

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 4/26/21**

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 4/26/21 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.

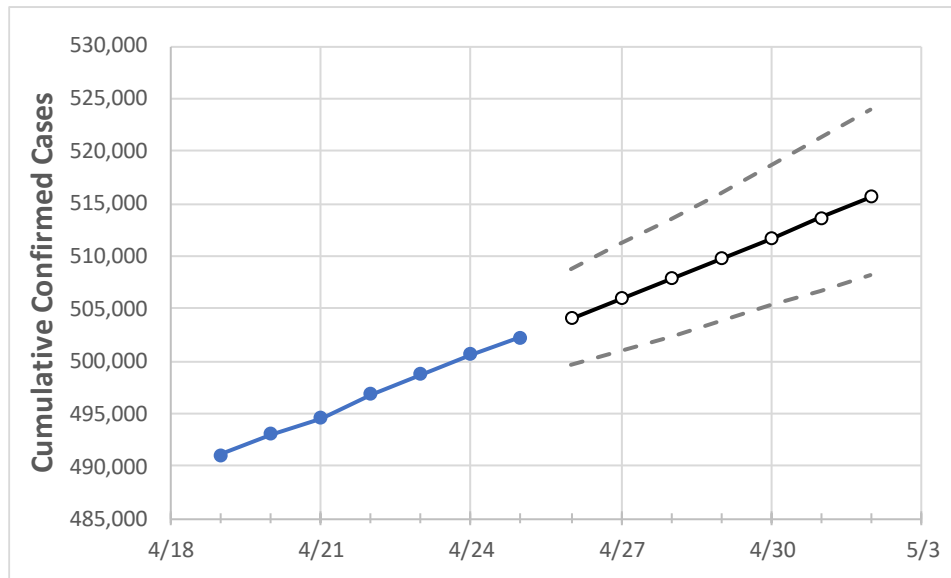
IEM's Modeling Lead

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:							
	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	
Colorado	496,882	498,758	500,675	502,242	504,088	505,942	507,807	509,715	511,666	513,600	515,598	

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:							
	4/22	4/23	4/24	4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2	
Adams	54,706	54,888	55,142	55,276	55,475	55,677	55,878	56,091	56,306	56,523	56,750	
Arapahoe	55,891	56,154	56,380	56,577	56,811	57,045	57,293	57,539	57,792	58,056	58,316	
Boulder	22,309	22,394	22,485	22,536	22,609	22,679	22,750	22,821	22,894	22,966	23,035	
Denver	68,849	69,048	69,248	69,387	69,585	69,775	69,977	70,176	70,374	70,567	70,767	
Douglas	26,671	26,820	26,994	27,142	27,295	27,451	27,606	27,763	27,927	28,096	28,268	
Eagle	6,123	6,138	6,150	6,157	6,170	6,183	6,195	6,207	6,219	6,231	6,243	
El Paso	61,751	62,034	62,254	62,522	62,791	63,066	63,341	63,619	63,906	64,202	64,501	
Gunnison	1,307	1,309	1,310	1,312	1,315	1,317	1,320	1,322	1,325	1,328	1,331	
Jefferson	43,651	43,818	44,019	44,215	44,401	44,593	44,787	44,985	45,186	45,398	45,609	
Larimer	24,685	24,786	24,899	24,969	25,071	25,176	25,280	25,384	25,489	25,593	25,694	
Pueblo	17,135	17,218	17,316	17,382	17,470	17,561	17,654	17,750	17,850	17,956	18,063	
Weld	29,626	29,754	29,860	29,957	30,076	30,198	30,319	30,442	30,569	30,695	30,824	

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:								
	4/22	4/23	4/24	4/25	4/27			4/29			5/1		
Adams	54,706	54,888	55,142	55,276	55,677	(11,135)	[2,672]	{1,336}	56,091	(11,218)	[2,692]	{1,346}	56,523 (11,305) [2,713] {1,357}
Arapahoe	55,891	56,154	56,380	56,577	57,045	(11,409)	[2,738]	{1,369}	57,539	(11,508)	[2,762]	{1,381}	58,056 (11,611) [2,787] {1,393}
Boulder	22,309	22,394	22,485	22,536	22,679	(4,536)	[1,089]	{544}	22,821	(4,564)	[1,095]	{548}	22,966 (4,593) [1,102] {551}
Denver	68,849	69,048	69,248	69,387	69,775	(13,955)	[3,349]	{1,675}	70,176	(14,035)	[3,368]	{1,684}	70,567 (14,113) [3,387] {1,694}
Douglas	26,671	26,820	26,994	27,142	27,451	(5,490)	[1,318]	{659}	27,763	(5,553)	[1,333]	{666}	28,096 (5,619) [1,349] {674}
Eagle	6,123	6,138	6,150	6,157	6,183	(1,237)	[297]	{148}	6,207	(1,241)	[298]	{149}	6,231 (1,246) [299] {150}
El Paso	61,751	62,034	62,254	62,522	63,066	(12,613)	[3,027]	{1,514}	63,619	(12,724)	[3,054]	{1,527}	64,202 (12,840) [3,082] {1,541}
Gunnison	1,307	1,309	1,310	1,312	1,317	(263)	[63]	{32}	1,322	(264)	[63]	{32}	1,328 (266) [64] {32}
Jefferson	43,651	43,818	44,019	44,215	44,593	(8,919)	[2,140]	{1,070}	44,985	(8,997)	[2,159]	{1,080}	45,398 (9,080) [2,179] {1,090}
Larimer	24,685	24,786	24,899	24,969	25,176	(5,035)	[1,208]	{604}	25,384	(5,077)	[1,218]	{609}	25,593 (5,119) [1,228] {614}
Pueblo	17,135	17,218	17,316	17,382	17,561	(3,512)	[843]	{421}	17,750	(3,550)	[852]	{426}	17,956 (3,591) [862] {431}
Weld	29,626	29,754	29,860	29,957	30,198	(6,040)	[1,449]	{725}	30,442	(6,088)	[1,461]	{731}	30,695 (6,139) [1,473] {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.