

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

Date: 4/27/21

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 4/27/21 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.

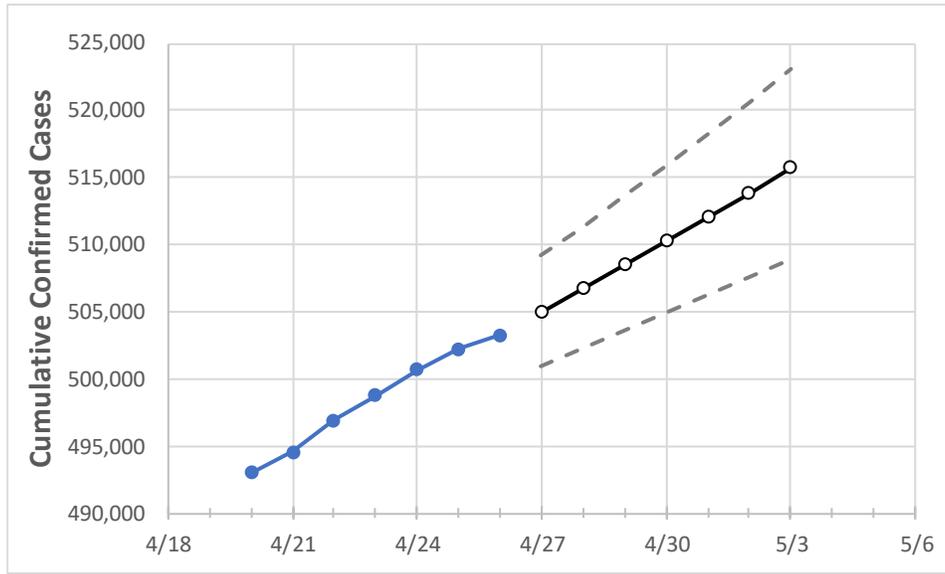
IEM's Modeling Lead

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:						
	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3
Colorado	498,758	500,675	502,242	503,254	504,987	506,727	508,491	510,251	512,068	513,864	515,755

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:						
	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	5/3
Adams	54,888	55,142	55,276	55,372	55,559	55,749	55,942	56,139	56,333	56,536	56,740
Arapahoe	56,154	56,380	56,577	56,709	56,934	57,159	57,389	57,623	57,864	58,109	58,356
Boulder	22,394	22,485	22,536	22,573	22,641	22,709	22,779	22,847	22,914	22,982	23,050
Denver	69,048	69,248	69,387	69,484	69,667	69,853	70,040	70,219	70,399	70,582	70,763
Douglas	26,820	26,994	27,142	27,206	27,349	27,498	27,645	27,795	27,942	28,093	28,247
Eagle	6,138	6,150	6,157	6,165	6,178	6,190	6,202	6,214	6,226	6,238	6,249
El Paso	62,034	62,254	62,522	62,722	62,991	63,257	63,533	63,816	64,103	64,387	64,677
Gunnison	1,309	1,310	1,312	1,314	1,316	1,319	1,321	1,324	1,327	1,329	1,332
Jefferson	43,818	44,019	44,215	44,314	44,494	44,671	44,853	45,040	45,227	45,416	45,608
Larimer	24,786	24,899	24,969	25,040	25,140	25,240	25,338	25,434	25,532	25,629	25,726
Pueblo	17,218	17,316	17,382	17,429	17,511	17,595	17,684	17,772	17,862	17,955	18,050
Weld	29,754	29,860	29,957	30,006	30,120	30,235	30,354	30,469	30,588	30,705	30,827

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:											
	4/23	4/24	4/25	4/26	4/28			4/30			5/2					
Adams	54,888	55,142	55,276	55,372	55,749	(11,150)	[2,676]	{1,338}	56,139	(11,228)	[2,695]	{1,347}	56,536	(11,307)	[2,714]	{1,357}
Arapahoe	56,154	56,380	56,577	56,709	57,159	(11,432)	[2,744]	{1,372}	57,623	(11,525)	[2,766]	{1,383}	58,109	(11,622)	[2,789]	{1,395}
Boulder	22,394	22,485	22,536	22,573	22,709	(4,542)	[1,090]	{545}	22,847	(4,569)	[1,097]	{548}	22,982	(4,596)	[1,103]	{552}
Denver	69,048	69,248	69,387	69,484	69,853	(13,971)	[3,353]	{1,676}	70,219	(14,044)	[3,371]	{1,685}	70,582	(14,116)	[3,388]	{1,694}
Douglas	26,820	26,994	27,142	27,206	27,498	(5,500)	[1,320]	{660}	27,795	(5,559)	[1,334]	{667}	28,093	(5,619)	[1,348]	{674}
Eagle	6,138	6,150	6,157	6,165	6,190	(1,238)	[297]	{149}	6,214	(1,243)	[298]	{149}	6,238	(1,248)	[299]	{150}
El Paso	62,034	62,254	62,522	62,722	63,257	(12,651)	[3,036]	{1,518}	63,816	(12,763)	[3,063]	{1,532}	64,387	(12,877)	[3,091]	{1,545}
Gunnison	1,309	1,310	1,312	1,314	1,319	(264)	[63]	{32}	1,324	(265)	[64]	{32}	1,329	(266)	[64]	{32}
Jefferson	43,818	44,019	44,215	44,314	44,671	(8,934)	[2,144]	{1,072}	45,040	(9,008)	[2,162]	{1,081}	45,416	(9,083)	[2,180]	{1,090}
Larimer	24,786	24,899	24,969	25,040	25,240	(5,048)	[1,212]	{606}	25,434	(5,087)	[1,221]	{610}	25,629	(5,126)	[1,230]	{615}
Pueblo	17,218	17,316	17,382	17,429	17,595	(3,519)	[845]	{422}	17,772	(3,554)	[853]	{427}	17,955	(3,591)	[862]	{431}
Weld	29,754	29,860	29,957	30,006	30,235	(6,047)	[1,451]	{726}	30,469	(6,094)	[1,463]	{731}	30,705	(6,141)	[1,474]	{737}

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.