

IEM's AI Modeling: Short-term COVID-19 Projections**Date: 2/12/21**

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 2/12/21 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.

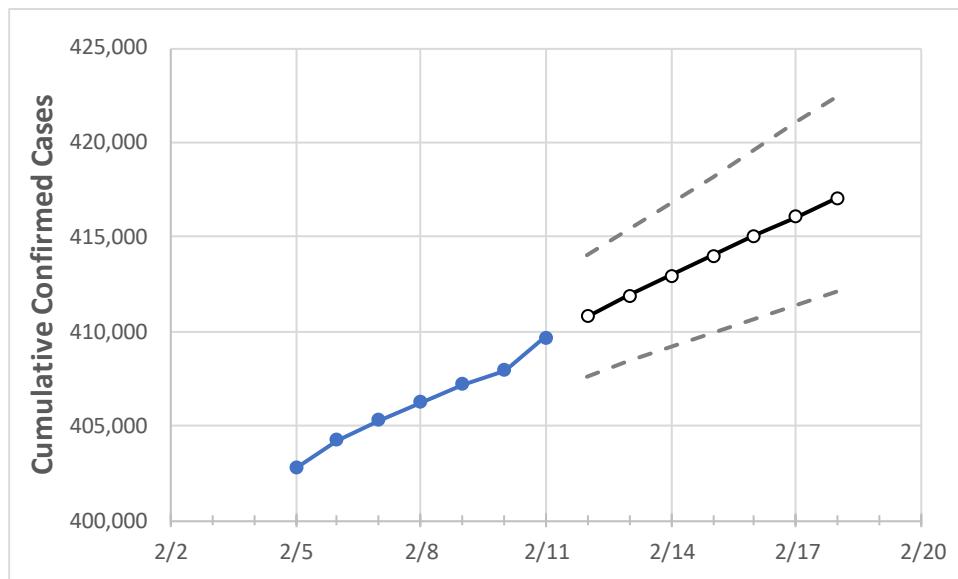
IEM's Modeling Lead

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:							
	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	
Colorado	406,276	407,210	407,961	409,683	410,794	411,902	412,971	414,017	415,068	416,067	417,081	

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:							
	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	
Adams	46,547	46,609	46,649	46,787	46,870	46,953	47,033	47,113	47,188	47,263	47,336	
Arapahoe	46,138	46,245	46,329	46,525	46,646	46,767	46,883	47,000	47,116	47,227	47,341	
Boulder	17,706	17,756	17,777	17,900	17,955	18,008	18,060	18,111	18,162	18,215	18,267	
Denver	56,844	56,997	57,068	57,283	57,415	57,546	57,677	57,804	57,931	58,053	58,177	
Douglas	19,739	19,813	19,864	19,994	20,088	20,185	20,282	20,379	20,477	20,571	20,669	
Eagle	4,621	4,635	4,648	4,673	4,694	4,716	4,736	4,757	4,777	4,796	4,816	
El Paso	48,961	49,081	49,219	49,427	49,567	49,706	49,842	49,980	50,121	50,259	50,398	
Gunnison	1,089	1,091	1,092	1,100	1,103	1,106	1,108	1,110	1,113	1,115	1,117	
Jefferson	35,360	35,433	35,480	35,660	35,747	35,830	35,914	35,996	36,075	36,152	36,232	
Larimer	18,622	18,669	18,719	18,781	18,839	18,896	18,952	19,007	19,061	19,112	19,162	
Pueblo	14,449	14,452	14,451	14,461	14,472	14,482	14,492	14,501	14,510	14,519	14,526	
Weld	24,247	24,310	24,380	24,459	24,530	24,599	24,669	24,738	24,807	24,875	24,942	

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:				2/13	Projected Cases (Hospitalized)	{ICU}	{Ventilator}	For:	2/17
	2/8	2/9	2/10	2/11						
Adams	46,547	46,609	46,649	46,787	46,953 (9,391) [2,254] {1,127}	47,113 (9,423) [2,261] {1,131}	47,263 (9,453) [2,269] {1,134}			
Arapahoe	46,138	46,245	46,329	46,525	46,767 (9,353) [2,245] {1,122}	47,000 (9,400) [2,256] {1,128}	47,227 (9,445) [2,267] {1,133}			
Boulder	17,706	17,756	17,777	17,900	18,008 (3,602) [864] {432}	18,111 (3,622) [869] {435}	18,215 (3,643) [874] {437}			
Denver	56,844	56,997	57,068	57,283	57,546 (11,509) [2,762] {1,381}	57,804 (11,561) [2,775] {1,387}	58,053 (11,611) [2,787] {1,393}			
Douglas	19,739	19,813	19,864	19,994	20,185 (4,037) [969] {484}	20,379 (4,076) [978] {489}	20,571 (4,114) [987] {494}			
Eagle	4,621	4,635	4,648	4,673	4,716 (943) [226] {113}	4,757 (951) [228] {114}	4,796 (959) [230] {115}			
El Paso	48,961	49,081	49,219	49,427	49,706 (9,941) [2,386] {1,193}	49,980 (9,996) [2,399] {1,200}	50,259 (10,052) [2,412] {1,206}			
Gunnison	1,089	1,091	1,092	1,100	1,106 (221) [53] {27}	1,110 (222) [53] {27}	1,115 (223) [54] {27}			
Jefferson	35,360	35,433	35,480	35,660	35,830 (7,166) [1,720] {860}	35,996 (7,199) [1,728] {864}	36,152 (7,230) [1,735] {868}			
Larimer	18,622	18,669	18,719	18,781	18,896 (3,779) [907] {454}	19,007 (3,801) [912] {456}	19,112 (3,822) [917] {459}			
Pueblo	14,449	14,452	14,451	14,461	14,482 (2,896) [695] {348}	14,501 (2,900) [696] {348}	14,519 (2,904) [697] {348}			
Weld	24,247	24,310	24,380	24,459	24,599 (4,920) [1,181] {590}	24,738 (4,948) [1,187] {594}	24,875 (4,975) [1,194] {597}			

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.