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

Date: 11/2/20

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 11/2/20 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.

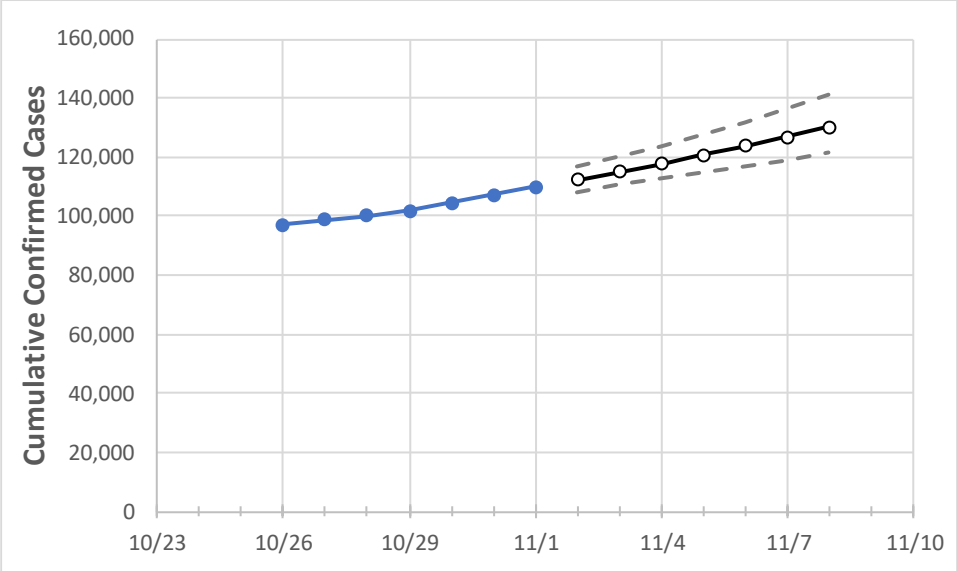
IEM's Modeling Lead

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:						
	10/29	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8
Colorado	101,991	104,403	107,327	109,887	112,354	114,954	117,695	120,585	123,630	126,840	130,223

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:						
	10/29	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8
Adams	14,411	14,830	15,216	15,538	15,885	16,247	16,625	17,020	17,431	17,861	18,310
Arapahoe	13,050	13,313	13,645	13,956	14,208	14,472	14,748	15,038	15,342	15,661	15,995
Boulder	5,660	5,756	5,870	5,988	6,070	6,155	6,245	6,339	6,438	6,541	6,650
Denver	18,539	18,937	19,441	19,878	20,258	20,657	21,078	21,522	21,989	22,481	22,998
Douglas	4,094	4,211	4,332	4,458	4,574	4,697	4,828	4,967	5,115	5,273	5,440
Eagle	1,465	1,492	1,510	1,521	1,536	1,552	1,569	1,587	1,607	1,628	1,651
El Paso	10,411	10,612	10,904	11,214	11,477	11,753	12,042	12,346	12,664	12,998	13,348
Gunnison	310	313	319	322	324	326	328	330	332	335	338
Jefferson	8,783	9,007	9,303	9,533	9,779	10,040	10,318	10,613	10,925	11,258	11,610
Larimer	4,183	4,274	4,440	4,555	4,640	4,728	4,819	4,913	5,010	5,109	5,212
Pueblo	2,141	2,227	2,331	2,436	2,520	2,609	2,705	2,807	2,917	3,035	3,160
Weld	6,255	6,394	6,583	6,766	6,917	7,079	7,255	7,444	7,648	7,869	8,106

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:		
	10/29	10/30	10/31	11/1	11/3	11/5	11/7
Adams	14,411	14,830	15,216	15,538	16,247 (3,249) [780] {390}	17,020 (3,404) [817] {408}	17,861 (3,572) [857] {429}
Arapahoe	13,050	13,313	13,645	13,956	14,472 (2,894) [695] {347}	15,038 (3,008) [722] {361}	15,661 (3,132) [752] {376}
Boulder	5,660	5,756	5,870	5,988	6,155 (1,231) [295] {148}	6,339 (1,268) [304] {152}	6,541 (1,308) [314] {157}
Denver	18,539	18,937	19,441	19,878	20,657 (4,131) [992] {496}	21,522 (4,304) [1,033] {517}	22,481 (4,496) [1,079] {540}
Douglas	4,094	4,211	4,332	4,458	4,697 (939) [225] {113}	4,967 (993) [238] {119}	5,273 (1,055) [253] {127}
Eagle	1,465	1,492	1,510	1,521	1,552 (310) [74] {37}	1,587 (317) [76] {38}	1,628 (326) [78] {39}
El Paso	10,411	10,612	10,904	11,214	11,753 (2,351) [564] {282}	12,346 (2,469) [593] {296}	12,998 (2,600) [624] {312}
Gunnison	310	313	319	322	326 (65) [16] {8}	330 (66) [16] {8}	335 (67) [16] {8}
Jefferson	8,783	9,007	9,303	9,533	10,040 (2,008) [482] {241}	10,613 (2,123) [509] {255}	11,258 (2,252) [540] {270}
Larimer	4,183	4,274	4,440	4,555	4,728 (946) [227] {113}	4,913 (983) [236] {118}	5,109 (1,022) [245] {123}
Pueblo	2,141	2,227	2,331	2,436	2,609 (522) [125] {63}	2,807 (561) [135] {67}	3,035 (607) [146] {73}
Weld	6,255	6,394	6,583	6,766	7,079 (1,416) [340] {170}	7,444 (1,489) [357] {179}	7,869 (1,574) [378] {189}

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.