

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

Date: 5/21/21

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 5/21/21 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.

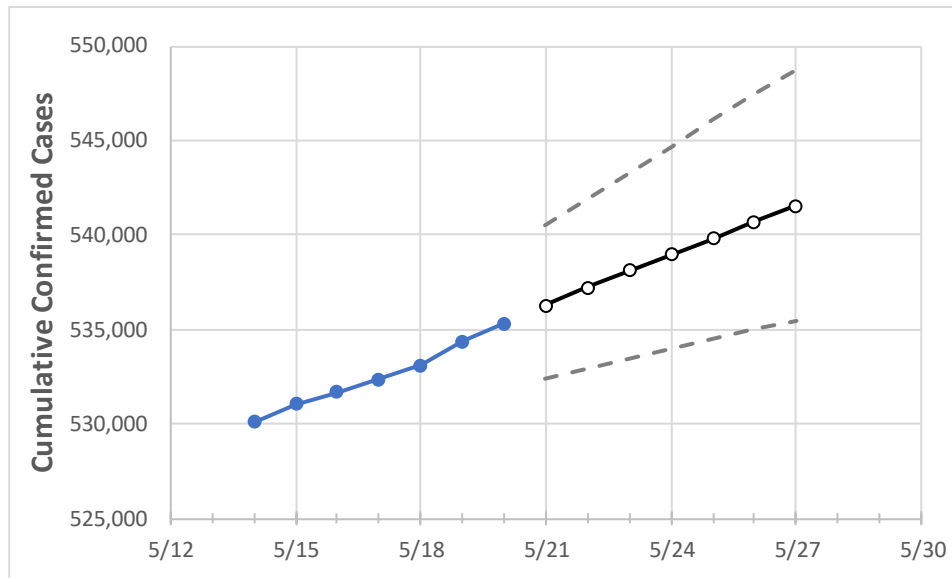
IEM's Modeling Lead

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:						
	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27
Colorado	532,389	533,119	534,364	535,316	536,276	537,196	538,117	538,973	539,825	540,694	541,530

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:						
	5/17	5/18	5/19	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27
Adams	58,722	58,802	58,991	59,080	59,199	59,322	59,438	59,555	59,666	59,774	59,883
Arapahoe	60,214	60,297	60,498	60,624	60,749	60,872	60,998	61,115	61,234	61,348	61,463
Boulder	23,412	23,425	23,453	23,466	23,483	23,498	23,513	23,526	23,539	23,551	23,563
Denver	72,378	72,418	72,484	72,566	72,637	72,706	72,775	72,841	72,907	72,968	73,024
Douglas	29,011	29,036	29,091	29,140	29,181	29,222	29,261	29,297	29,333	29,369	29,402
Eagle	6,298	6,298	6,302	6,307	6,310	6,312	6,314	6,316	6,318	6,320	6,322
El Paso	67,882	68,078	68,304	68,497	68,699	68,896	69,089	69,280	69,469	69,651	69,837
Gunnison	1,345	1,346	1,347	1,347	1,348	1,349	1,351	1,352	1,353	1,354	1,355
Jefferson	47,193	47,258	47,352	47,427	47,517	47,605	47,693	47,776	47,859	47,939	48,013
Larimer	26,539	26,572	26,628	26,680	26,726	26,770	26,815	26,858	26,898	26,937	26,976
Pueblo	18,770	18,786	18,818	18,855	18,878	18,900	18,919	18,937	18,955	18,971	18,987
Weld	31,890	31,944	32,012	32,073	32,137	32,199	32,262	32,322	32,381	32,440	32,498

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:							
	5/17	5/18	5/19	5/20	5/22		5/24		5/26			
Adams	58,722	58,802	58,991	59,080	59,322	(11,864) [2,847] {1,424}	59,555	(11,911) [2,859] {1,429}	59,774	(11,955) [2,869] {1,435}		
Arapahoe	60,214	60,297	60,498	60,624	60,872	(12,174) [2,922] {1,461}	61,115	(12,223) [2,934] {1,467}	61,348	(12,270) [2,945] {1,472}		
Boulder	23,412	23,425	23,453	23,466	23,498	(4,700) [1,128] {564}	23,526	(4,705) [1,129] {565}	23,551	(4,710) [1,130] {565}		
Denver	72,378	72,418	72,484	72,566	72,706	(14,541) [3,490] {1,745}	72,841	(14,568) [3,496] {1,748}	72,968	(14,594) [3,502] {1,751}		
Douglas	29,011	29,036	29,091	29,140	29,222	(5,844) [1,403] {701}	29,297	(5,859) [1,406] {703}	29,369	(5,874) [1,410] {705}		
Eagle	6,298	6,298	6,302	6,307	6,312	(1,262) [303] {151}	6,316	(1,263) [303] {152}	6,320	(1,264) [303] {152}		
El Paso	67,882	68,078	68,304	68,497	68,896	(13,779) [3,307] {1,654}	69,280	(13,856) [3,325] {1,663}	69,651	(13,930) [3,343] {1,672}		
Gunnison	1,345	1,346	1,347	1,347	1,349	(270) [65] {32}	1,352	(270) [65] {32}	1,354	(271) [65] {32}		
Jefferson	47,193	47,258	47,352	47,427	47,605	(9,521) [2,285] {1,143}	47,776	(9,555) [2,293] {1,147}	47,939	(9,588) [2,301] {1,151}		
Larimer	26,539	26,572	26,628	26,680	26,770	(5,354) [1,285] {642}	26,858	(5,372) [1,289] {645}	26,937	(5,387) [1,293] {646}		
Pueblo	18,770	18,786	18,818	18,855	18,900	(3,780) [907] {454}	18,937	(3,787) [909] {454}	18,971	(3,794) [911] {455}		
Weld	31,890	31,944	32,012	32,073	32,199	(6,440) [1,546] {773}	32,322	(6,464) [1,551] {776}	32,440	(6,488) [1,557] {779}		

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.