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

Date: 2/8/21

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 2/8/21 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.

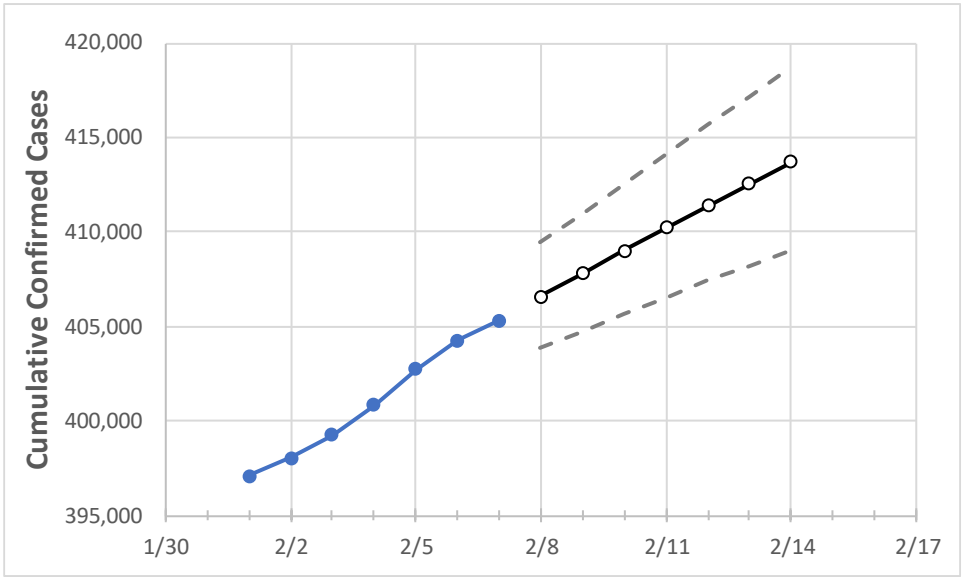
IEM's Modeling Lead

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:						
	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14
Colorado	400,851	402,754	404,256	405,330	406,585	407,819	409,024	410,205	411,361	412,541	413,694

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:						
	2/4	2/5	2/6	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14
Adams	46,098	46,271	46,398	46,481	46,579	46,672	46,767	46,858	46,949	47,036	47,123
Arapahoe	45,545	45,718	45,911	46,021	46,158	46,292	46,424	46,550	46,677	46,803	46,926
Boulder	17,437	17,531	17,589	17,646	17,706	17,763	17,820	17,879	17,936	17,992	18,046
Denver	56,202	56,402	56,574	56,677	56,810	56,941	57,073	57,197	57,322	57,442	57,559
Douglas	19,314	19,472	19,582	19,668	19,770	19,875	19,978	20,085	20,194	20,300	20,409
Eagle	4,522	4,553	4,578	4,598	4,622	4,647	4,671	4,694	4,720	4,741	4,766
El Paso	48,227	48,464	48,740	48,851	48,994	49,139	49,274	49,411	49,546	49,683	49,822
Gunnison	1,075	1,079	1,082	1,086	1,090	1,093	1,096	1,100	1,103	1,105	1,108
Jefferson	34,966	35,072	35,181	35,284	35,380	35,470	35,562	35,652	35,741	35,828	35,912
Larimer	18,341	18,443	18,516	18,564	18,632	18,699	18,764	18,831	18,895	18,959	19,021
Pueblo	14,389	14,407	14,426	14,441	14,457	14,472	14,487	14,501	14,515	14,529	14,542
Weld	23,919	24,019	24,090	24,185	24,263	24,340	24,418	24,495	24,573	24,651	24,729

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:		
	2/4	2/5	2/6	2/7	2/9	2/11	2/13
Adams	46,098	46,271	46,398	46,481	46,672 (9,334) [2,240] {1,120}	46,858 (9,372) [2,249] {1,125}	47,036 (9,407) [2,258] {1,129}
Arapahoe	45,545	45,718	45,911	46,021	46,292 (9,258) [2,222] {1,111}	46,550 (9,310) [2,234] {1,117}	46,803 (9,361) [2,247] {1,123}
Boulder	17,437	17,531	17,589	17,646	17,763 (3,553) [853] {426}	17,879 (3,576) [858] {429}	17,992 (3,598) [864] {432}
Denver	56,202	56,402	56,574	56,677	56,941 (11,388) [2,733] {1,367}	57,197 (11,439) [2,745] {1,373}	57,442 (11,488) [2,757] {1,379}
Douglas	19,314	19,472	19,582	19,668	19,875 (3,975) [954] {477}	20,085 (4,017) [964] {482}	20,300 (4,060) [974] {487}
Eagle	4,522	4,553	4,578	4,598	4,647 (929) [223] {112}	4,694 (939) [225] {113}	4,741 (948) [228] {114}
El Paso	48,227	48,464	48,740	48,851	49,139 (9,828) [2,359] {1,179}	49,411 (9,882) [2,372] {1,186}	49,683 (9,937) [2,385] {1,192}
Gunnison	1,075	1,079	1,082	1,086	1,093 (219) [52] {26}	1,100 (220) [53] {26}	1,105 (221) [53] {27}
Jefferson	34,966	35,072	35,181	35,284	35,470 (7,094) [1,703] {851}	35,652 (7,130) [1,711] {856}	35,828 (7,166) [1,720] {860}
Larimer	18,341	18,443	18,516	18,564	18,699 (3,740) [898] {449}	18,831 (3,766) [904] {452}	18,959 (3,792) [910] {455}
Pueblo	14,389	14,407	14,426	14,441	14,472 (2,894) [695] {347}	14,501 (2,900) [696] {348}	14,529 (2,906) [697] {349}
Weld	23,919	24,019	24,090	24,185	24,340 (4,868) [1,168] {584}	24,495 (4,899) [1,176] {588}	24,651 (4,930) [1,183] {592}

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.