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

Date: 2/1/21

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 2/1/21 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.

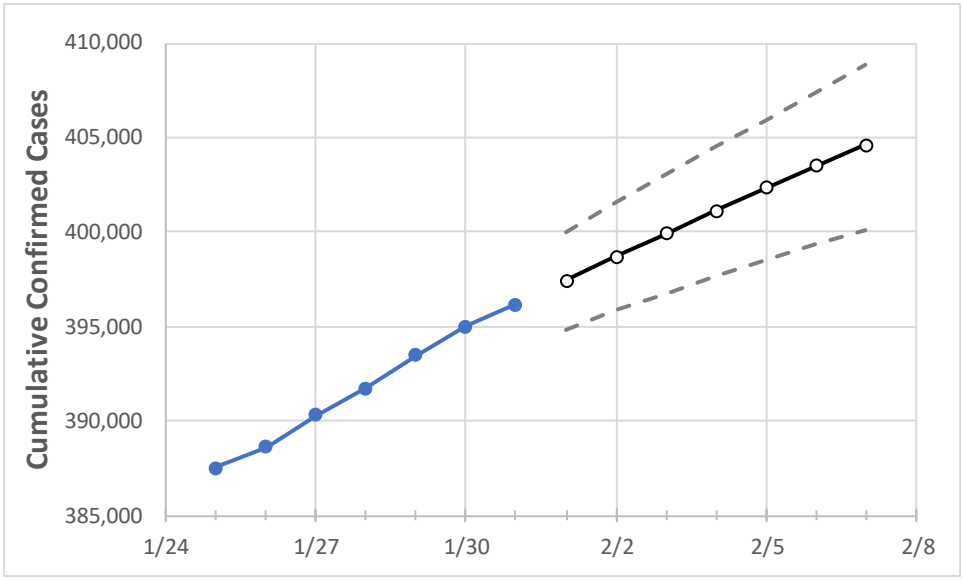
IEM's Modeling Lead

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:						
	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7
Colorado	391,737	393,459	395,019	396,185	397,455	398,707	399,921	401,143	402,324	403,476	404,589

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:						
	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7
Adams	45,363	45,508	45,618	45,735	45,846	45,955	46,063	46,167	46,269	46,370	46,464
Arapahoe	44,513	44,719	44,881	45,027	45,179	45,324	45,468	45,610	45,747	45,883	46,017
Boulder	17,035	17,108	17,179	17,224	17,286	17,346	17,407	17,466	17,524	17,582	17,640
Denver	55,170	55,377	55,588	55,734	55,875	56,009	56,143	56,270	56,395	56,516	56,637
Douglas	18,666	18,782	18,861	18,920	18,983	19,045	19,105	19,164	19,222	19,277	19,331
Eagle	4,311	4,342	4,375	4,390	4,416	4,441	4,467	4,492	4,516	4,540	4,565
El Paso	47,327	47,491	47,657	47,777	47,892	48,002	48,109	48,215	48,313	48,411	48,505
Gunnison	1,034	1,042	1,051	1,054	1,065	1,076	1,087	1,097	1,108	1,118	1,129
Jefferson	34,228	34,364	34,509	34,593	34,695	34,795	34,894	34,989	35,082	35,172	35,260
Larimer	17,834	17,914	17,999	18,065	18,141	18,217	18,291	18,364	18,438	18,511	18,583
Pueblo	14,246	14,302	14,326	14,339	14,357	14,375	14,392	14,409	14,426	14,441	14,457
Weld	23,380	23,453	23,523	23,586	23,648	23,708	23,765	23,820	23,873	23,925	23,975

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:		
	1/28	1/29	1/30	1/31	2/2	2/4	2/6
Adams	45,363	45,508	45,618	45,735	45,955 (9,191) [2,206] {1,103}	46,167 (9,233) [2,216] {1,108}	46,370 (9,274) [2,226] {1,113}
Arapahoe	44,513	44,719	44,881	45,027	45,324 (9,065) [2,176] {1,088}	45,610 (9,122) [2,189] {1,095}	45,883 (9,177) [2,202] {1,101}
Boulder	17,035	17,108	17,179	17,224	17,346 (3,469) [833] {416}	17,466 (3,493) [838] {419}	17,582 (3,516) [844] {422}
Denver	55,170	55,377	55,588	55,734	56,009 (11,202) [2,688] {1,344}	56,270 (11,254) [2,701] {1,350}	56,516 (11,303) [2,713] {1,356}
Douglas	18,666	18,782	18,861	18,920	19,045 (3,809) [914] {457}	19,164 (3,833) [920] {460}	19,277 (3,855) [925] {463}
Eagle	4,311	4,342	4,375	4,390	4,441 (888) [213] {107}	4,492 (898) [216] {108}	4,540 (908) [218] {109}
El Paso	47,327	47,491	47,657	47,777	48,002 (9,600) [2,304] {1,152}	48,215 (9,643) [2,314] {1,157}	48,411 (9,682) [2,324] {1,162}
Gunnison	1,034	1,042	1,051	1,054	1,076 (215) [52] {26}	1,097 (219) [53] {26}	1,118 (224) [54] {27}
Jefferson	34,228	34,364	34,509	34,593	34,795 (6,959) [1,670] {835}	34,989 (6,998) [1,679] {840}	35,172 (7,034) [1,688] {844}
Larimer	17,834	17,914	17,999	18,065	18,217 (3,643) [874] {437}	18,364 (3,673) [881] {441}	18,511 (3,702) [889] {444}
Pueblo	14,246	14,302	14,326	14,339	14,375 (2,875) [690] {345}	14,409 (2,882) [692] {346}	14,441 (2,888) [693] {347}
Weld	23,380	23,453	23,523	23,586	23,708 (4,742) [1,138] {569}	23,820 (4,764) [1,143] {572}	23,925 (4,785) [1,148] {574}

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.