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

Date: 5/3/21

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 5/3/21 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.

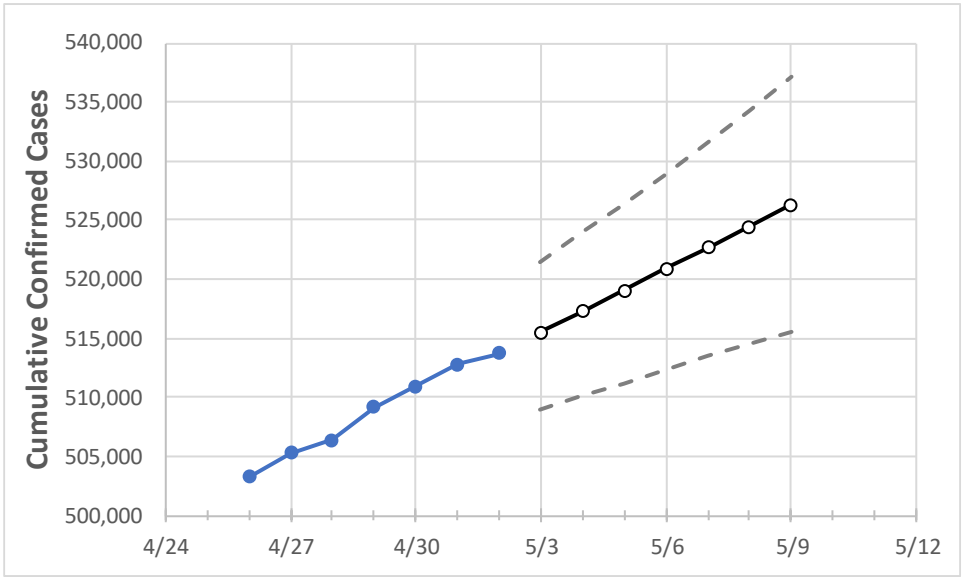
IEM's Modeling Lead

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:						
	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9
Colorado	509,194	510,966	512,804	513,765	515,488	517,254	519,078	520,874	522,650	524,464	526,298

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:						
	4/29	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9
Adams	56,038	56,204	56,387	56,473	56,659	56,851	57,045	57,247	57,444	57,643	57,851
Arapahoe	57,412	57,632	57,834	57,947	58,162	58,376	58,599	58,814	59,037	59,262	59,490
Boulder	22,769	22,855	22,909	22,954	23,014	23,074	23,133	23,191	23,248	23,305	23,359
Denver	70,296	70,444	70,636	70,708	70,878	71,041	71,205	71,364	71,521	71,675	71,828
Douglas	27,704	27,809	27,891	27,960	28,075	28,191	28,305	28,420	28,537	28,649	28,763
Eagle	6,197	6,215	6,230	6,231	6,241	6,250	6,259	6,268	6,277	6,285	6,294
El Paso	63,562	63,886	64,179	64,366	64,651	64,938	65,234	65,539	65,845	66,149	66,457
Gunnison	1,321	1,322	1,324	1,324	1,326	1,327	1,329	1,331	1,333	1,335	1,336
Jefferson	44,888	45,079	45,266	45,356	45,536	45,713	45,893	46,077	46,259	46,446	46,630
Larimer	25,350	25,434	25,541	25,579	25,667	25,757	25,847	25,934	26,023	26,110	26,195
Pueblo	17,717	17,799	17,906	17,982	18,081	18,184	18,287	18,393	18,503	18,615	18,736
Weld	30,397	30,521	30,639	30,688	30,804	30,922	31,038	31,160	31,281	31,402	31,524

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:		
	4/29	4/30	5/1	5/2	5/4	5/6	5/8
Adams	56,038	56,204	56,387	56,473	56,851 (11,370) [2,729] {1,364}	57,247 (11,449) [2,748] {1,374}	57,643 (11,529) [2,767] {1,383}
Arapahoe	57,412	57,632	57,834	57,947	58,376 (11,675) [2,802] {1,401}	58,814 (11,763) [2,823] {1,412}	59,262 (11,852) [2,845] {1,422}
Boulder	22,769	22,855	22,909	22,954	23,074 (4,615) [1,108] {554}	23,191 (4,638) [1,113] {557}	23,305 (4,661) [1,119] {559}
Denver	70,296	70,444	70,636	70,708	71,041 (14,208) [3,410] {1,705}	71,364 (14,273) [3,425] {1,713}	71,675 (14,335) [3,440] {1,720}
Douglas	27,704	27,809	27,891	27,960	28,191 (5,638) [1,353] {677}	28,420 (5,684) [1,364] {682}	28,649 (5,730) [1,375] {688}
Eagle	6,197	6,215	6,230	6,231	6,250 (1,250) [300] {150}	6,268 (1,254) [301] {150}	6,285 (1,257) [302] {151}
El Paso	63,562	63,886	64,179	64,366	64,938 (12,988) [3,117] {1,559}	65,539 (13,108) [3,146] {1,573}	66,149 (13,230) [3,175] {1,588}
Gunnison	1,321	1,322	1,324	1,324	1,327 (265) [64] {32}	1,331 (266) [64] {32}	1,335 (267) [64] {32}
Jefferson	44,888	45,079	45,266	45,356	45,713 (9,143) [2,194] {1,097}	46,077 (9,215) [2,212] {1,106}	46,446 (9,289) [2,229] {1,115}
Larimer	25,350	25,434	25,541	25,579	25,757 (5,151) [1,236] {618}	25,934 (5,187) [1,245] {622}	26,110 (5,222) [1,253] {627}
Pueblo	17,717	17,799	17,906	17,982	18,184 (3,637) [873] {436}	18,393 (3,679) [883] {441}	18,615 (3,723) [894] {447}
Weld	30,397	30,521	30,639	30,688	30,922 (6,184) [1,484] {742}	31,160 (6,232) [1,496] {748}	31,402 (6,280) [1,507] {754}

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.