

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

Date: 2/23/21

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 2/23/21 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.

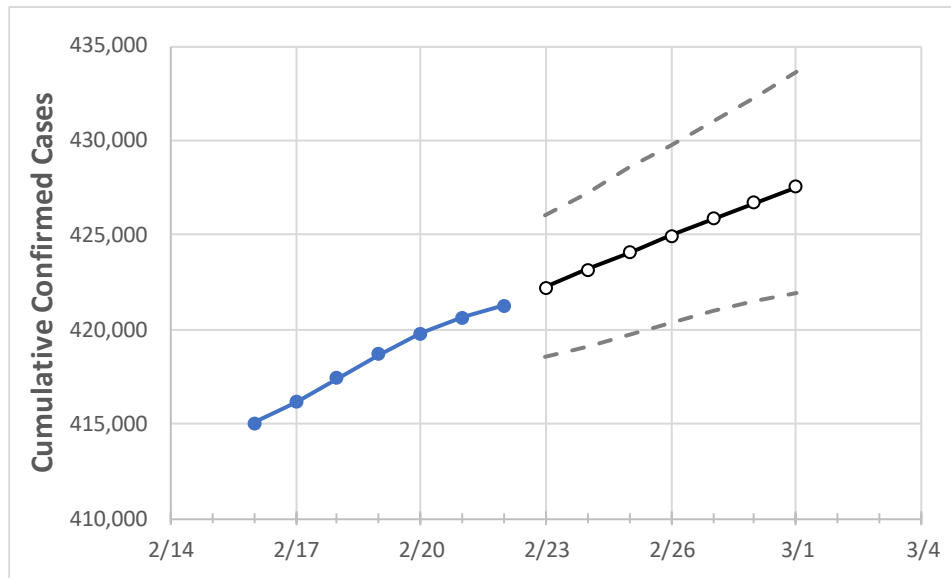
IEM's Modeling Lead

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:						
	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1
Colorado	418,695	419,812	420,614	421,294	422,240	423,165	424,062	424,974	425,838	426,717	427,533

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:						
	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1
Adams	47,502	47,631	47,716	47,787	47,865	47,942	48,018	48,093	48,169	48,241	48,314
Arapahoe	47,418	47,554	47,644	47,734	47,830	47,925	48,016	48,110	48,197	48,280	48,367
Boulder	18,369	18,435	18,476	18,515	18,570	18,624	18,678	18,732	18,783	18,837	18,889
Denver	58,311	58,420	58,534	58,582	58,686	58,793	58,896	58,999	59,099	59,197	59,295
Douglas	20,646	20,734	20,776	20,827	20,900	20,972	21,042	21,114	21,184	21,252	21,321
Eagle	4,860	4,878	4,897	4,907	4,925	4,943	4,961	4,978	4,995	5,011	5,029
El Paso	50,690	50,831	50,951	51,036	51,178	51,322	51,463	51,607	51,755	51,901	52,043
Gunnison	1,181	1,182	1,181	1,182	1,188	1,193	1,199	1,204	1,209	1,214	1,219
Jefferson	36,348	36,435	36,523	36,588	36,665	36,742	36,817	36,889	36,964	37,036	37,107
Larimer	19,382	19,494	19,532	19,594	19,658	19,725	19,790	19,858	19,926	19,990	20,057
Pueblo	14,853	14,874	14,879	14,881	14,910	14,939	14,969	14,999	15,030	15,061	15,094
Weld	24,895	24,961	25,018	25,061	25,111	25,160	25,209	25,257	25,304	25,351	25,397

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:											
	2/19	2/20	2/21	2/22	2/24				2/26				2/28			
Adams	47,502	47,631	47,716	47,787	47,942	(9,588)	[2,301]	{1,151}	48,093	(9,619)	[2,308]	{1,154}	48,241	(9,648)	[2,316]	{1,158}
Arapahoe	47,418	47,554	47,644	47,734	47,925	(9,585)	[2,300]	{1,150}	48,110	(9,622)	[2,309]	{1,155}	48,280	(9,656)	[2,317]	{1,159}
Boulder	18,369	18,435	18,476	18,515	18,624	(3,725)	[894]	{447}	18,732	(3,746)	[899]	{450}	18,837	(3,767)	[904]	{452}
Denver	58,311	58,420	58,534	58,582	58,793	(11,759)	[2,822]	{1,411}	58,999	(11,800)	[2,832]	{1,416}	59,197	(11,839)	[2,841]	{1,421}
Douglas	20,646	20,734	20,776	20,827	20,972	(4,194)	[1,007]	{503}	21,114	(4,223)	[1,013]	{507}	21,252	(4,250)	[1,020]	{510}
Eagle	4,860	4,878	4,897	4,907	4,943	(989)	[237]	{119}	4,978	(996)	[239]	{119}	5,011	(1,002)	[241]	{120}
El Paso	50,690	50,831	50,951	51,036	51,322	(10,264)	[2,463]	{1,232}	51,607	(10,321)	[2,477]	{1,239}	51,901	(10,380)	[2,491]	{1,246}
Gunnison	1,181	1,182	1,181	1,182	1,193	(239)	[57]	{29}	1,204	(241)	[58]	{29}	1,214	(243)	[58]	{29}
Jefferson	36,348	36,435	36,523	36,588	36,742	(7,348)	[1,764]	{882}	36,889	(7,378)	[1,771]	{885}	37,036	(7,407)	[1,778]	{889}
Larimer	19,382	19,494	19,532	19,594	19,725	(3,945)	[947]	{473}	19,858	(3,972)	[953]	{477}	19,990	(3,998)	[960]	{480}
Pueblo	14,853	14,874	14,879	14,881	14,939	(2,988)	[717]	{359}	14,999	(3,000)	[720]	{360}	15,061	(3,012)	[723]	{361}
Weld	24,895	24,961	25,018	25,061	25,160	(5,032)	[1,208]	{604}	25,257	(5,051)	[1,212]	{606}	25,351	(5,070)	[1,217]	{608}

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.