

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

Date: 5/25/21

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 5/25/21 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.

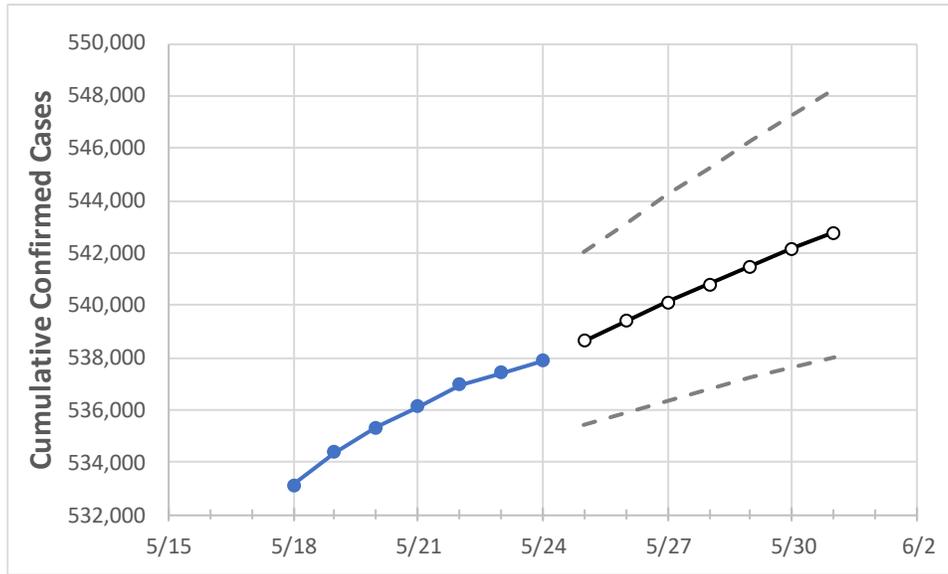
IEM's Modeling Lead

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:						
	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31
Colorado	536,128	536,969	537,401	537,858	538,638	539,386	540,109	540,807	541,489	542,154	542,791

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:						
	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31
Adams	59,162	59,264	59,317	59,366	59,465	59,557	59,647	59,738	59,824	59,909	59,991
Arapahoe	60,750	60,848	60,886	60,933	61,033	61,132	61,227	61,320	61,413	61,502	61,589
Boulder	23,480	23,496	23,500	23,506	23,517	23,529	23,539	23,549	23,558	23,567	23,576
Denver	72,622	72,655	72,688	72,734	72,786	72,836	72,884	72,930	72,973	73,016	73,054
Douglas	29,164	29,210	29,231	29,244	29,276	29,305	29,334	29,362	29,388	29,412	29,436
Eagle	6,311	6,315	6,314	6,313	6,315	6,318	6,320	6,322	6,324	6,325	6,327
El Paso	68,653	68,836	68,937	69,031	69,187	69,340	69,489	69,633	69,772	69,905	70,040
Gunnison	1,348	1,349	1,349	1,349	1,350	1,352	1,353	1,354	1,356	1,357	1,358
Jefferson	47,504	47,571	47,614	47,649	47,723	47,795	47,862	47,930	47,993	48,058	48,121
Larimer	26,705	26,740	26,757	26,775	26,809	26,842	26,873	26,903	26,931	26,959	26,985
Pueblo	18,870	18,884	18,894	18,908	18,924	18,940	18,954	18,967	18,980	18,992	19,003
Weld	32,112	32,174	32,215	32,258	32,311	32,362	32,410	32,459	32,506	32,552	32,597

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:								
	5/21	5/22	5/23	5/24	5/26		5/28		5/30				
Adams	59,162	59,264	59,317	59,366	59,557 (11,911)	[2,859]	{1,429}	59,738 (11,948)	[2,867]	{1,434}	59,909 (11,982)	[2,876]	{1,438}
Arapahoe	60,750	60,848	60,886	60,933	61,132 (12,226)	[2,934]	{1,467}	61,320 (12,264)	[2,943]	{1,472}	61,502 (12,300)	[2,952]	{1,476}
Boulder	23,480	23,496	23,500	23,506	23,529 (4,706)	[1,129]	{565}	23,549 (4,710)	[1,130]	{565}	23,567 (4,713)	[1,131]	{566}
Denver	72,622	72,655	72,688	72,734	72,836 (14,567)	[3,496]	{1,748}	72,930 (14,586)	[3,501]	{1,750}	73,016 (14,603)	[3,505]	{1,752}
Douglas	29,164	29,210	29,231	29,244	29,305 (5,861)	[1,407]	{703}	29,362 (5,872)	[1,409]	{705}	29,412 (5,882)	[1,412]	{706}
Eagle	6,311	6,315	6,314	6,313	6,318 (1,264)	[303]	{152}	6,322 (1,264)	[303]	{152}	6,325 (1,265)	[304]	{152}
El Paso	68,653	68,836	68,937	69,031	69,340 (13,868)	[3,328]	{1,664}	69,633 (13,927)	[3,342]	{1,671}	69,905 (13,981)	[3,355]	{1,678}
Gunnison	1,348	1,349	1,349	1,349	1,352 (270)	[65]	{32}	1,354 (271)	[65]	{33}	1,357 (271)	[65]	{33}
Jefferson	47,504	47,571	47,614	47,649	47,795 (9,559)	[2,294]	{1,147}	47,930 (9,586)	[2,301]	{1,150}	48,058 (9,612)	[2,307]	{1,153}
Larimer	26,705	26,740	26,757	26,775	26,842 (5,368)	[1,288]	{644}	26,903 (5,381)	[1,291]	{646}	26,959 (5,392)	[1,294]	{647}
Pueblo	18,870	18,884	18,894	18,908	18,940 (3,788)	[909]	{455}	18,967 (3,793)	[910]	{455}	18,992 (3,798)	[912]	{456}
Weld	32,112	32,174	32,215	32,258	32,362 (6,472)	[1,553]	{777}	32,459 (6,492)	[1,558]	{779}	32,552 (6,510)	[1,563]	{781}

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.