IEM's AI Modeling: Short-term COVID-19 Projections
Date: 12/29/21

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 <u>not</u> 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 12/29/21 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
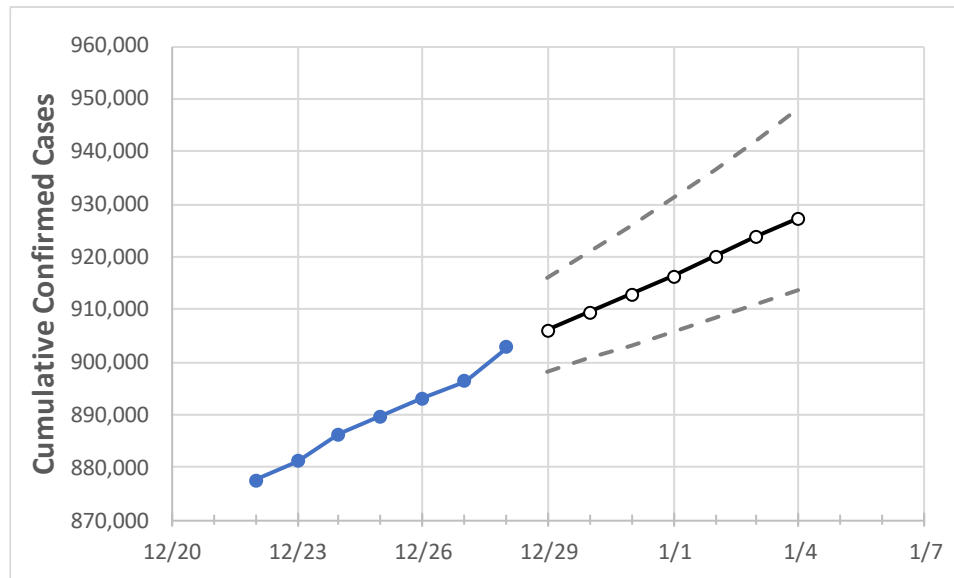
	Actual Confirmed Cases On:				Projected Cases For:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
Colorado	889,634	893,019	896,403	902,783	906,091	909,425	912,869	916,357	920,100	923,794	927,354

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:						
	12/25	12/26	12/27	12/28	12/29	12/30	12/31	1/1	1/2	1/3	1/4
Adams	90,114	90,409	90,705	91,156	91,483	91,830	92,177	92,559	92,920	93,314	93,695
Arapahoe	96,364	96,861	97,359	98,268	98,769	99,313	99,851	100,429	101,007	101,582	102,202
Boulder	37,522	37,753	37,983	38,313	38,537	38,768	39,003	39,243	39,498	39,760	40,034
Denver	110,525	111,075	111,625	113,204	113,986	114,805	115,657	116,530	117,481	118,454	119,464
Douglas	48,990	49,246	49,501	49,946	50,212	50,478	50,754	51,046	51,345	51,651	51,967
Eagle	10,520	10,656	10,791	10,899	11,087	11,287	11,501	11,737	11,984	12,257	12,550
El Paso	121,588	121,894	122,201	122,792	123,106	123,411	123,726	124,043	124,354	124,678	125,013
Gunnison	2,101	2,103	2,105	2,107	2,110	2,113	2,116	2,118	2,120	2,123	2,126
Jefferson	78,469	78,784	79,098	79,857	80,157	80,485	80,792	81,117	81,460	81,801	82,146
Larimer	48,305	48,480	48,655	48,848	49,002	49,167	49,329	49,493	49,659	49,829	50,000
Pueblo	31,033	31,086	31,139	31,211	31,259	31,304	31,349	31,393	31,439	31,481	31,527
Weld	56,284	56,411	56,539	56,766	56,896	57,019	57,147	57,275	57,397	57,525	57,650

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:		
	12/25	12/26	12/27	12/28	12/30	1/1	1/3
Adams	90,114	90,409	90,705	91,156	91,830 (18,366) [4,408] {2,204}	92,559 (18,512) [4,443] {2,221}	93,314 (18,663) [4,479] {2,240}
Arapahoe	96,364	96,861	97,359	98,268	99,313 (19,863) [4,767] {2,384}	100,429 (20,086) [4,821] {2,410}	101,582 (20,316) [4,876] {2,438}
Boulder	37,522	37,753	37,983	38,313	38,768 (7,754) [1,861] {930}	39,243 (7,849) [1,884] {942}	39,760 (7,952) [1,908] {954}
Denver	110,525	111,075	111,625	113,204	114,805 (22,961) [5,511] {2,755}	116,530 (23,306) [5,593] {2,797}	118,454 (23,691) [5,686] {2,843}
Douglas	48,990	49,246	49,501	49,946	50,478 (10,096) [2,423] {1,211}	51,046 (10,209) [2,450] {1,225}	51,651 (10,330) [2,479] {1,240}
Eagle	10,520	10,656	10,791	10,899	11,287 (2,257) [542] {271}	11,737 (2,347) [563] {282}	12,257 (2,451) [588] {294}
El Paso	121,588	121,894	122,201	122,792	123,411 (24,682) [5,924] {2,962}	124,043 (24,809) [5,954] {2,977}	124,678 (24,936) [5,985] {2,992}
Gunnison	2,101	2,103	2,105	2,107	2,113 (423) [101] {51}	2,118 (424) [102] {51}	2,123 (425) [102] {51}
Jefferson	78,469	78,784	79,098	79,857	80,485 (16,097) [3,863] {1,932}	81,117 (16,223) [3,894] {1,947}	81,801 (16,360) [3,926] {1,963}
Larimer	48,305	48,480	48,655	48,848	49,167 (9,833) [2,360] {1,180}	49,493 (9,899) [2,376] {1,188}	49,829 (9,966) [2,392] {1,196}
Pueblo	31,033	31,086	31,139	31,211	31,304 (6,261) [1,503] {751}	31,393 (6,279) [1,507] {753}	31,481 (6,296) [1,511] {756}
Weld	56,284	56,411	56,539	56,766	57,019 (11,404) [2,737] {1,368}	57,275 (11,455) [2,749] {1,375}	57,525 (11,505) [2,761] {1,381}

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.