

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

Date: 2/24/21

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 2/24/21 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.

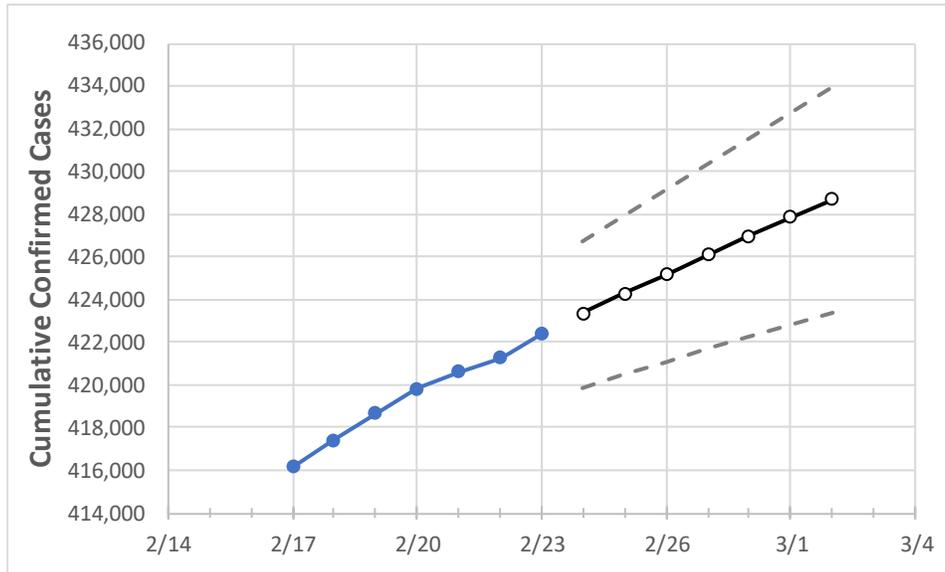
IEM's Modeling Lead

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:						
	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2
Colorado	419,812	420,614	421,294	422,390	423,356	424,281	425,185	426,089	426,991	427,857	428,681

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:						
	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2
Adams	47,631	47,716	47,787	47,861	47,942	48,020	48,099	48,174	48,249	48,323	48,399
Arapahoe	47,554	47,644	47,734	47,849	47,949	48,045	48,140	48,234	48,325	48,417	48,505
Boulder	18,435	18,476	18,515	18,548	18,598	18,649	18,697	18,743	18,791	18,839	18,887
Denver	58,420	58,534	58,582	58,778	58,893	59,010	59,118	59,228	59,334	59,440	59,549
Douglas	20,734	20,776	20,827	20,902	20,973	21,042	21,110	21,177	21,243	21,310	21,373
Eagle	4,878	4,897	4,907	4,940	4,960	4,980	5,000	5,020	5,039	5,057	5,077
El Paso	50,831	50,951	51,036	51,210	51,358	51,509	51,657	51,803	51,952	52,099	52,247
Gunnison	1,182	1,181	1,182	1,192	1,198	1,204	1,209	1,215	1,220	1,226	1,232
Jefferson	36,435	36,523	36,588	36,660	36,735	36,807	36,878	36,947	37,013	37,080	37,147
Larimer	19,494	19,532	19,594	19,663	19,730	19,794	19,860	19,926	19,991	20,057	20,123
Pueblo	14,874	14,879	14,881	14,900	14,928	14,957	14,986	15,016	15,044	15,076	15,107
Weld	24,961	25,018	25,061	25,142	25,194	25,247	25,297	25,347	25,395	25,442	25,489

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:											
	2/20	2/21	2/22	2/23	2/25			2/27			3/1					
Adams	47,631	47,716	47,787	47,861	48,020	(9,604)	[2,305]	{1,152}	48,174	(9,635)	[2,312]	{1,156}	48,323	(9,665)	[2,320]	{1,160}
Arapahoe	47,554	47,644	47,734	47,849	48,045	(9,609)	[2,306]	{1,153}	48,234	(9,647)	[2,315]	{1,158}	48,417	(9,683)	[2,324]	{1,162}
Boulder	18,435	18,476	18,515	18,548	18,649	(3,730)	[895]	{448}	18,743	(3,749)	[900]	{450}	18,839	(3,768)	[904]	{452}
Denver	58,420	58,534	58,582	58,778	59,010	(11,802)	[2,832]	{1,416}	59,228	(11,846)	[2,843]	{1,421}	59,440	(11,888)	[2,853]	{1,427}
Douglas	20,734	20,776	20,827	20,902	21,042	(4,208)	[1,010]	{505}	21,177	(4,235)	[1,017]	{508}	21,310	(4,262)	[1,023]	{511}
Eagle	4,878	4,897	4,907	4,940	4,980	(996)	[239]	{120}	5,020	(1,004)	[241]	{120}	5,057	(1,011)	[243]	{121}
El Paso	50,831	50,951	51,036	51,210	51,509	(10,302)	[2,472]	{1,236}	51,803	(10,361)	[2,487]	{1,243}	52,099	(10,420)	[2,501]	{1,250}
Gunnison	1,182	1,181	1,182	1,192	1,204	(241)	[58]	{29}	1,215	(243)	[58]	{29}	1,226	(245)	[59]	{29}
Jefferson	36,435	36,523	36,588	36,660	36,807	(7,361)	[1,767]	{883}	36,947	(7,389)	[1,773]	{887}	37,080	(7,416)	[1,780]	{890}
Larimer	19,494	19,532	19,594	19,663	19,794	(3,959)	[950]	{475}	19,926	(3,985)	[956]	{478}	20,057	(4,011)	[963]	{481}
Pueblo	14,874	14,879	14,881	14,900	14,957	(2,991)	[718]	{359}	15,016	(3,003)	[721]	{360}	15,076	(3,015)	[724]	{362}
Weld	24,961	25,018	25,061	25,142	25,247	(5,049)	[1,212]	{606}	25,347	(5,069)	[1,217]	{608}	25,442	(5,088)	[1,221]	{611}

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.