

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

Date: 4/13/21

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 4/13/21 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.

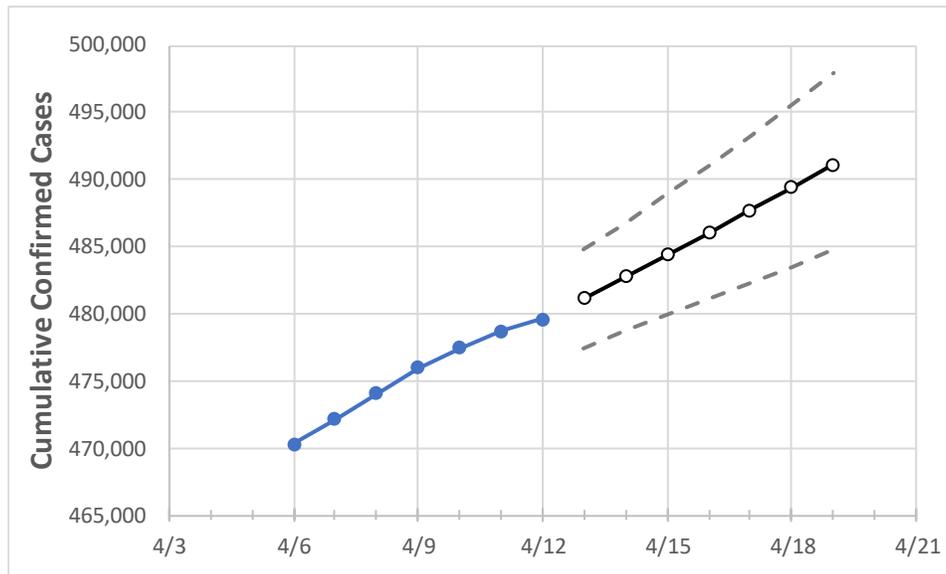
IEM's Modeling Lead

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:						
	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19
Colorado	475,989	477,443	478,678	479,590	481,157	482,784	484,402	486,050	487,732	489,419	491,116

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:						
	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19
Adams	52,619	52,761	52,901	52,997	53,148	53,302	53,463	53,627	53,791	53,962	54,136
Arapahoe	53,452	53,612	53,770	53,861	54,037	54,217	54,398	54,590	54,782	54,979	55,171
Boulder	21,379	21,428	21,477	21,518	21,601	21,684	21,767	21,851	21,934	22,018	22,101
Denver	66,166	66,359	66,509	66,592	66,793	66,996	67,199	67,407	67,618	67,828	68,042
Douglas	24,902	25,016	25,116	25,205	25,341	25,478	25,618	25,761	25,910	26,062	26,216
Eagle	5,910	5,937	5,955	5,961	5,979	5,996	6,014	6,031	6,048	6,064	6,082
El Paso	58,702	58,854	59,003	59,168	59,387	59,604	59,825	60,045	60,262	60,487	60,709
Gunnison	1,272	1,273	1,275	1,275	1,277	1,280	1,283	1,285	1,288	1,290	1,293
Jefferson	41,687	41,807	41,917	41,987	42,126	42,270	42,415	42,559	42,706	42,857	43,006
Larimer	23,307	23,477	23,576	23,647	23,778	23,912	24,050	24,187	24,331	24,480	24,628
Pueblo	16,263	16,338	16,399	16,449	16,514	16,584	16,654	16,729	16,807	16,887	16,970
Weld	28,311	28,405	28,478	28,538	28,634	28,733	28,835	28,939	29,045	29,150	29,259

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:											
	4/9	4/10	4/11	4/12	4/14				4/16				4/18			
Adams	52,619	52,761	52,901	52,997	53,302	(10,660)	[2,558]	{1,279}	53,627	(10,725)	[2,574]	{1,287}	53,962	(10,792)	[2,590]	{1,295}
Arapahoe	53,452	53,612	53,770	53,861	54,217	(10,843)	[2,602]	{1,301}	54,590	(10,918)	[2,620]	{1,310}	54,979	(10,996)	[2,639]	{1,319}
Boulder	21,379	21,428	21,477	21,518	21,684	(4,337)	[1,041]	{520}	21,851	(4,370)	[1,049]	{524}	22,018	(4,404)	[1,057]	{528}
Denver	66,166	66,359	66,509	66,592	66,996	(13,399)	[3,216]	{1,608}	67,407	(13,481)	[3,236]	{1,618}	67,828	(13,566)	[3,256]	{1,628}
Douglas	24,902	25,016	25,116	25,205	25,478	(5,096)	[1,223]	{611}	25,761	(5,152)	[1,237]	{618}	26,062	(5,212)	[1,251]	{625}
Eagle	5,910	5,937	5,955	5,961	5,996	(1,199)	[288]	{144}	6,031	(1,206)	[289]	{145}	6,064	(1,213)	[291]	{146}
El Paso	58,702	58,854	59,003	59,168	59,604	(11,921)	[2,861]	{1,431}	60,045	(12,009)	[2,882]	{1,441}	60,487	(12,097)	[2,903]	{1,452}
Gunnison	1,272	1,273	1,275	1,275	1,280	(256)	[61]	{31}	1,285	(257)	[62]	{31}	1,290	(258)	[62]	{31}
Jefferson	41,687	41,807	41,917	41,987	42,270	(8,454)	[2,029]	{1,014}	42,559	(8,512)	[2,043]	{1,021}	42,857	(8,571)	[2,057]	{1,029}
Larimer	23,307	23,477	23,576	23,647	23,912	(4,782)	[1,148]	{574}	24,187	(4,837)	[1,161]	{580}	24,480	(4,896)	[1,175]	{588}
Pueblo	16,263	16,338	16,399	16,449	16,584	(3,317)	[796]	{398}	16,729	(3,346)	[803]	{401}	16,887	(3,377)	[811]	{405}
Weld	28,311	28,405	28,478	28,538	28,733	(5,747)	[1,379]	{690}	28,939	(5,788)	[1,389]	{695}	29,150	(5,830)	[1,399]	{700}

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.