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

Date: 11/3/21

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 11/3/21 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.

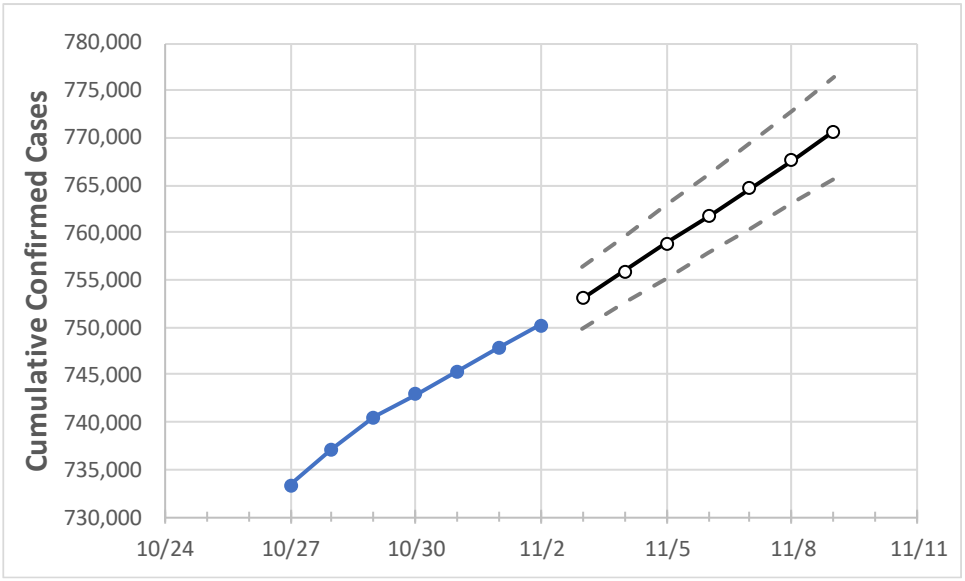
IEM's Modeling Lead

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:						
	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9
Colorado	742,926	745,390	747,855	750,251	753,113	755,966	758,839	761,742	764,687	767,646	770,653

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:						
	10/30	10/31	11/1	11/2	11/3	11/4	11/5	11/6	11/7	11/8	11/9
Adams	76,534	76,735	76,937	77,119	77,357	77,596	77,838	78,083	78,330	78,580	78,835
Arapahoe	80,409	80,657	80,906	81,127	81,375	81,620	81,867	82,118	82,369	82,622	82,875
Boulder	31,156	31,246	31,336	31,441	31,540	31,639	31,739	31,842	31,945	32,052	32,157
Denver	92,485	92,759	93,034	93,244	93,521	93,805	94,090	94,375	94,670	94,971	95,262
Douglas	40,923	41,046	41,168	41,307	41,454	41,601	41,747	41,898	42,050	42,206	42,362
Eagle	8,444	8,456	8,467	8,500	8,523	8,547	8,570	8,594	8,618	8,643	8,668
El Paso	102,833	103,159	103,484	103,867	104,279	104,690	105,104	105,523	105,936	106,361	106,791
Gunnison	1,842	1,845	1,847	1,847	1,850	1,852	1,855	1,858	1,860	1,863	1,866
Jefferson	64,226	64,474	64,722	64,916	65,190	65,464	65,740	66,022	66,314	66,601	66,899
Larimer	39,957	40,106	40,256	40,408	40,601	40,795	40,991	41,190	41,394	41,593	41,800
Pueblo	25,823	25,954	26,086	26,175	26,330	26,479	26,632	26,792	26,950	27,114	27,278
Weld	47,277	47,451	47,625	47,807	48,013	48,220	48,428	48,632	48,840	49,056	49,265

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:		
	10/30	10/31	11/1	11/2	11/4	11/6	11/8
Adams	76,534	76,735	76,937	77,119	77,596 (15,519) [3,725] {1,862}	78,083 (15,617) [3,748] {1,874}	78,580 (15,716) [3,772] {1,886}
Arapahoe	80,409	80,657	80,906	81,127	81,620 (16,324) [3,918] {1,959}	82,118 (16,424) [3,942] {1,971}	82,622 (16,524) [3,966] {1,983}
Boulder	31,156	31,246	31,336	31,441	31,639 (6,328) [1,519] {759}	31,842 (6,368) [1,528] {764}	32,052 (6,410) [1,538] {769}
Denver	92,485	92,759	93,034	93,244	93,805 (18,761) [4,503] {2,251}	94,375 (18,875) [4,530] {2,265}	94,971 (18,994) [4,559] {2,279}
Douglas	40,923	41,046	41,168	41,307	41,601 (8,320) [1,997] {998}	41,898 (8,380) [2,011] {1,006}	42,206 (8,441) [2,026] {1,013}
Eagle	8,444	8,456	8,467	8,500	8,547 (1,709) [410] {205}	8,594 (1,719) [413] {206}	8,643 (1,729) [415] {207}
El Paso	102,833	103,159	103,484	103,867	104,690 (20,938) [5,025] {2,513}	105,523 (21,105) [5,065] {2,533}	106,361 (21,272) [5,105] {2,553}
Gunnison	1,842	1,845	1,847	1,847	1,852 (370) [89] {44}	1,858 (372) [89] {45}	1,863 (373) [89] {45}
Jefferson	64,226	64,474	64,722	64,916	65,464 (13,093) [3,142] {1,571}	66,022 (13,204) [3,169] {1,585}	66,601 (13,320) [3,197] {1,598}
Larimer	39,957	40,106	40,256	40,408	40,795 (8,159) [1,958] {979}	41,190 (8,238) [1,977] {989}	41,593 (8,319) [1,996] {998}
Pueblo	25,823	25,954	26,086	26,175	26,479 (5,296) [1,271] {635}	26,792 (5,358) [1,286] {643}	27,114 (5,423) [1,301] {651}
Weld	47,277	47,451	47,625	47,807	48,220 (9,644) [2,315] {1,157}	48,632 (9,726) [2,334] {1,167}	49,056 (9,811) [2,355] {1,177}

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.