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

Date: 2/19/21

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 2/19/21 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.

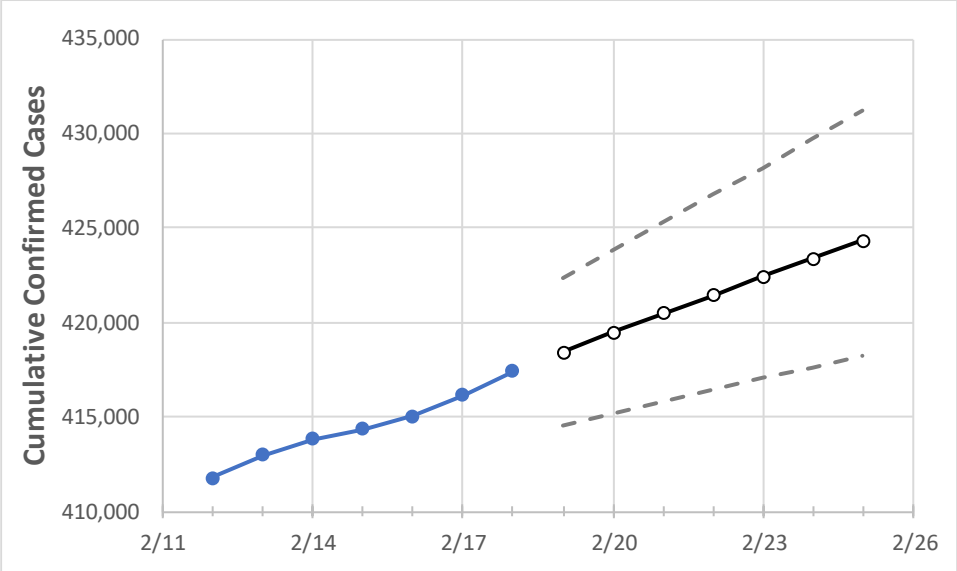
IEM's Modeling Lead

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:						
	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25
Colorado	414,369	415,037	416,174	417,415	418,445	419,478	420,467	421,453	422,428	423,398	424,354

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:						
	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25
Adams	47,135	47,184	47,268	47,377	47,451	47,524	47,597	47,667	47,736	47,803	47,868
Arapahoe	46,988	47,052	47,160	47,265	47,366	47,464	47,563	47,658	47,749	47,837	47,929
Boulder	18,128	18,158	18,233	18,303	18,360	18,417	18,478	18,535	18,593	18,650	18,707
Denver	57,845	57,911	58,034	58,144	58,267	58,385	58,502	58,617	58,731	58,844	58,953
Douglas	20,307	20,391	20,479	20,573	20,657	20,738	20,820	20,900	20,980	21,060	21,139
Eagle	4,755	4,778	4,800	4,825	4,844	4,862	4,880	4,899	4,916	4,934	4,951
El Paso	50,029	50,107	50,294	50,493	50,643	50,799	50,957	51,114	51,270	51,422	51,582
Gunnison	1,176	1,176	1,179	1,179	1,187	1,194	1,202	1,209	1,216	1,224	1,231
Jefferson	36,057	36,104	36,182	36,263	36,343	36,423	36,503	36,581	36,659	36,733	36,809
Larimer	19,066	19,120	19,204	19,312	19,381	19,448	19,518	19,586	19,654	19,722	19,787
Pueblo	14,796	14,802	14,814	14,839	14,879	14,920	14,964	15,010	15,056	15,104	15,154
Weld	24,653	24,690	24,752	24,841	24,895	24,948	25,000	25,050	25,101	25,147	25,195

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:		
	2/15	2/16	2/17	2/18	2/20	2/22	2/24
Adams	47,135	47,184	47,268	47,377	47,524 (9,505) [2,281] {1,141}	47,667 (9,533) [2,288] {1,144}	47,803 (9,561) [2,295] {1,147}
Arapahoe	46,988	47,052	47,160	47,265	47,464 (9,493) [2,278] {1,139}	47,658 (9,532) [2,288] {1,144}	47,837 (9,567) [2,296] {1,148}
Boulder	18,128	18,158	18,233	18,303	18,417 (3,683) [884] {442}	18,535 (3,707) [890] {445}	18,650 (3,730) [895] {448}
Denver	57,845	57,911	58,034	58,144	58,385 (11,677) [2,802] {1,401}	58,617 (11,723) [2,814] {1,407}	58,844 (11,769) [2,824] {1,412}
Douglas	20,307	20,391	20,479	20,573	20,738 (4,148) [995] {498}	20,900 (4,180) [1,003] {502}	21,060 (4,212) [1,011] {505}
Eagle	4,755	4,778	4,800	4,825	4,862 (972) [233] {117}	4,899 (980) [235] {118}	4,934 (987) [237] {118}
El Paso	50,029	50,107	50,294	50,493	50,799 (10,160) [2,438] {1,219}	51,114 (10,223) [2,453] {1,227}	51,422 (10,284) [2,468] {1,234}
Gunnison	1,176	1,176	1,179	1,179	1,194 (239) [57] {29}	1,209 (242) [58] {29}	1,224 (245) [59] {29}
Jefferson	36,057	36,104	36,182	36,263	36,423 (7,285) [1,748] {874}	36,581 (7,316) [1,756] {878}	36,733 (7,347) [1,763] {882}
Larimer	19,066	19,120	19,204	19,312	19,448 (3,890) [934] {467}	19,586 (3,917) [940] {470}	19,722 (3,944) [947] {473}
Pueblo	14,796	14,802	14,814	14,839	14,920 (2,984) [716] {358}	15,010 (3,002) [720] {360}	15,104 (3,021) [725] {363}
Weld	24,653	24,690	24,752	24,841	24,948 (4,990) [1,198] {599}	25,050 (5,010) [1,202] {601}	25,147 (5,029) [1,207] {604}

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.