

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

Date: 3/12/21

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 3/12/21 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.

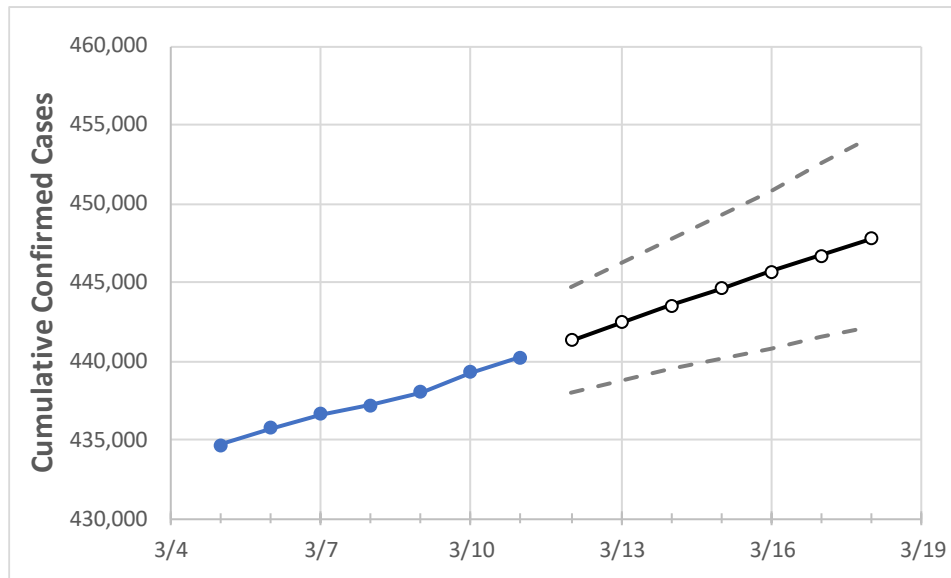
IEM's Modeling Lead

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:						
	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18
Colorado	437,187	438,025	439,265	440,220	441,331	442,423	443,494	444,571	445,652	446,711	447,768

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:						
	3/8	3/9	3/10	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18
Adams	49,259	49,325	49,430	49,520	49,622	49,725	49,827	49,932	50,031	50,133	50,235
Arapahoe	49,374	49,452	49,593	49,700	49,812	49,924	50,036	50,143	50,251	50,365	50,474
Boulder	19,222	19,262	19,309	19,351	19,400	19,447	19,495	19,543	19,592	19,639	19,685
Denver	60,715	60,810	61,117	61,246	61,410	61,573	61,744	61,913	62,089	62,260	62,432
Douglas	22,024	22,078	22,152	22,224	22,306	22,388	22,472	22,556	22,640	22,724	22,807
Eagle	5,265	5,289	5,311	5,323	5,345	5,367	5,389	5,411	5,433	5,454	5,475
El Paso	53,140	53,258	53,373	53,484	53,613	53,742	53,869	53,995	54,120	54,241	54,371
Gunnison	1,213	1,214	1,215	1,218	1,219	1,220	1,221	1,222	1,222	1,223	1,224
Jefferson	38,093	38,165	38,265	38,359	38,470	38,582	38,695	38,811	38,926	39,040	39,156
Larimer	20,628	20,673	20,750	20,798	20,862	20,925	20,986	21,048	21,108	21,166	21,226
Pueblo	15,195	15,250	15,266	15,279	15,300	15,321	15,341	15,361	15,383	15,403	15,424
Weld	26,018	26,099	26,172	26,223	26,292	26,361	26,431	26,501	26,573	26,643	26,713

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:											
	3/8	3/9	3/10	3/11	3/13				3/15				3/17			
Adams	49,259	49,325	49,430	49,520	49,725	(9,945)	[2,387]	{1,193}	49,932	(9,986)	[2,397]	{1,198}	50,133	(10,027)	[2,406]	{1,203}
Arapahoe	49,374	49,452	49,593	49,700	49,924	(9,985)	[2,396]	{1,198}	50,143	(10,029)	[2,407]	{1,203}	50,365	(10,073)	[2,418]	{1,209}
Boulder	19,222	19,262	19,309	19,351	19,447	(3,889)	[933]	{467}	19,543	(3,909)	[938]	{469}	19,639	(3,928)	[943]	{471}
Denver	60,715	60,810	61,117	61,246	61,573	(12,315)	[2,956]	{1,478}	61,913	(12,383)	[2,972]	{1,486}	62,260	(12,452)	[2,988]	{1,494}
Douglas	22,024	22,078	22,152	22,224	22,388	(4,478)	[1,075]	{537}	22,556	(4,511)	[1,083]	{541}	22,724	(4,545)	[1,091]	{545}
Eagle	5,265	5,289	5,311	5,323	5,367	(1,073)	[258]	{129}	5,411	(1,082)	[260]	{130}	5,454	(1,091)	[262]	{131}
El Paso	53,140	53,258	53,373	53,484	53,742	(10,748)	[2,580]	{1,290}	53,995	(10,799)	[2,592]	{1,296}	54,241	(10,848)	[2,604]	{1,302}
Gunnison	1,213	1,214	1,215	1,218	1,220	(244)	[59]	{29}	1,222	(244)	[59]	{29}	1,223	(245)	[59]	{29}
Jefferson	38,093	38,165	38,265	38,359	38,582	(7,716)	[1,852]	{926}	38,811	(7,762)	[1,863]	{931}	39,040	(7,808)	[1,874]	{937}
Larimer	20,628	20,673	20,750	20,798	20,925	(4,185)	[1,004]	{502}	21,048	(4,210)	[1,010]	{505}	21,166	(4,233)	[1,016]	{508}
Pueblo	15,195	15,250	15,266	15,279	15,321	(3,064)	[735]	{368}	15,361	(3,072)	[737]	{369}	15,403	(3,081)	[739]	{370}
Weld	26,018	26,099	26,172	26,223	26,361	(5,272)	[1,265]	{633}	26,501	(5,300)	[1,272]	{636}	26,643	(5,329)	[1,279]	{639}

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.