figure 2 in the report shows the estimated prevalence of infectious people in the individual regions per 100,000 people in that region’s population. This figure is formatted as a “heat map” as well—the darker the red, the higher the number of infectious people per 100, 000 in the same region’s population.



Percent of Population Recovered from Infections to Date

People can develop immunity to COVID-19 infection by having already had the infection or by vaccination in the future. As more people in a region become immune to COVID-19, those who are not immune have less chance of encountering someone who is infectious. Note that immunity to COVID-19 is not well understood yet and vaccines are not currently available.

Figure 3 estimates the percent of the population that has been infected with COVID-19 and then recovered (now immune) to date for each region. This is an uncertain estimate as we still don’t know how long immunity lasts. These estimates will be updated as we learn more about how immunity to COVID-19 works.



Additional Representative Figures Included in the Regional Modeling Reports

COVID-19 Hospitalizations

COVID-19 hospitalizations are a sensitive measure of COVID-19 transmission in a region that show the severity of infections in that region. While many COVID-19 infections are not captured by the state surveillance system because of no or mild symptoms experienced by some people infected with COVID-19, we expect that almost all COVID-19 hospitalizations are identified. The populations of the regions

vary, so to allow for comparing across regions, COVID-19 hospitalizations are shown per 100,000 people of the same region.

Figure 4 shows the daily number of people who are hospitalized in each region with COVID-19 (per 100,000 people in that same region) over the past 12 weeks.

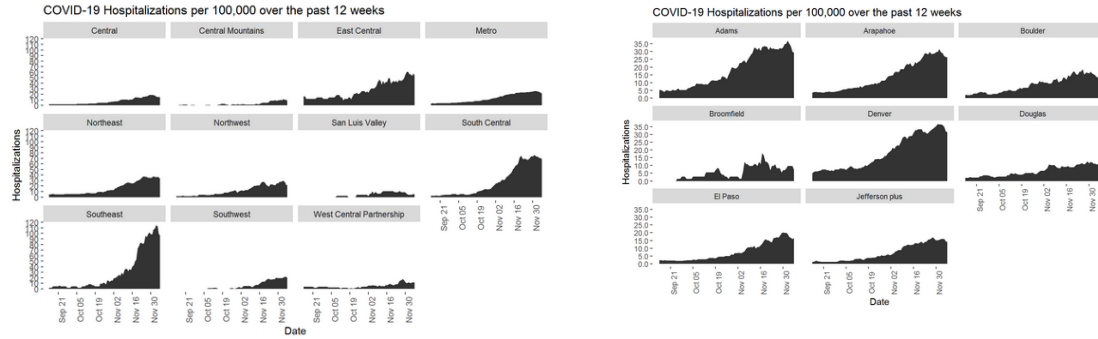


Figure 5 shows the daily number of people who are hospitalized in each region with COVID-19 (per 100,000 people in that same region) since the first case was reported in March 2020.

