

IEM's AI Modeling: Short-term COVID-19 Projections

Date: 6/2/21

Leveraging over 15 years of support to HHS for medical consequence modeling and our proprietary artificial intelligence (AI) models, IEM believes that our Coronavirus model outputs can be used to assist localities and their medical facilities to better prepare for an increase in hospitalizations, to better plan for and locate drive-through testing facilities, and to determine where increased levels of transmission may be occurring.

We have been refining our AI model over the past month and are confident in its ability to provide accurate 7-day projections that can be used for operational and logistical planning.

AI-based Model Background

IEM is currently using an AI model to fit data from various sources and project new cases of COVID-19. We do not assume the average number of secondary infections (R-value) stays the same over time. IEM's AI model finds the best R-value over time to evaluate how it changes over the course of the outbreak. The IEM modeling team is running ~11 million simulations to fit each state's data and using the best fit for the R-value to project new cases over the next 7 days. The AI models are executed on a daily basis to evaluate the changing dynamics of the COVID-19 pandemic. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

The projections shown in this document are based on data pulled in as of 6/2/21 9 a.m.

Please provide any feedback or send any questions that you might have to us. We are continually updating and improving the model, so your feedback is critical.

Also, if you have more current or refined data for your State, Commonwealth or Territory that you would like IEM to factor in, please let us know.

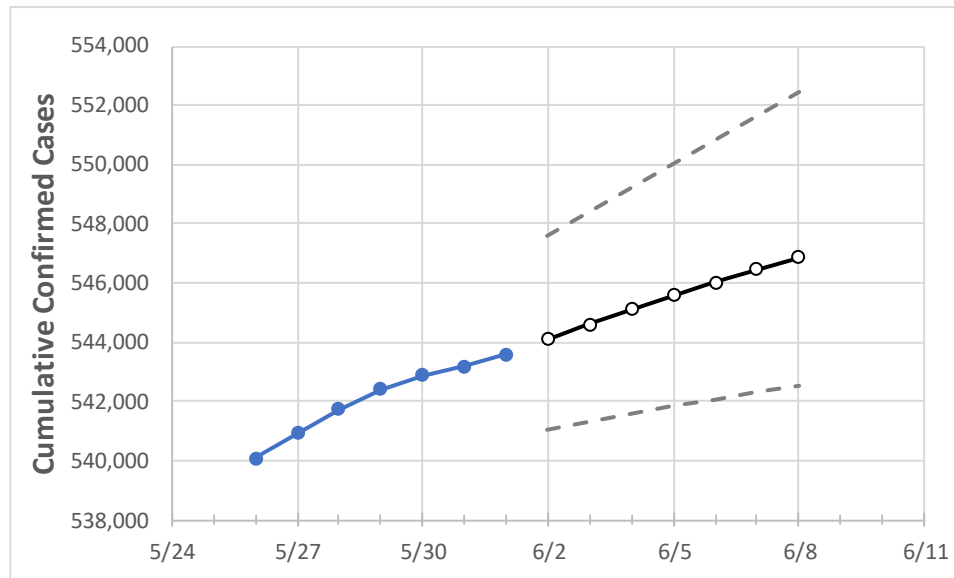
IEM's Modeling Lead

Dr. Prasith "Sid" Baccam is a **Computational Epidemiologist expert** at IEM with more than **20 years of experience in medical consequence modeling and simulation of disease outbreaks** and medical consequences following hypothetical attacks with biological agents or emerging infectious diseases. He develops key simulation models and decision support tools at IEM, specializing in public health, disaster response, and medical countermeasures (MCM) to enhance data-driven decision making and improve modeling assumptions.

Upon receiving his **Ph.D. in Applied Mathematics and Immunobiology** at Iowa State University, Dr. Baccam worked as a Postdoctoral Research Associate at Los Alamos National Laboratory where he focused on researching viral and immunological modeling. After his stint at Los Alamos, Dr. Baccam has served as Task Lead in multiple public health projects have allowed him to develop expertise as a mathematical biologist and a leader on high-performance modeling and simulation teams.

He has worked with state and local public health officials as well as Federal agencies, including **HHS**, the Centers for Disease Control and Prevention (**CDC**), and the Department of Homeland Security (**DHS**). Dr. Baccam has published numerous papers on public health response models and implications on policy and has been invited to participate in workshops and symposiums held by the Institute of Medicine (now the National Academy of Health). His modeling results have been briefed to the **Executive Office of the President** and informed two presidential policy actions.

Colorado State Projections



	Actual Confirmed Cases On:				Projected Cases For:							
	5/29	5/30	5/31	6/1	6/2	6/3	6/4	6/5	6/6	6/7	6/8	
Colorado	542,405	542,889	543,174	543,581	544,104	544,616	545,100	545,572	546,026	546,454	546,873	

Note: The State's projection shows a "best estimate" curve (the solid line with circles) and the dotted lines are the upper and lower estimates around that best estimate. Our projections have typically been within 10%, and are often within 5%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:							
	5/29	5/30	5/31	6/1	6/2	6/3	6/4	6/5	6/6	6/7	6/8	
Adams	59,705	59,741	59,771	59,799	59,841	59,881	59,918	59,954	59,986	60,020	60,050	
Arapahoe	61,397	61,448	61,469	61,516	61,572	61,629	61,681	61,734	61,785	61,833	61,875	
Boulder	23,658	23,667	23,675	23,684	23,698	23,712	23,724	23,736	23,749	23,761	23,772	
Denver	73,055	73,101	73,118	73,145	73,179	73,213	73,244	73,273	73,302	73,330	73,355	
Douglas	29,499	29,531	29,540	29,557	29,582	29,607	29,631	29,653	29,675	29,695	29,715	
Eagle	6,321	6,322	6,323	6,323	6,325	6,327	6,328	6,330	6,332	6,333	6,334	
El Paso	70,244	70,339	70,400	70,525	70,666	70,805	70,944	71,073	71,202	71,331	71,453	
Gunnison	1,350	1,351	1,352	1,351	1,352	1,353	1,354	1,355	1,356	1,357	1,358	
Jefferson	47,914	47,943	47,963	47,981	48,011	48,039	48,066	48,089	48,112	48,133	48,153	
Larimer	26,942	26,965	26,978	26,997	27,016	27,035	27,052	27,069	27,085	27,099	27,114	
Pueblo	19,079	19,088	19,094	19,101	19,115	19,130	19,143	19,155	19,167	19,179	19,190	
Weld	32,522	32,551	32,578	32,604	32,638	32,672	32,703	32,732	32,761	32,790	32,816	

Some recipients of our daily COVID-19 short-term (7 day) projections have requested projections of demand for: hospital bed, intensive care unit (ICU) beds, and mechanical ventilation. We realize that different states and localities will have different characteristics for hospital demand of COVID-19 cases, and we are presenting the best assumptions we could find for those medical demands based on scientific literature and health data reporting. Specifically:

- **Beds:** For hospitalization, we use a range of 10% and 20% of cases require hospitalization based on CDC's report ([MMWR, March 18, 2020](#)) and state reports of COVID-19 cases.
- **ICU:** The CDC report found that 24% of hospitalized cases require ICU care.
- **Ventilators:** Based on clinical data from China and state reports, we assume that 50% of ICU cases require a ventilator.

If you have other estimates for these assumptions, please share them with us as we work to refine our modeling, assumptions, and data on a daily basis.

The medical demands shown in the table assume 20% of **cumulative** confirmed cases require hospitalization. To get the medical demand for the assumption that 10% of confirmed cases require hospitalization, simply divide the demand by 2.

Colorado Medical Demands by County

	Actual Confirmed Cases On:				Projected Cases (Hospitalized) [ICU] {Ventilator} For:							
	5/29	5/30	5/31	6/1	6/3		6/5		6/7			
Adams	59,705	59,741	59,771	59,799	59,881	(11,976) [2,874] {1,437}	59,954	(11,991) [2,878] {1,439}	60,020	(12,004) [2,881] {1,440}		
Arapahoe	61,397	61,448	61,469	61,516	61,629	(12,326) [2,958] {1,479}	61,734	(12,347) [2,963] {1,482}	61,833	(12,367) [2,968] {1,484}		
Boulder	23,658	23,667	23,675	23,684	23,712	(4,742) [1,138] {569}	23,736	(4,747) [1,139] {570}	23,761	(4,752) [1,141] {570}		
Denver	73,055	73,101	73,118	73,145	73,213	(14,643) [3,514] {1,757}	73,273	(14,655) [3,517] {1,759}	73,330	(14,666) [3,520] {1,760}		
Douglas	29,499	29,531	29,540	29,557	29,607	(5,921) [1,421] {711}	29,653	(5,931) [1,423] {712}	29,695	(5,939) [1,425] {713}		
Eagle	6,321	6,322	6,323	6,323	6,327	(1,265) [304] {152}	6,330	(1,266) [304] {152}	6,333	(1,267) [304] {152}		
El Paso	70,244	70,339	70,400	70,525	70,805	(14,161) [3,399] {1,699}	71,073	(14,215) [3,412] {1,706}	71,331	(14,266) [3,424] {1,712}		
Gunnison	1,350	1,351	1,352	1,351	1,353	(271) [65] {32}	1,355	(271) [65] {33}	1,357	(271) [65] {33}		
Jefferson	47,914	47,943	47,963	47,981	48,039	(9,608) [2,306] {1,153}	48,089	(9,618) [2,308] {1,154}	48,133	(9,627) [2,310] {1,155}		
Larimer	26,942	26,965	26,978	26,997	27,035	(5,407) [1,298] {649}	27,069	(5,414) [1,299] {650}	27,099	(5,420) [1,301] {650}		
Pueblo	19,079	19,088	19,094	19,101	19,130	(3,826) [918] {459}	19,155	(3,831) [919] {460}	19,179	(3,836) [921] {460}		
Weld	32,522	32,551	32,578	32,604	32,672	(6,534) [1,568] {784}	32,732	(6,546) [1,571] {786}	32,790	(6,558) [1,574] {787}		

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at bryan.koon@iem.com or 850-519-7966 or Stephanie Tennyson at stephanie.tennyson@iem.com or 202-309-4257.