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

Date: 12/21/20

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 12/21/20 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.

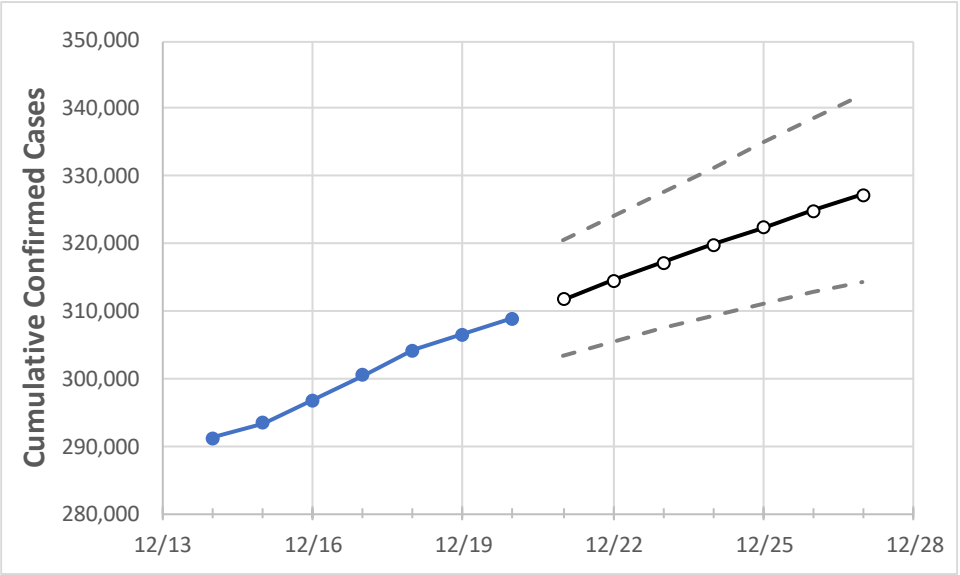
IEM's Modeling Lead

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:						
	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27
Colorado	300,414	304,107	306,598	308,890	311,720	314,478	317,166	319,786	322,339	324,828	327,253

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 20%, and are often within 10%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	12/17	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27
Adams	36,396	36,782	36,997	37,203	37,472	37,734	37,988	38,234	38,473	38,706	38,931
Arapahoe	34,227	34,651	34,934	35,187	35,480	35,766	36,045	36,316	36,581	36,838	37,089
Boulder	13,360	13,508	13,568	13,643	13,724	13,802	13,877	13,950	14,020	14,088	14,154
Denver	43,765	44,197	44,489	44,748	45,031	45,306	45,574	45,836	46,090	46,338	46,580
Douglas	14,035	14,180	14,271	14,381	14,496	14,607	14,713	14,815	14,913	15,007	15,097
Eagle	2,982	3,030	3,070	3,082	3,116	3,151	3,185	3,219	3,253	3,287	3,321
El Paso	36,752	37,225	37,552	37,815	38,168	38,510	38,841	39,162	39,472	39,772	40,062
Gunnison	569	583	599	602	610	619	627	637	646	656	665
Jefferson	26,831	27,074	27,254	27,481	27,698	27,907	28,108	28,301	28,486	28,665	28,836
Larimer	13,639	13,782	13,922	14,031	14,160	14,285	14,407	14,526	14,640	14,752	14,860
Pueblo	11,990	12,150	12,236	12,320	12,439	12,554	12,665	12,771	12,874	12,974	13,069
Weld	17,946	18,088	18,259	18,390	18,538	18,681	18,820	18,955	19,085	19,211	19,334

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:		
	12/17	12/18	12/19	12/20	12/22	12/24	12/26
Adams	36,396	36,782	36,997	37,203	37,734 (7,547) [1,811] {906}	38,234 (7,647) [1,835] {918}	38,706 (7,741) [1,858] {929}
Arapahoe	34,227	34,651	34,934	35,187	35,766 (7,153) [1,717] {858}	36,316 (7,263) [1,743] {872}	36,838 (7,368) [1,768] {884}
Boulder	13,360	13,508	13,568	13,643	13,802 (2,760) [662] {331}	13,950 (2,790) [670] {335}	14,088 (2,818) [676] {338}
Denver	43,765	44,197	44,489	44,748	45,306 (9,061) [2,175] {1,087}	45,836 (9,167) [2,200] {1,100}	46,338 (9,268) [2,224] {1,112}
Douglas	14,035	14,180	14,271	14,381	14,607 (2,921) [701] {351}	14,815 (2,963) [711] {356}	15,007 (3,001) [720] {360}
Eagle	2,982	3,030	3,070	3,082	3,151 (630) [151] {76}	3,219 (644) [155] {77}	3,287 (657) [158] {79}
El Paso	36,752	37,225	37,552	37,815	38,510 (7,702) [1,848] {924}	39,162 (7,832) [1,880] {940}	39,772 (7,954) [1,909] {955}
Gunnison	569	583	599	602	619 (124) [30] {15}	637 (127) [31] {15}	656 (131) [31] {16}
Jefferson	26,831	27,074	27,254	27,481	27,907 (5,581) [1,340] {670}	28,301 (5,660) [1,358] {679}	28,665 (5,733) [1,376] {688}
Larimer	13,639	13,782	13,922	14,031	14,285 (2,857) [686] {343}	14,526 (2,905) [697] {349}	14,752 (2,950) [708] {354}
Pueblo	11,990	12,150	12,236	12,320	12,554 (2,511) [603] {301}	12,771 (2,554) [613] {307}	12,974 (2,595) [623] {311}
Weld	17,946	18,088	18,259	18,390	18,681 (3,736) [897] {448}	18,955 (3,791) [910] {455}	19,211 (3,842) [922] {461}

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.