

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

Date: 4/5/21

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 4/5/21 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.**

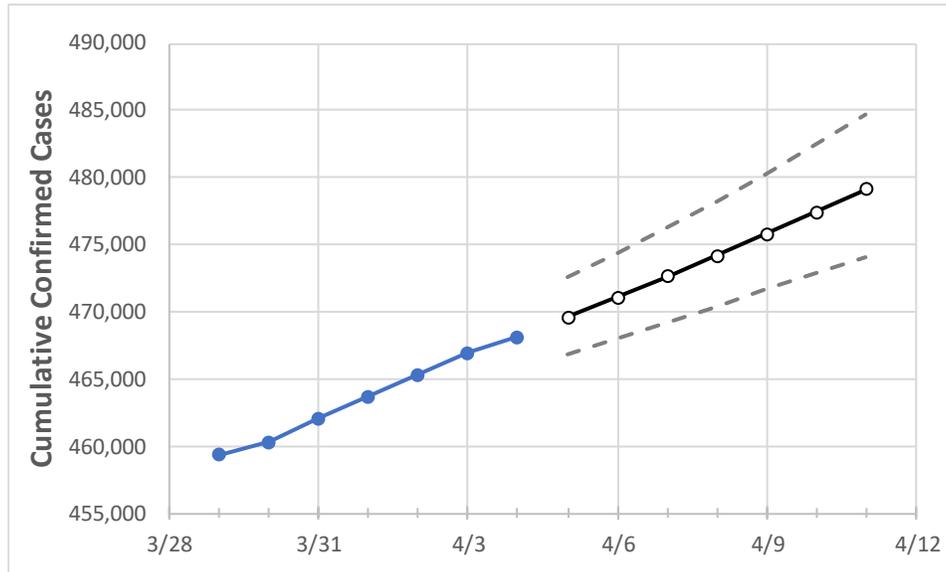
### IEM's Modeling Lead

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:						
	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11
Colorado	463,685	465,330	466,901	468,121	469,601	471,109	472,626	474,201	475,806	477,429	479,110

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:						
	4/1	4/2	4/3	4/4	4/5	4/6	4/7	4/8	4/9	4/10	4/11
Adams	51,495	51,642	51,797	51,910	52,029	52,149	52,274	52,402	52,530	52,660	52,792
Arapahoe	52,135	52,279	52,447	52,580	52,726	52,873	53,021	53,173	53,329	53,487	53,645
Boulder	20,668	20,761	20,861	20,949	21,048	21,153	21,262	21,375	21,495	21,620	21,751
Denver	64,542	64,742	64,930	65,044	65,231	65,422	65,618	65,813	66,019	66,222	66,426
Douglas	23,895	24,038	24,186	24,290	24,411	24,535	24,663	24,793	24,933	25,074	25,215
Eagle	5,756	5,777	5,790	5,799	5,817	5,835	5,853	5,871	5,889	5,906	5,923
El Paso	56,922	57,190	57,413	57,603	57,822	58,047	58,280	58,517	58,761	59,010	59,271
Gunnison	1,258	1,259	1,260	1,262	1,265	1,268	1,270	1,274	1,277	1,280	1,284
Jefferson	40,529	40,674	40,823	40,951	41,073	41,200	41,326	41,457	41,588	41,720	41,854
Larimer	22,407	22,535	22,665	22,740	22,856	22,973	23,097	23,224	23,353	23,488	23,624
Pueblo	15,876	15,945	15,986	16,045	16,103	16,166	16,231	16,301	16,376	16,454	16,537
Weld	27,578	27,662	27,742	27,813	27,892	27,971	28,051	28,134	28,219	28,305	28,392

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:							
	4/1	4/2	4/3	4/4	4/6		4/8		4/10			
Adams	51,495	51,642	51,797	51,910	52,149 (10,430) [2,503] {1,252}	52,402 (10,480) [2,515] {1,258}	52,660 (10,532) [2,528] {1,264}					
Arapahoe	52,135	52,279	52,447	52,580	52,873 (10,575) [2,538] {1,269}	53,173 (10,635) [2,552] {1,276}	53,487 (10,697) [2,567] {1,284}					
Boulder	20,668	20,761	20,861	20,949	21,153 (4,231) [1,015] {508}	21,375 (4,275) [1,026] {513}	21,620 (4,324) [1,038] {519}					
Denver	64,542	64,742	64,930	65,044	65,422 (13,084) [3,140] {1,570}	65,813 (13,163) [3,159] {1,580}	66,222 (13,244) [3,179] {1,589}					
Douglas	23,895	24,038	24,186	24,290	24,535 (4,907) [1,178] {589}	24,793 (4,959) [1,190] {595}	25,074 (5,015) [1,204] {602}					
Eagle	5,756	5,777	5,790	5,799	5,835 (1,167) [280] {140}	5,871 (1,174) [282] {141}	5,906 (1,181) [283] {142}					
El Paso	56,922	57,190	57,413	57,603	58,047 (11,609) [2,786] {1,393}	58,517 (11,703) [2,809] {1,404}	59,010 (11,802) [2,832] {1,416}					
Gunnison	1,258	1,259	1,260	1,262	1,268 (254) [61] {30}	1,274 (255) [61] {31}	1,280 (256) [61] {31}					
Jefferson	40,529	40,674	40,823	40,951	41,200 (8,240) [1,978] {989}	41,457 (8,291) [1,990] {995}	41,720 (8,344) [2,003] {1,001}					
Larimer	22,407	22,535	22,665	22,740	22,973 (4,595) [1,103] {551}	23,224 (4,645) [1,115] {557}	23,488 (4,698) [1,127] {564}					
Pueblo	15,876	15,945	15,986	16,045	16,166 (3,233) [776] {388}	16,301 (3,260) [782] {391}	16,454 (3,291) [790] {395}					
Weld	27,578	27,662	27,742	27,813	27,971 (5,594) [1,343] {671}	28,134 (5,627) [1,350] {675}	28,305 (5,661) [1,359] {679}					

For additional information from IEM, please contact Bryan Koon, Vice President of Emergency Management and Homeland Security at [bryan.koon@iem.com](mailto:bryan.koon@iem.com) or 850-519-7966 or Stephanie Tennyson at [stephanie.tennyson@iem.com](mailto:stephanie.tennyson@iem.com) or 202-309-4257.