

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

Date: 4/8/21

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 4/8/21 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.

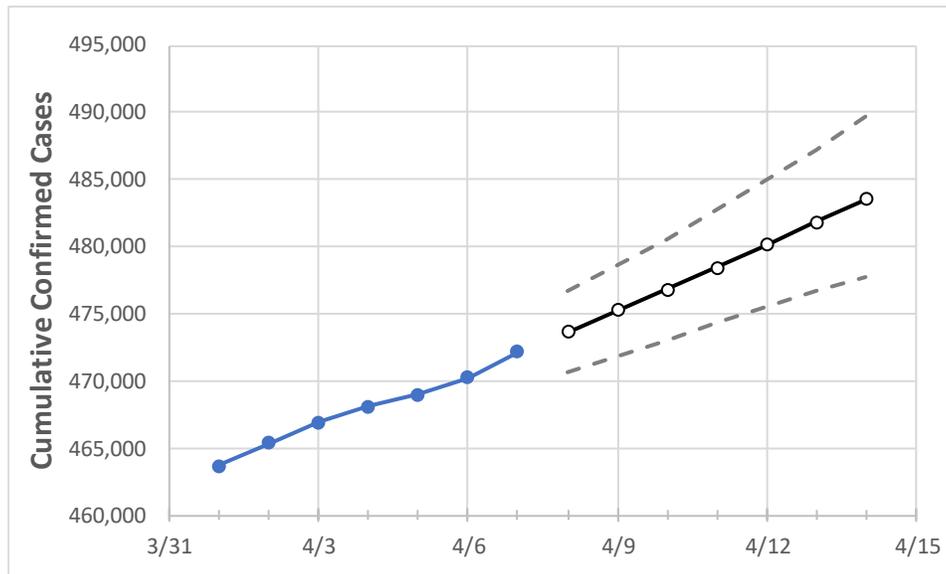
IEM's Modeling Lead

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:							
	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	
Colorado	468,121	468,988	470,254	472,168	473,659	475,233	476,842	478,472	480,113	481,821	483,515	

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:							
	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11	4/12	4/13	4/14	
Adams	51,910	51,997	52,098	52,241	52,365	52,492	52,619	52,748	52,884	53,019	53,157	
Arapahoe	52,580	52,671	52,789	53,007	53,165	53,327	53,488	53,648	53,819	53,993	54,168	
Boulder	20,949	21,018	21,071	21,173	21,264	21,358	21,456	21,554	21,657	21,761	21,868	
Denver	65,044	65,148	65,395	65,737	65,964	66,193	66,430	66,670	66,910	67,164	67,431	
Douglas	24,290	24,365	24,467	24,611	24,740	24,875	25,012	25,153	25,303	25,453	25,612	
Eagle	5,799	5,809	5,842	5,860	5,877	5,893	5,909	5,926	5,942	5,957	5,972	
El Paso	57,603	57,731	57,917	58,206	58,445	58,693	58,947	59,206	59,477	59,755	60,041	
Gunnison	1,262	1,263	1,263	1,264	1,266	1,268	1,270	1,272	1,275	1,277	1,279	
Jefferson	40,951	41,024	41,129	41,296	41,427	41,559	41,697	41,838	41,978	42,119	42,263	
Larimer	22,740	22,805	22,892	23,050	23,169	23,288	23,416	23,546	23,681	23,819	23,965	
Pueblo	16,045	16,075	16,093	16,139	16,191	16,244	16,299	16,355	16,414	16,475	16,537	
Weld	27,813	27,875	27,948	28,075	28,169	28,266	28,363	28,465	28,568	28,675	28,783	

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:								
	4/4	4/5	4/6	4/7	4/9		4/11		4/13				
Adams	51,910	51,997	52,098	52,241	52,492 (10,498)	[2,520]	{1,260}	52,748 (10,550)	[2,532]	{1,266}	53,019 (10,604)	[2,545]	{1,272}
Arapahoe	52,580	52,671	52,789	53,007	53,327 (10,665)	[2,560]	{1,280}	53,648 (10,730)	[2,575]	{1,288}	53,993 (10,799)	[2,592]	{1,296}
Boulder	20,949	21,018	21,071	21,173	21,358 (4,272)	[1,025]	{513}	21,554 (4,311)	[1,035]	{517}	21,761 (4,352)	[1,045]	{522}
Denver	65,044	65,148	65,395	65,737	66,193 (13,239)	[3,177]	{1,589}	66,670 (13,334)	[3,200]	{1,600}	67,164 (13,433)	[3,224]	{1,612}
Douglas	24,290	24,365	24,467	24,611	24,875 (4,975)	[1,194]	{597}	25,153 (5,031)	[1,207]	{604}	25,453 (5,091)	[1,222]	{611}
Eagle	5,799	5,809	5,842	5,860	5,893 (1,179)	[283]	{141}	5,926 (1,185)	[284]	{142}	5,957 (1,191)	[286]	{143}
El Paso	57,603	57,731	57,917	58,206	58,693 (11,739)	[2,817]	{1,409}	59,206 (11,841)	[2,842]	{1,421}	59,755 (11,951)	[2,868]	{1,434}
Gunnison	1,262	1,263	1,263	1,264	1,268 (254)	[61]	{30}	1,272 (254)	[61]	{31}	1,277 (255)	[61]	{31}
Jefferson	40,951	41,024	41,129	41,296	41,559 (8,312)	[1,995]	{997}	41,838 (8,368)	[2,008]	{1,004}	42,119 (8,424)	[2,022]	{1,011}
Larimer	22,740	22,805	22,892	23,050	23,288 (4,658)	[1,118]	{559}	23,546 (4,709)	[1,130]	{565}	23,819 (4,764)	[1,143]	{572}
Pueblo	16,045	16,075	16,093	16,139	16,244 (3,249)	[780]	{390}	16,355 (3,271)	[785]	{393}	16,475 (3,295)	[791]	{395}
Weld	27,813	27,875	27,948	28,075	28,266 (5,653)	[1,357]	{678}	28,465 (5,693)	[1,366]	{683}	28,675 (5,735)	[1,376]	{688}

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.