

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 5/18/21**

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 5/18/21 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.

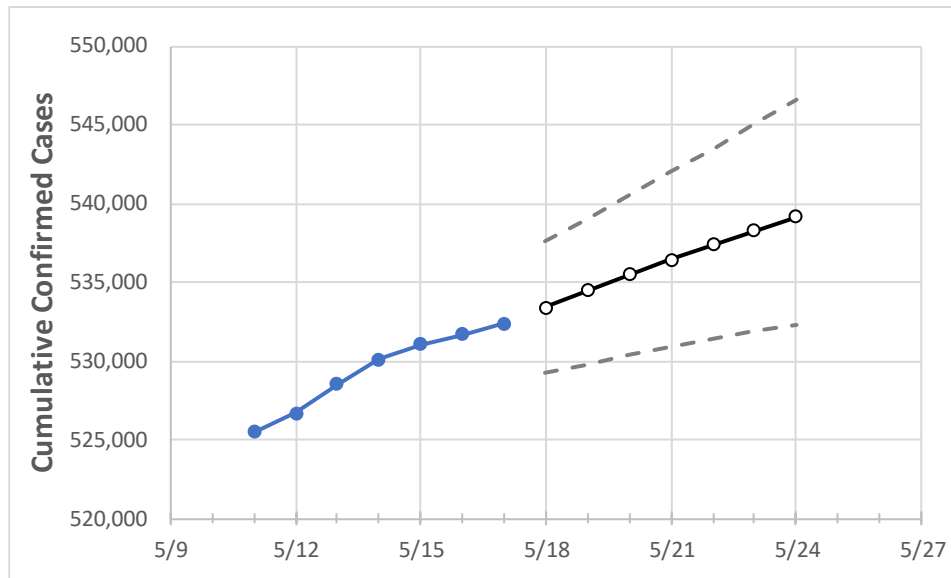
IEM's Modeling Lead

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:						
	5/14	5/15	5/16	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24
Colorado	530,098	531,070	531,700	532,389	533,426	534,448	535,456	536,426	537,367	538,262	539,149

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:						
	5/14	5/15	5/16	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24
Adams	58,460	58,584	58,669	58,722	58,856	58,988	59,121	59,251	59,380	59,514	59,639
Arapahoe	59,947	60,071	60,158	60,214	60,348	60,481	60,612	60,742	60,871	60,994	61,116
Boulder	23,365	23,389	23,396	23,412	23,432	23,450	23,468	23,485	23,502	23,517	23,532
Denver	72,212	72,279	72,338	72,378	72,461	72,542	72,622	72,701	72,773	72,842	72,913
Douglas	28,906	28,952	28,967	29,011	29,061	29,108	29,153	29,196	29,238	29,277	29,314
Eagle	6,291	6,295	6,297	6,297	6,300	6,304	6,307	6,309	6,312	6,315	6,317
El Paso	67,407	67,582	67,698	67,882	68,084	68,287	68,483	68,677	68,866	69,055	69,244
Gunnison	1,338	1,343	1,344	1,345	1,346	1,348	1,349	1,351	1,352	1,354	1,355
Jefferson	46,989	47,073	47,148	47,193	47,295	47,395	47,494	47,587	47,685	47,779	47,868
Larimer	26,392	26,461	26,483	26,539	26,590	26,640	26,689	26,737	26,782	26,826	26,868
Pueblo	18,691	18,724	18,747	18,770	18,797	18,823	18,847	18,870	18,890	18,910	18,927
Weld	31,735	31,799	31,829	31,890	31,965	32,037	32,109	32,179	32,247	32,316	32,384

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:							
	5/14	5/15	5/16	5/17	5/19		5/21		5/23			
Adams	58,460	58,584	58,669	58,722	58,988	(11,798) [2,831] {1,416}	59,251	(11,850) [2,844] {1,422}	59,514	(11,903) [2,857] {1,428}		
Arapahoe	59,947	60,071	60,158	60,214	60,481	(12,096) [2,903] {1,452}	60,742	(12,148) [2,916] {1,458}	60,994	(12,199) [2,928] {1,464}		
Boulder	23,365	23,389	23,396	23,412	23,450	(4,690) [1,126] {563}	23,485	(4,697) [1,127] {564}	23,517	(4,703) [1,129] {564}		
Denver	72,212	72,279	72,338	72,378	72,542	(14,508) [3,482] {1,741}	72,701	(14,540) [3,490] {1,745}	72,842	(14,568) [3,496] {1,748}		
Douglas	28,906	28,952	28,967	29,011	29,108	(5,822) [1,397] {699}	29,196	(5,839) [1,401] {701}	29,277	(5,855) [1,405] {703}		
Eagle	6,291	6,295	6,297	6,297	6,304	(1,261) [303] {151}	6,309	(1,262) [303] {151}	6,315	(1,263) [303] {152}		
El Paso	67,407	67,582	67,698	67,882	68,287	(13,657) [3,278] {1,639}	68,677	(13,735) [3,297] {1,648}	69,055	(13,811) [3,315] {1,657}		
Gunnison	1,338	1,343	1,344	1,345	1,348	(270) [65] {32}	1,351	(270) [65] {32}	1,354	(271) [65] {32}		
Jefferson	46,989	47,073	47,148	47,193	47,395	(9,479) [2,275] {1,137}	47,587	(9,517) [2,284] {1,142}	47,779	(9,556) [2,293] {1,147}		
Larimer	26,392	26,461	26,483	26,539	26,640	(5,328) [1,279] {639}	26,737	(5,347) [1,283] {642}	26,826	(5,365) [1,288] {644}		
Pueblo	18,691	18,724	18,747	18,770	18,823	(3,765) [904] {452}	18,870	(3,774) [906] {453}	18,910	(3,782) [908] {454}		
Weld	31,735	31,799	31,829	31,890	32,037	(6,407) [1,538] {769}	32,179	(6,436) [1,545] {772}	32,316	(6,463) [1,551] {776}		

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.