

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 12/30/20**

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 12/30/20 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.

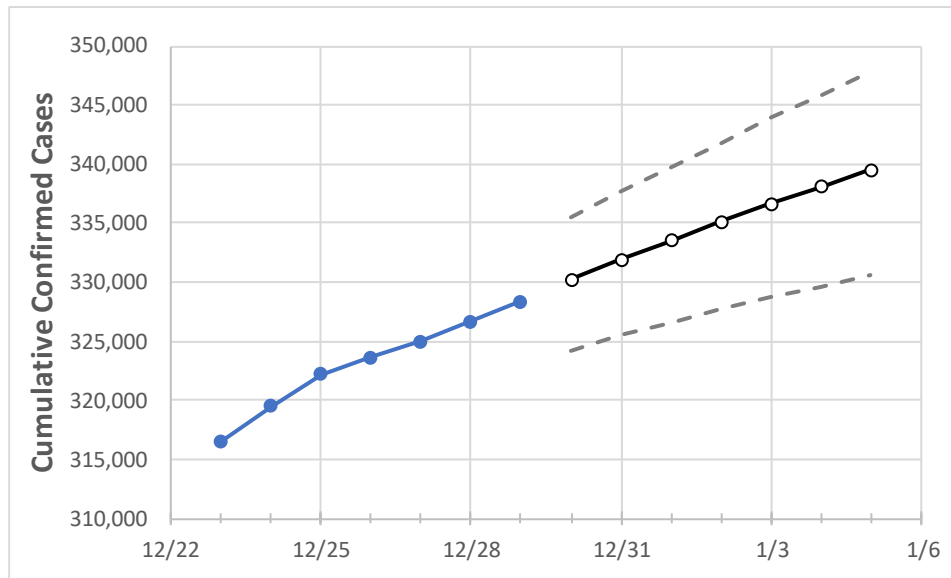
IEM's Modeling Lead

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:						
	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4	1/5
Colorado	323,619	325,018	326,668	328,408	330,209	331,931	333,550	335,121	336,636	338,118	339,532

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:					
	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4	1/5
Adams	38,691	38,849	39,072	39,253	39,443	39,619	39,791	39,958	40,118	40,275	40,427
Arapahoe	36,844	36,976	37,162	37,306	37,505	37,692	37,871	38,046	38,214	38,375	38,534
Boulder	14,222	14,276	14,363	14,423	14,499	14,572	14,645	14,717	14,786	14,853	14,919
Denver	46,455	46,570	46,708	46,857	47,055	47,248	47,430	47,621	47,791	47,964	48,130
Douglas	15,116	15,168	15,263	15,364	15,450	15,533	15,613	15,690	15,763	15,835	15,908
Eagle	3,200	3,226	3,250	3,268	3,283	3,297	3,310	3,323	3,335	3,346	3,357
El Paso	39,805	39,887	40,057	40,340	40,538	40,720	40,896	41,063	41,223	41,374	41,516
Gunnison	667	670	680	686	695	704	713	723	733	742	753
Jefferson	28,695	28,828	28,964	29,109	29,239	29,361	29,477	29,584	29,684	29,787	29,891
Larimer	14,619	14,676	14,741	14,858	14,926	14,994	15,055	15,112	15,164	15,218	15,269
Pueblo	12,854	12,884	12,955	12,991	13,047	13,101	13,151	13,198	13,241	13,283	13,322
Weld	19,228	19,361	19,503	19,642	19,757	19,865	19,973	20,073	20,173	20,274	20,369

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:							
	12/26	12/27	12/28	12/29	12/31	1/2		1/4				
Adams	38,691	38,849	39,072	39,253	39,619 (7,924)	[1,902]	{951}	39,958 (7,992)	[1,918]	{959}	40,275 (8,055)	[1,933] {967}
Arapahoe	36,844	36,976	37,162	37,306	37,692 (7,538)	[1,809]	{905}	38,046 (7,609)	[1,826]	{913}	38,375 (7,675)	[1,842] {921}
Boulder	14,222	14,276	14,363	14,423	14,572 (2,914)	[699]	{350}	14,717 (2,943)	[706]	{353}	14,853 (2,971)	[713] {356}
Denver	46,455	46,570	46,708	46,857	47,248 (9,450)	[2,268]	{1,134}	47,621 (9,524)	[2,286]	{1,143}	47,964 (9,593)	[2,302] {1,151}
Douglas	15,116	15,168	15,263	15,364	15,533 (3,107)	[746]	{373}	15,690 (3,138)	[753]	{377}	15,835 (3,167)	[760] {380}
Eagle	3,200	3,226	3,250	3,268	3,297 (659)	[158]	{79}	3,323 (665)	[160]	{80}	3,346 (669)	[161] {80}
El Paso	39,805	39,887	40,057	40,340	40,720 (8,144)	[1,955]	{977}	41,063 (8,213)	[1,971]	{986}	41,374 (8,275)	[1,986] {993}
Gunnison	667	670	680	686	704 (141)	[34]	{17}	723 (145)	[35]	{17}	742 (148)	[36] {18}
Jefferson	28,695	28,828	28,964	29,109	29,361 (5,872)	[1,409]	{705}	29,584 (5,917)	[1,420]	{710}	29,787 (5,957)	[1,430] {715}
Larimer	14,619	14,676	14,741	14,858	14,994 (2,999)	[720]	{360}	15,112 (3,022)	[725]	{363}	15,218 (3,044)	[730] {365}
Pueblo	12,854	12,884	12,955	12,991	13,101 (2,620)	[629]	{314}	13,198 (2,640)	[633]	{317}	13,283 (2,657)	[638] {319}
Weld	19,228	19,361	19,503	19,642	19,865 (3,973)	[954]	{477}	20,073 (4,015)	[963]	{482}	20,274 (4,055)	[973] {487}

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.