

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

Date: 4/12/21

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 4/12/21 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.

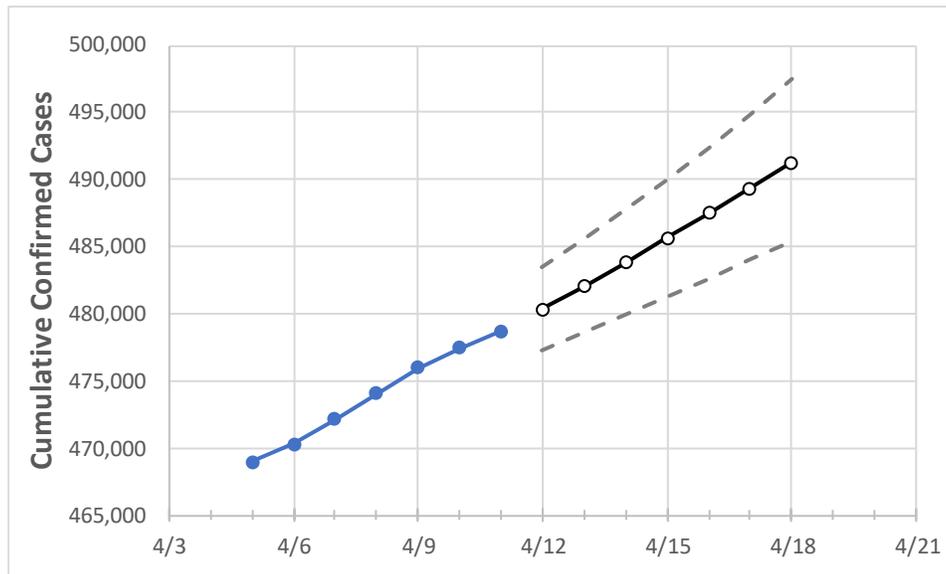
IEM's Modeling Lead

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:						
	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18
Colorado	474,053	475,989	477,443	478,678	480,356	482,059	483,821	485,625	487,476	489,339	491,237

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:						
	4/8	4/9	4/10	4/11	4/12	4/13	4/14	4/15	4/16	4/17	4/18
Adams	52,421	52,619	52,761	52,901	53,064	53,230	53,403	53,581	53,766	53,959	54,157
Arapahoe	53,228	53,452	53,612	53,770	53,961	54,157	54,358	54,569	54,783	55,003	55,232
Boulder	21,272	21,379	21,428	21,477	21,564	21,651	21,740	21,829	21,920	22,011	22,106
Denver	65,934	66,166	66,359	66,509	66,727	66,945	67,169	67,390	67,621	67,857	68,095
Douglas	24,774	24,902	25,016	25,116	25,250	25,392	25,537	25,683	25,831	25,991	26,148
Eagle	5,889	5,910	5,937	5,955	5,975	5,996	6,016	6,036	6,056	6,077	6,097
El Paso	58,473	58,702	58,854	59,003	59,227	59,455	59,693	59,926	60,175	60,418	60,665
Gunnison	1,265	1,272	1,273	1,275	1,277	1,279	1,281	1,283	1,285	1,288	1,290
Jefferson	41,488	41,687	41,807	41,917	42,068	42,223	42,384	42,547	42,714	42,883	43,059
Larimer	23,158	23,307	23,477	23,576	23,714	23,859	24,009	24,163	24,319	24,479	24,648
Pueblo	16,216	16,263	16,338	16,399	16,466	16,536	16,608	16,683	16,762	16,849	16,937
Weld	28,196	28,311	28,405	28,478	28,580	28,687	28,796	28,907	29,019	29,138	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:											
	4/8	4/9	4/10	4/11	4/13			4/15			4/17					
Adams	52,421	52,619	52,761	52,901	53,230	(10,646)	[2,555]	{1,278}	53,581	(10,716)	[2,572]	{1,286}	53,959	(10,792)	[2,590]	{1,295}
Arapahoe	53,228	53,452	53,612	53,770	54,157	(10,831)	[2,600]	{1,300}	54,569	(10,914)	[2,619]	{1,310}	55,003	(11,001)	[2,640]	{1,320}
Boulder	21,272	21,379	21,428	21,477	21,651	(4,330)	[1,039]	{520}	21,829	(4,366)	[1,048]	{524}	22,011	(4,402)	[1,057]	{528}
Denver	65,934	66,166	66,359	66,509	66,945	(13,389)	[3,213]	{1,607}	67,390	(13,478)	[3,235]	{1,617}	67,857	(13,571)	[3,257]	{1,629}
Douglas	24,774	24,902	25,016	25,116	25,392	(5,078)	[1,219]	{609}	25,683	(5,137)	[1,233]	{616}	25,991	(5,198)	[1,248]	{624}
Eagle	5,889	5,910	5,937	5,955	5,996	(1,199)	[288]	{144}	6,036	(1,207)	[290]	{145}	6,077	(1,215)	[292]	{146}
El Paso	58,473	58,702	58,854	59,003	59,455	(11,891)	[2,854]	{1,427}	59,926	(11,985)	[2,876]	{1,438}	60,418	(12,084)	[2,900]	{1,450}
Gunnison	1,265	1,272	1,273	1,275	1,279	(256)	[61]	{31}	1,283	(257)	[62]	{31}	1,288	(258)	[62]	{31}
Jefferson	41,488	41,687	41,807	41,917	42,223	(8,445)	[2,027]	{1,013}	42,547	(8,509)	[2,042]	{1,021}	42,883	(8,577)	[2,058]	{1,029}
Larimer	23,158	23,307	23,477	23,576	23,859	(4,772)	[1,145]	{573}	24,163	(4,833)	[1,160]	{580}	24,479	(4,896)	[1,175]	{587}
Pueblo	16,216	16,263	16,338	16,399	16,536	(3,307)	[794]	{397}	16,683	(3,337)	[801]	{400}	16,849	(3,370)	[809]	{404}
Weld	28,196	28,311	28,405	28,478	28,687	(5,737)	[1,377]	{688}	28,907	(5,781)	[1,388]	{694}	29,138	(5,828)	[1,399]	{699}

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.