Parameter estimates and model fit – 10/05/2020

Based on Colorado COVID-19 hospitalization data through 10/05/2020
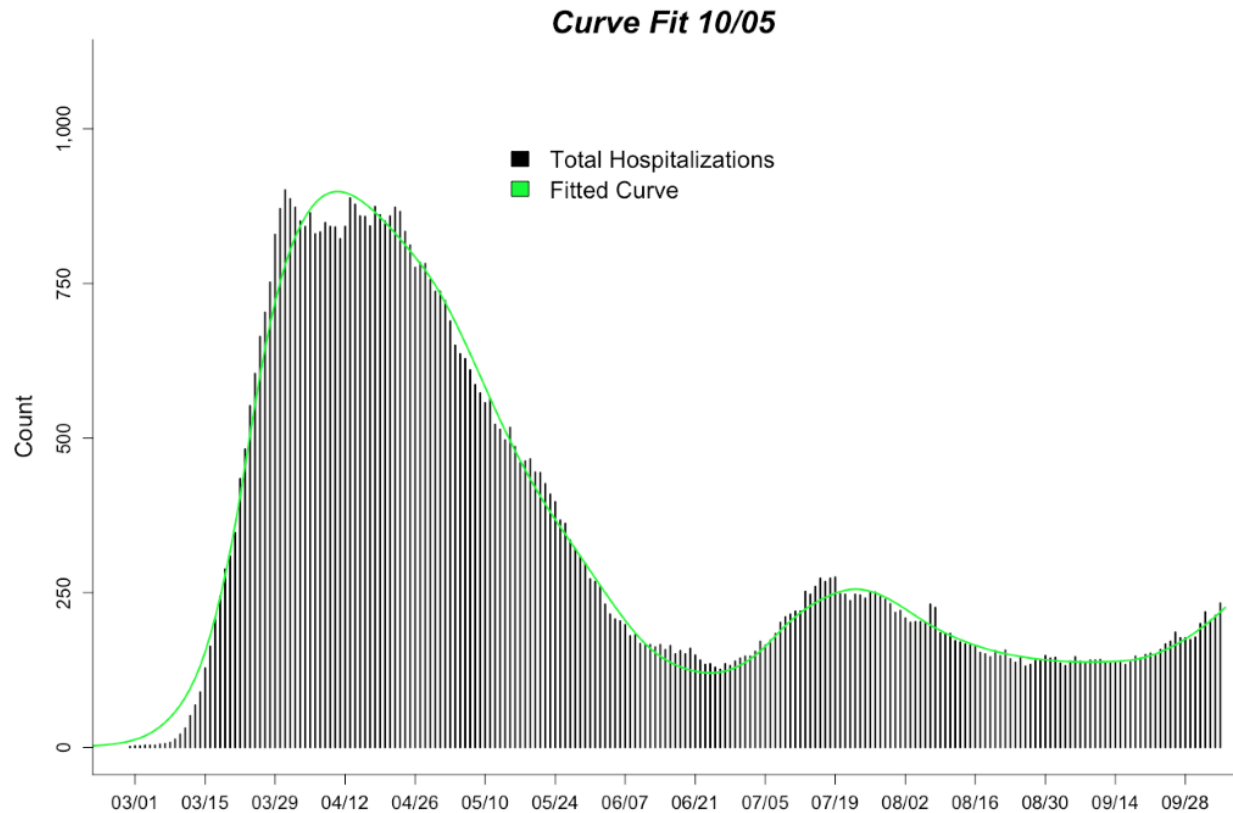

Figure 1. Current model fit (green line) to hospitalized COVID-19 cases (black lines) using the age-structured SEIR model. Hospitalized COVID-19 cases are from CDPHE reported COVID-19 hospitalizations and EMResource (EMR) hospital census data provided by CDPHE.

Table 1. Current and prior estimates of the effective reproductive number (Re) in Colorado.

	Current Estimate (10/05)	Estimate one week ago (09/28)	Estimate two weeks ago (09/21)
Estimate of Re, approach 1, SD model*	1.48	1.24	1.08
Estimate of Re, approach 2, SD model*	1.27	1.27	1.05
Estimate of Re, approach 1, from TR model *	1.49	1.21	-
Estimate from RT-Live	1.00	1.10	1.16
covid-19-projections.com	1.04	1.03	1.04

*Our estimates are based on hospitalization data through the date listed. Estimates from the external sites are extracted on the day listed. Because of the 13-day lag between infection and hospitalization, on average, our current estimate reflects transmission up to approximately September 22. Approach 1 uses SD model output to estimate the average number of new cases generated by existing cases, accounting for the latent period and

duration of infectiousness. The second method uses the SD model structure to estimate the dominant eigenvalue for a matrix describing population flows across the model compartments. The Re from the TR model uses Approach 1 for calculation.

Table 2. Estimated model parameters based on fitting our model output of total hospitalizations to reported hospitalizations in Colorado.

	Range of possible values	Fitted value, SD model	Fitted value, TR model	Fit using data through
Social distancing*				
Estimated social distancing level over past three weeks, 08/31 – 09/22	0-99%	58%		10/05
Estimated current social distancing level, 09/13 – 09/22	0-99%	50%		10/05
Transmission Reduction				
Estimated transmission reduction level over past three weeks, 08/31 – 09/22	0-99%		74%	10/05
Estimated current transmission reduction level, 09/13 – 09/22	0-99%		67%	10/05
Mask wearing				
Percent of individuals wearing masks, 4/4 to 4/27		50%	N/A	Assumed¶
Percent of individuals wearing masks, 4/27 to 7/15		70%	N/A	Assumed¶
Percent of individuals wearing masks, 7/16 to present		90%	N/A	Assumed
Case isolation				
Decrease in infectious - symptomatic contact rate due to self-isolation by symptomatic after March 5 (dividing by 0.57 gives proportion that self-isolate) **	0.1 - 0.8††	0.44	N/A	06/24
Transmission parameters				
The rate of infection (beta)	0.2 - 0.6††	0.48	0.48	06/24
Ratio of infectiousness for symptomatic vs. asymptomatic individuals (lambda)	1.0 - 4.0††	1.39	1.39	06/24

*The social distancing parameter estimates the percent decrease in effective contacts between susceptible and infectious individuals. This parameter accounts for social distancing policies intended to avoid contact altogether (e.g., through workplace and school closures) as well as policies and individual behaviors to reduce potential contact with the virus (e.g., maintaining at least 6 feet of distance between people outside of one's household, and handwashing).

The transmission reduction parameter is an estimate of total decrease in transmission-relevant contact rates compared to baseline, it incorporates the impact of all policy measures and behavioral changes that effect transmission.

†Social distancing estimated weekly and averaged over time period of interest.

¶Given the difficulty in disentangling the effect of mask wearing from social distancing in decreasing transmission, we cannot fit this parameter at this time. Survey data suggests levels of mask wearing in June were approximately 70% [1]. Recent data from local public health agencies suggest mask wearing is above 90% in stores.

**Self-isolation by symptomatic cases is assumed to occur 1 day after the onset of infectiousness and decrease the 67% of contacts that typically occur outside of the home. This parameter jointly accounts for the percent of symptomatic individuals that self-isolate and the imperfect decline in contacts. Dividing the value in the table by 0.57 gives the proportion of symptomatic individuals that self-isolate.

††The range of potential parameter values for case isolation [2] and the rate of infectiousness for symptomatic vs. asymptomatic individuals [3, 4] are based on the literature, and for the rate of infection, were obtained from the MIDAS Online COVID-19 compilation of parameter estimates [5].

References

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3. Li R, Pei S, Chen B, Song Y, Zhang T, Yang W, et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). Science. 2020;368(6490):489-93. Epub 2020/03/18. doi: 10.1126/science.abb3221. PubMed PMID: 32179701; PubMed Central PMCID: PMCPMC7164387.

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5. MIDAS. MIDAS Online COVID-19 Portal 2020. Available from: https://github.com/midas-network/COVID-19/tree/master/parameter_estimates/2019_novel_coronavirus.