

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/29/20**

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 12/29/20 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.

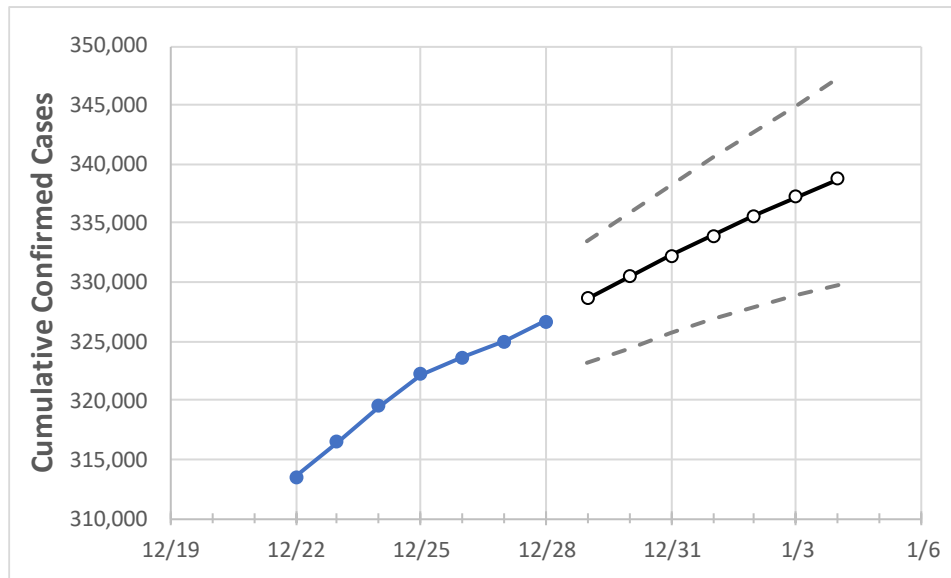
IEM's Modeling Lead

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:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
Colorado	322,189	323,619	325,018	326,668	328,597	330,477	332,267	333,976	335,653	337,242	338,765

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:							
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4	
Adams	38,525	38,691	38,849	39,072	39,273	39,469	39,658	39,843	40,027	40,206	40,377	
Arapahoe	36,692	36,844	36,976	37,162	37,377	37,584	37,782	37,984	38,170	38,356	38,538	
Boulder	14,125	14,222	14,276	14,363	14,443	14,520	14,595	14,671	14,746	14,817	14,890	
Denver	46,258	46,455	46,570	46,708	46,928	47,134	47,343	47,552	47,752	47,948	48,132	
Douglas	15,039	15,116	15,168	15,263	15,352	15,439	15,522	15,604	15,679	15,752	15,825	
Eagle	3,190	3,200	3,226	3,250	3,265	3,280	3,294	3,307	3,320	3,332	3,342	
El Paso	39,656	39,805	39,887	40,057	40,253	40,446	40,626	40,791	40,961	41,110	41,251	
Gunnison	665	667	670	680	689	699	709	720	730	741	753	
Jefferson	28,559	28,695	28,828	28,964	29,106	29,237	29,362	29,485	29,604	29,714	29,817	
Larimer	14,570	14,619	14,676	14,741	14,808	14,873	14,931	14,992	15,049	15,104	15,156	
Pueblo	12,827	12,854	12,884	12,955	13,014	13,069	13,120	13,169	13,214	13,258	13,299	
Weld	19,157	19,228	19,361	19,503	19,623	19,738	19,849	19,956	20,062	20,163	20,266	

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:											
	12/25	12/26	12/27	12/28	12/30				1/1				1/3			
Adams	38,525	38,691	38,849	39,072	39,469	(7,894)	[1,895]	{947}	39,843	(7,969)	[1,912]	{956}	40,206	(8,041)	[1,930]	{965}
Arapahoe	36,692	36,844	36,976	37,162	37,584	(7,517)	[1,804]	{902}	37,984	(7,597)	[1,823]	{912}	38,356	(7,671)	[1,841]	{921}
Boulder	14,125	14,222	14,276	14,363	14,520	(2,904)	[697]	{348}	14,671	(2,934)	[704]	{352}	14,817	(2,963)	[711]	{356}
Denver	46,258	46,455	46,570	46,708	47,134	(9,427)	[2,262]	{1,131}	47,552	(9,510)	[2,283]	{1,141}	47,948	(9,590)	[2,301]	{1,151}
Douglas	15,039	15,116	15,168	15,263	15,439	(3,088)	[741]	{371}	15,604	(3,121)	[749]	{374}	15,752	(3,150)	[756]	{378}
Eagle	3,190	3,200	3,226	3,250	3,280	(656)	[157]	{79}	3,307	(661)	[159]	{79}	3,332	(666)	[160]	{80}
El Paso	39,656	39,805	39,887	40,057	40,446	(8,089)	[1,941]	{971}	40,791	(8,158)	[1,958]	{979}	41,110	(8,222)	[1,973]	{987}
Gunnison	665	667	670	680	699	(140)	[34]	{17}	720	(144)	[35]	{17}	741	(148)	[36]	{18}
Jefferson	28,559	28,695	28,828	28,964	29,237	(5,847)	[1,403]	{702}	29,485	(5,897)	[1,415]	{708}	29,714	(5,943)	[1,426]	{713}
Larimer	14,570	14,619	14,676	14,741	14,873	(2,975)	[714]	{357}	14,992	(2,998)	[720]	{360}	15,104	(3,021)	[725]	{362}
Pueblo	12,827	12,854	12,884	12,955	13,069	(2,614)	[627]	{314}	13,169	(2,634)	[632]	{316}	13,258	(2,652)	[636]	{318}
Weld	19,157	19,228	19,361	19,503	19,738	(3,948)	[947]	{474}	19,956	(3,991)	[958]	{479}	20,163	(4,033)	[968]	{484}

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.