

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

Date: 11/24/21

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 11/24/21 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.

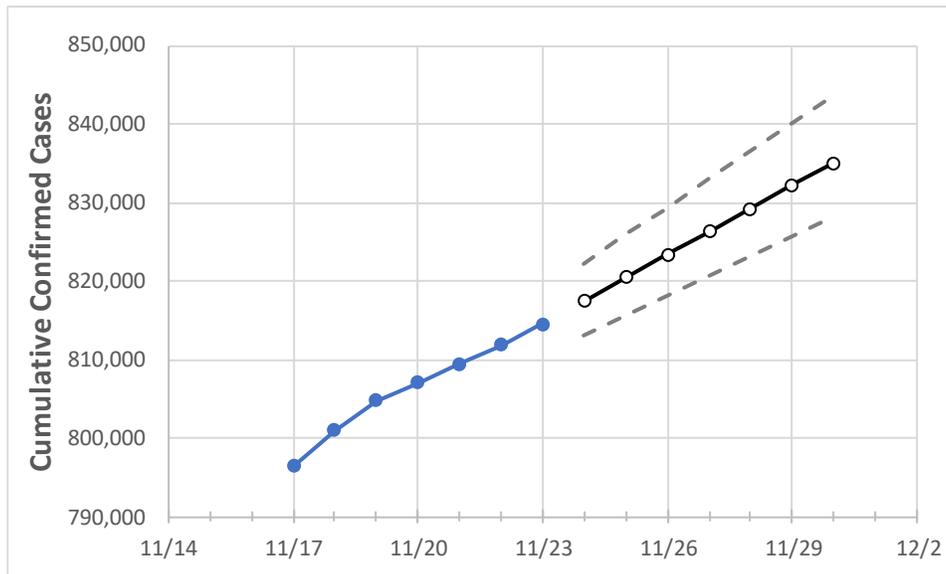
IEM's Modeling Lead

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:						
	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30
Colorado	807,094	809,453	811,813	814,468	817,462	820,419	823,328	826,302	829,184	832,187	835,076

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:						
	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30
Adams	82,257	82,486	82,715	82,993	83,296	83,604	83,906	84,225	84,535	84,856	85,170
Arapahoe	86,634	86,905	87,176	87,419	87,748	88,080	88,421	88,758	89,108	89,457	89,818
Boulder	33,726	33,825	33,923	34,004	34,120	34,233	34,348	34,461	34,576	34,691	34,807
Denver	99,300	99,604	99,909	100,180	100,583	100,976	101,387	101,787	102,218	102,644	103,097
Douglas	44,320	44,476	44,632	44,766	44,953	45,141	45,328	45,522	45,722	45,920	46,121
Eagle	9,068	9,091	9,114	9,143	9,167	9,190	9,212	9,235	9,258	9,281	9,303
El Paso	111,516	111,809	112,103	112,452	112,832	113,201	113,571	113,947	114,313	114,687	115,055
Gunnison	1,946	1,954	1,961	1,966	1,974	1,982	1,991	2,000	2,009	2,018	2,028
Jefferson	70,486	70,743	71,001	71,294	71,641	71,987	72,341	72,693	73,059	73,424	73,789
Larimer	43,921	44,041	44,161	44,262	44,427	44,585	44,747	44,907	45,064	45,228	45,383
Pueblo	28,698	28,782	28,867	28,954	29,058	29,158	29,257	29,355	29,451	29,546	29,642
Weld	51,390	51,528	51,667	51,845	52,025	52,207	52,384	52,559	52,736	52,915	53,090

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:											
	11/20	11/21	11/22	11/23	11/25		11/27		11/29							
Adams	82,257	82,486	82,715	82,993	83,604	(16,721)	[4,013]	{2,006}	84,225	(16,845)	[4,043]	{2,021}	84,856	(16,971)	[4,073]	{2,037}
Arapahoe	86,634	86,905	87,176	87,419	88,080	(17,616)	[4,228]	{2,114}	88,758	(17,752)	[4,260]	{2,130}	89,457	(17,891)	[4,294]	{2,147}
Boulder	33,726	33,825	33,923	34,004	34,233	(6,847)	[1,643]	{822}	34,461	(6,892)	[1,654]	{827}	34,691	(6,938)	[1,665]	{833}
Denver	99,300	99,604	99,909	100,180	100,976	(20,195)	[4,847]	{2,423}	101,787	(20,357)	[4,886]	{2,443}	102,644	(20,529)	[4,927]	{2,463}
Douglas	44,320	44,476	44,632	44,766	45,141	(9,028)	[2,167]	{1,083}	45,522	(9,104)	[2,185]	{1,093}	45,920	(9,184)	[2,204]	{1,102}
Eagle	9,068	9,091	9,114	9,143	9,190	(1,838)	[441]	{221}	9,235	(1,847)	[443]	{222}	9,281	(1,856)	[446]	{223}
El Paso	111,516	111,809	112,103	112,452	113,201	(22,640)	[5,434]	{2,717}	113,947	(22,789)	[5,469]	{2,735}	114,687	(22,937)	[5,505]	{2,752}
Gunnison	1,946	1,954	1,961	1,966	1,982	(396)	[95]	{48}	2,000	(400)	[96]	{48}	2,018	(404)	[97]	{48}
Jefferson	70,486	70,743	71,001	71,294	71,987	(14,397)	[3,455]	{1,728}	72,693	(14,539)	[3,489]	{1,745}	73,424	(14,685)	[3,524]	{1,762}
Larimer	43,921	44,041	44,161	44,262	44,585	(8,917)	[2,140]	{1,070}	44,907	(8,981)	[2,156]	{1,078}	45,228	(9,046)	[2,171]	{1,085}
Pueblo	28,698	28,782	28,867	28,954	29,158	(5,832)	[1,400]	{700}	29,355	(5,871)	[1,409]	{705}	29,546	(5,909)	[1,418]	{709}
Weld	51,390	51,528	51,667	51,845	52,207	(10,441)	[2,506]	{1,253}	52,559	(10,512)	[2,523]	{1,261}	52,915	(10,583)	[2,540]	{1,270}

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.