

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

Date: 4/29/21

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 4/29/21 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.

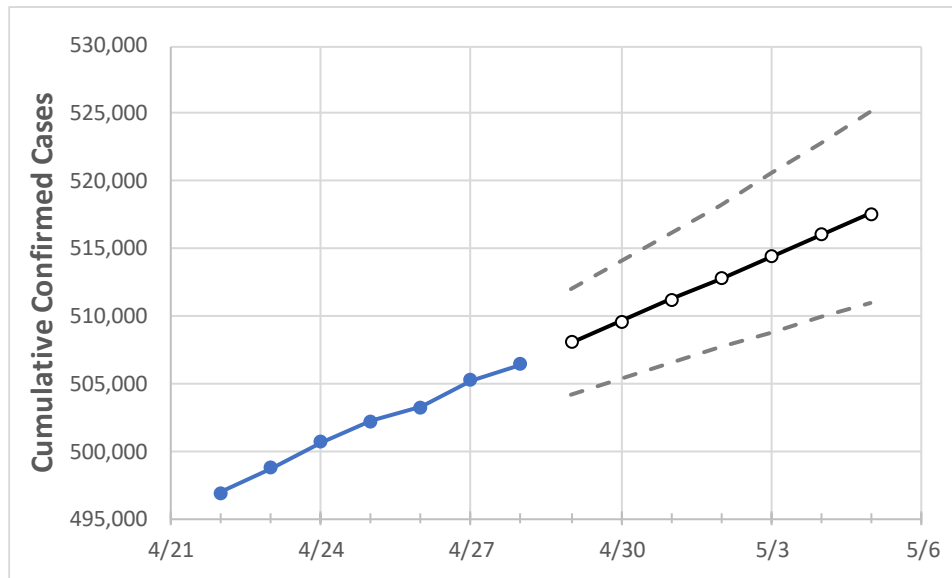
IEM's Modeling Lead

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:						
	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5
Colorado	502,242	503,254	505,268	506,405	508,018	509,603	511,208	512,782	514,402	515,992	517,600

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:						
	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3	5/4	5/5
Adams	55,276	55,372	55,572	55,682	55,859	56,034	56,206	56,384	56,561	56,743	56,927
Arapahoe	56,577	56,709	56,966	57,089	57,299	57,507	57,716	57,925	58,143	58,353	58,567
Boulder	22,536	22,573	22,646	22,669	22,727	22,785	22,844	22,901	22,957	23,011	23,067
Denver	69,387	69,484	69,820	70,027	70,193	70,358	70,526	70,692	70,849	71,005	71,157
Douglas	27,142	27,206	27,396	27,477	27,595	27,715	27,835	27,953	28,074	28,188	28,303
Eagle	6,157	6,165	6,176	6,184	6,194	6,204	6,214	6,223	6,232	6,241	6,250
El Paso	62,522	62,722	62,982	63,082	63,327	63,571	63,812	64,057	64,306	64,554	64,798
Gunnison	1,312	1,314	1,317	1,317	1,319	1,321	1,323	1,326	1,328	1,330	1,332
Jefferson	44,215	44,314	44,558	44,644	44,814	44,981	45,158	45,339	45,514	45,690	45,863
Larimer	24,969	25,040	25,127	25,211	25,302	25,393	25,484	25,575	25,666	25,756	25,844
Pueblo	17,382	17,429	17,475	17,563	17,645	17,729	17,814	17,903	17,992	18,086	18,180
Weld	29,957	30,006	30,131	30,218	30,326	30,436	30,546	30,657	30,768	30,879	30,996

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:											
	4/25	4/26	4/27	4/28	4/30				5/2				5/4			
Adams	55,276	55,372	55,572	55,682	56,034	(11,207)	[2,690]	{1,345}	56,384	(11,277)	[2,706]	{1,353}	56,743	(11,349)	[2,724]	{1,362}
Arapahoe	56,577	56,709	56,966	57,089	57,507	(11,501)	[2,760]	{1,380}	57,925	(11,585)	[2,780]	{1,390}	58,353	(11,671)	[2,801]	{1,400}
Boulder	22,536	22,573	22,646	22,669	22,785	(4,557)	[1,094]	{547}	22,901	(4,580)	[1,099]	{550}	23,011	(4,602)	[1,105]	{552}
Denver	69,387	69,484	69,820	70,027	70,358	(14,072)	[3,377]	{1,689}	70,692	(14,138)	[3,393]	{1,697}	71,005	(14,201)	[3,408]	{1,704}
Douglas	27,142	27,206	27,396	27,477	27,715	(5,543)	[1,330]	{665}	27,953	(5,591)	[1,342]	{671}	28,188	(5,638)	[1,353]	{677}
Eagle	6,157	6,165	6,176	6,184	6,204	(1,241)	[298]	{149}	6,223	(1,245)	[299]	{149}	6,241	(1,248)	[300]	{150}
El Paso	62,522	62,722	62,982	63,082	63,571	(12,714)	[3,051]	{1,526}	64,057	(12,811)	[3,075]	{1,537}	64,554	(12,911)	[3,099]	{1,549}
Gunnison	1,312	1,314	1,317	1,317	1,321	(264)	[63]	{32}	1,326	(265)	[64]	{32}	1,330	(266)	[64]	{32}
Jefferson	44,215	44,314	44,558	44,644	44,981	(8,996)	[2,159]	{1,080}	45,339	(9,068)	[2,176]	{1,088}	45,690	(9,138)	[2,193]	{1,097}
Larimer	24,969	25,040	25,127	25,211	25,393	(5,079)	[1,219]	{609}	25,575	(5,115)	[1,228]	{614}	25,756	(5,151)	[1,236]	{618}
Pueblo	17,382	17,429	17,475	17,563	17,729	(3,546)	[851]	{425}	17,903	(3,581)	[859]	{430}	18,086	(3,617)	[868]	{434}
Weld	29,957	30,006	30,131	30,218	30,436	(6,087)	[1,461]	{730}	30,657	(6,131)	[1,472]	{736}	30,879	(6,176)	[1,482]	{741}

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.