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

Date: 12/27/21

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 12/27/21 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.

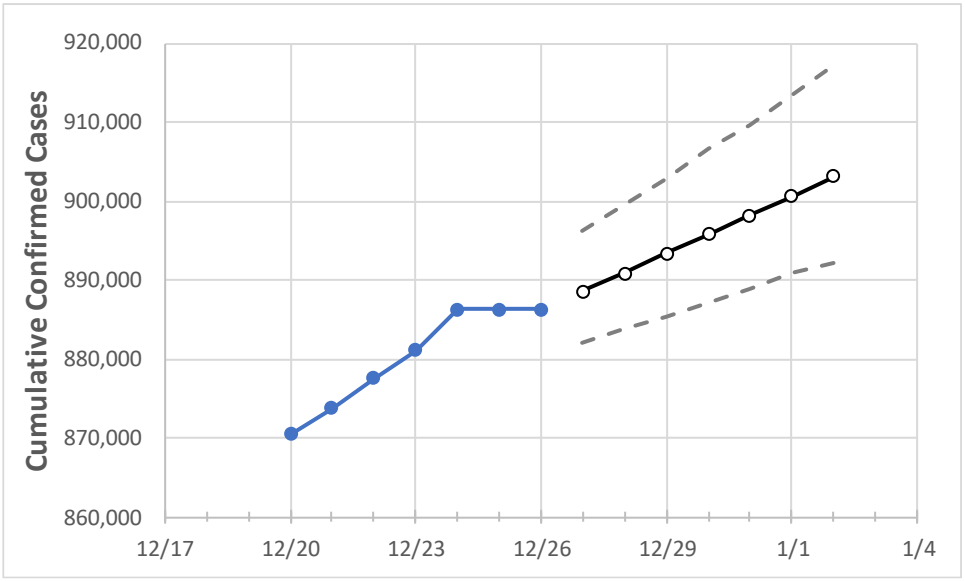
IEM's Modeling Lead

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:						
	12/23	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2
Colorado	881,118	886,250	886,250	886,250	888,600	890,895	893,387	895,724	898,196	900,553	903,188

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:						
	12/23	12/24	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2
Adams	89,438	89,818	89,818	89,818	90,017	90,220	90,419	90,626	90,826	91,039	91,237
Arapahoe	95,160	95,866	95,866	95,866	96,236	96,598	96,961	97,328	97,728	98,090	98,487
Boulder	36,985	37,292	37,292	37,292	37,453	37,607	37,774	37,943	38,110	38,303	38,476
Denver	108,827	109,975	109,975	109,975	110,573	111,216	111,874	112,583	113,275	114,038	114,773
Douglas	48,421	48,735	48,735	48,735	48,872	48,995	49,125	49,261	49,395	49,539	49,670
Eagle	10,213	10,385	10,385	10,385	10,598	10,824	11,074	11,344	11,640	11,968	12,321
El Paso	120,891	121,281	121,281	121,281	121,527	121,770	122,006	122,236	122,495	122,730	122,982
Gunnison	2,084	2,099	2,099	2,099	2,102	2,105	2,109	2,112	2,115	2,118	2,121
Jefferson	77,603	78,155	78,155	78,155	78,366	78,579	78,779	79,001	79,199	79,422	79,640
Larimer	47,955	48,130	48,130	48,130	48,250	48,362	48,478	48,597	48,713	48,829	48,941
Pueblo	30,920	30,980	30,980	30,980	31,021	31,058	31,097	31,134	31,170	31,209	31,244
Weld	55,994	56,156	56,156	56,156	56,263	56,374	56,477	56,586	56,687	56,801	56,902

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:		
	12/23	12/24	12/25	12/26	12/28	12/30	1/1
Adams	89,438	89,818	89,818	89,818	90,220 (18,044) [4,331] {2,165}	90,626 (18,125) [4,350] {2,175}	91,039 (18,208) [4,370] {2,185}
Arapahoe	95,160	95,866	95,866	95,866	96,598 (19,320) [4,637] {2,318}	97,328 (19,466) [4,672] {2,336}	98,090 (19,618) [4,708] {2,354}
Boulder	36,985	37,292	37,292	37,292	37,607 (7,521) [1,805] {903}	37,943 (7,589) [1,821] {911}	38,303 (7,661) [1,839] {919}
Denver	108,827	109,975	109,975	109,975	111,216 (22,243) [5,338] {2,669}	112,583 (22,517) [5,404] {2,702}	114,038 (22,808) [5,474] {2,737}
Douglas	48,421	48,735	48,735	48,735	48,995 (9,799) [2,352] {1,176}	49,261 (9,852) [2,365] {1,182}	49,539 (9,908) [2,378] {1,189}
Eagle	10,213	10,385	10,385	10,385	10,824 (2,165) [520] {260}	11,344 (2,269) [545] {272}	11,968 (2,394) [574] {287}
El Paso	120,891	121,281	121,281	121,281	121,770 (24,354) [5,845] {2,922}	122,236 (24,447) [5,867] {2,934}	122,730 (24,546) [5,891] {2,946}
Gunnison	2,084	2,099	2,099	2,099	2,105 (421) [101] {51}	2,112 (422) [101] {51}	2,118 (424) [102] {51}
Jefferson	77,603	78,155	78,155	78,155	78,579 (15,716) [3,772] {1,886}	79,001 (15,800) [3,792] {1,896}	79,422 (15,884) [3,812] {1,906}
Larimer	47,955	48,130	48,130	48,130	48,362 (9,672) [2,321] {1,161}	48,597 (9,719) [2,333] {1,166}	48,829 (9,766) [2,344] {1,172}
Pueblo	30,920	30,980	30,980	30,980	31,058 (6,212) [1,491] {745}	31,134 (6,227) [1,494] {747}	31,209 (6,242) [1,498] {749}
Weld	55,994	56,156	56,156	56,156	56,374 (11,275) [2,706] {1,353}	56,586 (11,317) [2,716] {1,358}	56,801 (11,360) [2,726] {1,363}

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.