

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 1/21/22**

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 1/21/22 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.

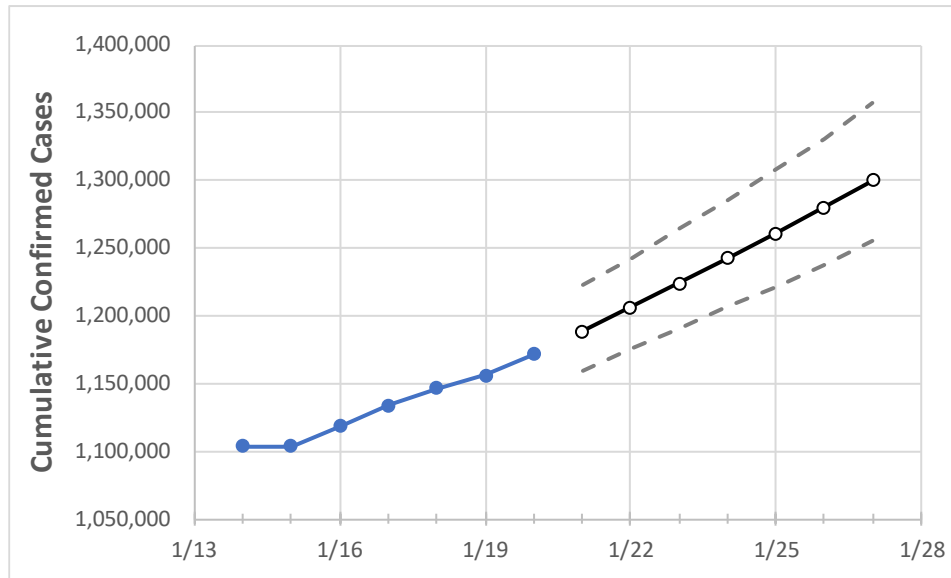
IEM's Modeling Lead

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:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
Colorado	1,133,675	1,146,740	1,156,371	1,171,789	1,188,777	1,206,650	1,224,361	1,242,164	1,260,967	1,280,381	1,300,275

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:						
	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27
Adams	114,294	115,661	116,453	117,553	119,335	121,028	122,903	124,750	126,642	128,664	130,660
Arapahoe	129,259	130,746	131,868	133,375	135,449	137,565	139,712	141,843	144,071	146,337	148,605
Boulder	50,594	51,410	51,925	52,675	53,592	54,561	55,531	56,560	57,584	58,643	59,715
Denver	146,030	147,662	148,647	150,245	152,237	154,334	156,322	158,448	160,577	162,763	164,828
Douglas	65,246	66,076	66,775	67,647	68,767	69,905	71,035	72,225	73,413	74,670	75,926
Eagle	14,156	14,235	14,308	14,413	14,527	14,639	14,746	14,847	14,956	15,060	15,160
El Paso	152,480	154,411	155,663	158,444	161,029	163,743	166,530	169,473	172,424	175,577	178,809
Gunnison	2,835	2,861	2,885	2,914	2,974	3,038	3,102	3,172	3,243	3,318	3,394
Jefferson	102,004	103,068	103,944	105,272	106,808	108,337	109,941	111,506	113,147	114,838	116,525
Larimer	61,398	62,031	62,550	63,857	64,893	65,956	67,057	68,167	69,329	70,570	71,793
Pueblo	37,341	37,800	38,120	38,733	39,368	40,027	40,710	41,430	42,186	42,984	43,808
Weld	68,616	69,562	70,223	71,183	72,240	73,362	74,487	75,645	76,887	78,168	79,492

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:											
	1/17	1/18	1/19	1/20	1/22				1/24				1/26			
Adams	114,294	115,661	116,453	117,553	121,028	(24,206)	[5,809]	{2,905}	124,750	(24,950)	[5,988]	{2,994}	128,664	(25,733)	[6,176]	{3,088}
Arapahoe	129,259	130,746	131,868	133,375	137,565	(27,513)	[6,603]	{3,302}	141,843	(28,369)	[6,808]	{3,404}	146,337	(29,267)	[7,024]	{3,512}
Boulder	50,594	51,410	51,925	52,675	54,561	(10,912)	[2,619]	{1,309}	56,560	(11,312)	[2,715]	{1,357}	58,643	(11,729)	[2,815]	{1,407}
Denver	146,030	147,662	148,647	150,245	154,334	(30,867)	[7,408]	{3,704}	158,448	(31,690)	[7,606]	{3,803}	162,763	(32,553)	[7,813]	{3,906}
Douglas	65,246	66,076	66,775	67,647	69,905	(13,981)	[3,355]	{1,678}	72,225	(14,445)	[3,467]	{1,733}	74,670	(14,934)	[3,584]	{1,792}
Eagle	14,156	14,235	14,308	14,413	14,639	(2,928)	[703]	{351}	14,847	(2,969)	[713]	{356}	15,060	(3,012)	[723]	{361}
El Paso	152,480	154,411	155,663	158,444	163,743	(32,749)	[7,860]	{3,930}	169,473	(33,895)	[8,135]	{4,067}	175,577	(35,115)	[8,428]	{4,214}
Gunnison	2,835	2,861	2,885	2,914	3,038	(608)	[146]	{73}	3,172	(634)	[152]	{76}	3,318	(664)	[159]	{80}
Jefferson	102,004	103,068	103,944	105,272	108,337	(21,667)	[5,200]	{2,600}	111,506	(22,301)	[5,352]	{2,676}	114,838	(22,968)	[5,512]	{2,756}
Larimer	61,398	62,031	62,550	63,857	65,956	(13,191)	[3,166]	{1,583}	68,167	(13,633)	[3,272]	{1,636}	70,570	(14,114)	[3,387]	{1,694}
Pueblo	37,341	37,800	38,120	38,733	40,027	(8,005)	[1,921]	{961}	41,430	(8,286)	[1,989]	{994}	42,984	(8,597)	[2,063]	{1,032}
Weld	68,616	69,562	70,223	71,183	73,362	(14,672)	[3,521]	{1,761}	75,645	(15,129)	[3,631]	{1,815}	78,168	(15,634)	[3,752]	{1,876}

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.