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

Date: 12/22/21

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 12/22/21 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.

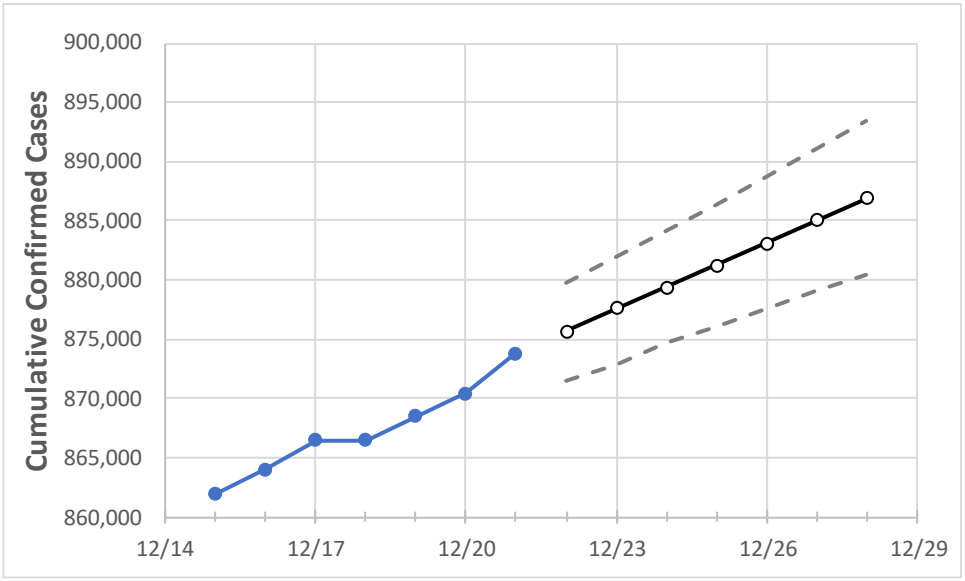
IEM's Modeling Lead

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:						
	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28
Colorado	866,482	868,457	870,432	873,784	875,651	877,591	879,384	881,276	883,110	885,051	886,906

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:						
	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28
Adams	88,235	88,364	88,493	88,828	89,017	89,211	89,395	89,583	89,772	89,957	90,142
Arapahoe	93,423	93,608	93,792	94,197	94,426	94,657	94,888	95,122	95,350	95,593	95,817
Boulder	36,258	36,321	36,384	36,571	36,662	36,756	36,848	36,942	37,037	37,132	37,227
Denver	106,334	106,541	106,747	107,530	107,794	108,063	108,318	108,595	108,858	109,142	109,415
Douglas	47,714	47,790	47,865	48,021	48,113	48,205	48,292	48,384	48,472	48,559	48,646
Eagle	9,621	9,668	9,714	9,824	9,865	9,911	9,952	9,999	10,045	10,093	10,146
El Paso	119,477	119,624	119,772	120,057	120,268	120,481	120,677	120,878	121,072	121,267	121,455
Gunnison	2,067	2,068	2,068	2,072	2,075	2,078	2,081	2,084	2,087	2,090	2,092
Jefferson	76,503	76,618	76,732	77,080	77,257	77,426	77,596	77,774	77,935	78,109	78,276
Larimer	47,298	47,371	47,444	47,548	47,648	47,742	47,838	47,935	48,026	48,122	48,215
Pueblo	30,691	30,715	30,739	30,793	30,837	30,882	30,925	30,967	31,008	31,050	31,088
Weld	55,383	55,451	55,518	55,658	55,767	55,875	55,980	56,092	56,191	56,297	56,399

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:		
	12/18	12/19	12/20	12/21	12/23	12/25	12/27
Adams	88,235	88,364	88,493	88,828	89,211 (17,842) [4,282] {2,141}	89,583 (17,917) [4,300] {2,150}	89,957 (17,991) [4,318] {2,159}
Arapahoe	93,423	93,608	93,792	94,197	94,657 (18,931) [4,544] {2,272}	95,122 (19,024) [4,566] {2,283}	95,593 (19,119) [4,588] {2,294}
Boulder	36,258	36,321	36,384	36,571	36,756 (7,351) [1,764] {882}	36,942 (7,388) [1,773] {887}	37,132 (7,426) [1,782] {891}
Denver	106,334	106,541	106,747	107,530	108,063 (21,613) [5,187] {2,594}	108,595 (21,719) [5,213] {2,606}	109,142 (21,828) [5,239] {2,619}
Douglas	47,714	47,790	47,865	48,021	48,205 (9,641) [2,314] {1,157}	48,384 (9,677) [2,322] {1,161}	48,559 (9,712) [2,331] {1,165}
Eagle	9,621	9,668	9,714	9,824	9,911 (1,982) [476] {238}	9,999 (2,000) [480] {240}	10,093 (2,019) [484] {242}
El Paso	119,477	119,624	119,772	120,057	120,481 (24,096) [5,783] {2,892}	120,878 (24,176) [5,802] {2,901}	121,267 (24,253) [5,821] {2,910}
Gunnison	2,067	2,068	2,068	2,072	2,078 (416) [100] {50}	2,084 (417) [100] {50}	2,090 (418) [100] {50}
Jefferson	76,503	76,618	76,732	77,080	77,426 (15,485) [3,716] {1,858}	77,774 (15,555) [3,733] {1,867}	78,109 (15,622) [3,749] {1,875}
Larimer	47,298	47,371	47,444	47,548	47,742 (9,548) [2,292] {1,146}	47,935 (9,587) [2,301] {1,150}	48,122 (9,624) [2,310] {1,155}
Pueblo	30,691	30,715	30,739	30,793	30,882 (6,176) [1,482] {741}	30,967 (6,193) [1,486] {743}	31,050 (6,210) [1,490] {745}
Weld	55,383	55,451	55,518	55,658	55,875 (11,175) [2,682] {1,341}	56,092 (11,218) [2,692] {1,346}	56,297 (11,259) [2,702] {1,351}

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.