

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/31/20**

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 12/31/20 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.

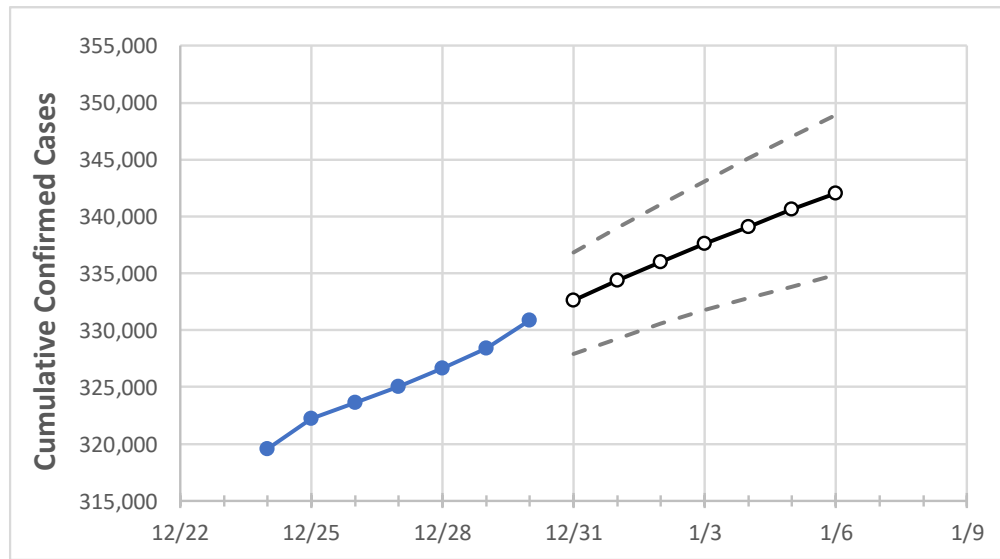
IEM's Modeling Lead

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:					
	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4	1/5	1/6
Colorado	325,018	326,668	328,408	330,859	332,639	334,341	335,979	337,583	339,084	340,593	342,027

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 20%, and are often within 10%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4	1/5	1/6
Adams	38,849	39,072	39,253	39,554	39,753	39,949	40,139	40,327	40,509	40,681	40,848
Arapahoe	36,976	37,162	37,306	37,562	37,751	37,938	38,117	38,291	38,455	38,615	38,769
Boulder	14,276	14,363	14,423	14,512	14,590	14,666	14,741	14,814	14,887	14,958	15,025
Denver	46,570	46,708	46,857	47,167	47,363	47,552	47,739	47,916	48,089	48,254	48,415
Douglas	15,168	15,263	15,364	15,488	15,574	15,656	15,738	15,816	15,891	15,963	16,035
Eagle	3,226	3,250	3,268	3,323	3,341	3,358	3,375	3,390	3,406	3,422	3,436
El Paso	39,887	40,057	40,340	40,752	40,963	41,169	41,364	41,553	41,717	41,895	42,062
Gunnison	670	680	686	693	702	711	719	729	738	748	757
Jefferson	28,828	28,964	29,109	29,295	29,434	29,564	29,690	29,813	29,928	30,039	30,146
Larimer	14,676	14,741	14,858	14,985	15,056	15,124	15,184	15,245	15,304	15,359	15,411
Pueblo	12,884	12,955	12,991	13,103	13,157	13,207	13,257	13,301	13,343	13,384	13,422
Weld	19,361	19,503	19,642	19,777	19,889	20,000	20,108	20,213	20,320	20,419	20,516

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:											
	12/27	12/28	12/29	12/30	1/1				1/3				1/5			
Adams	38,849	39,072	39,253	39,554	39,949	(7,990)	[1,918]	{959}	40,327	(8,065)	[1,936]	{968}	40,681	(8,136)	[1,953]	{976}
Arapahoe	36,976	37,162	37,306	37,562	37,938	(7,588)	[1,821]	{911}	38,291	(7,658)	[1,838]	{919}	38,615	(7,723)	[1,854]	{927}
Boulder	14,276	14,363	14,423	14,512	14,666	(2,933)	[704]	{352}	14,814	(2,963)	[711]	{356}	14,958	(2,992)	[718]	{359}
Denver	46,570	46,708	46,857	47,167	47,552	(9,510)	[2,282]	{1,141}	47,916	(9,583)	[2,300]	{1,150}	48,254	(9,651)	[2,316]	{1,158}
Douglas	15,168	15,263	15,364	15,488	15,656	(3,131)	[752]	{376}	15,816	(3,163)	[759]	{380}	15,963	(3,193)	[766]	{383}
Eagle	3,226	3,250	3,268	3,323	3,358	(672)	[161]	{81}	3,390	(678)	[163]	{81}	3,422	(684)	[164]	{82}
El Paso	39,887	40,057	40,340	40,752	41,169	(8,234)	[1,976]	{988}	41,553	(8,311)	[1,995]	{997}	41,895	(8,379)	[2,011]	{1,005}
Gunnison	670	680	686	693	711	(142)	[34]	{17}	729	(146)	[35]	{17}	748	(150)	[36]	{18}
Jefferson	28,828	28,964	29,109	29,295	29,564	(5,913)	[1,419]	{710}	29,813	(5,963)	[1,431]	{716}	30,039	(6,008)	[1,442]	{721}
Larimer	14,676	14,741	14,858	14,985	15,124	(3,025)	[726]	{363}	15,245	(3,049)	[732]	{366}	15,359	(3,072)	[737]	{369}
Pueblo	12,884	12,955	12,991	13,103	13,207	(2,641)	[634]	{317}	13,301	(2,660)	[638]	{319}	13,384	(2,677)	[642]	{321}
Weld	19,361	19,503	19,642	19,777	20,000	(4,000)	[960]	{480}	20,213	(4,043)	[970]	{485}	20,419	(4,084)	[980]	{490}

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.