IEM's AI Modeling: Short-term COVID-19 Projections
Date: 8/23/21

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 8/23/21 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
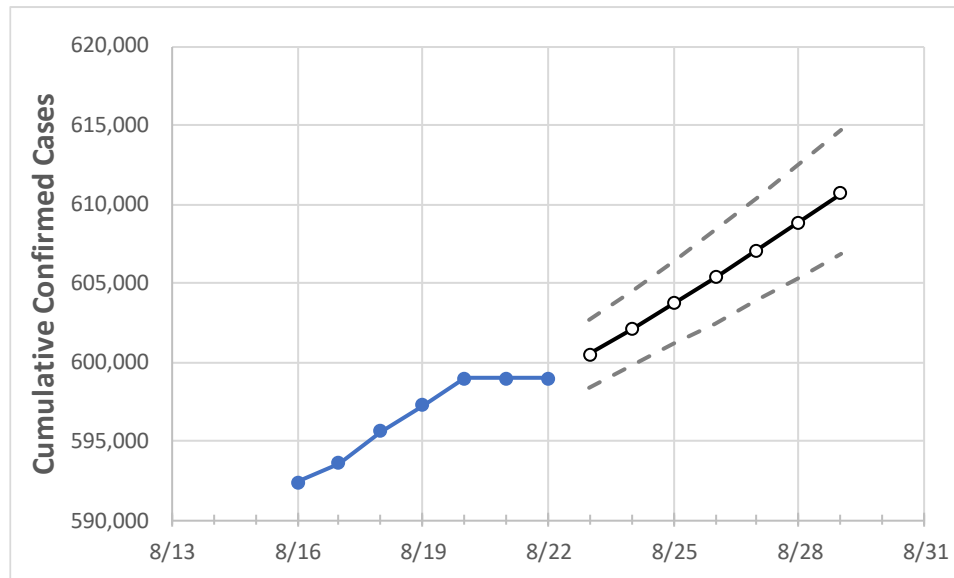
	Actual Confirmed Cases On:				Projected Cases For:						
	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29
Colorado	597,281	598,940	598,940	598,940	600,498	602,094	603,715	605,382	607,076	608,852	610,655

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:						
	8/19	8/20	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29
Adams	64,449	64,649	64,649	64,649	64,803	64,949	65,105	65,265	65,431	65,598	65,766
Arapahoe	66,886	67,044	67,044	67,044	67,221	67,400	67,583	67,772	67,969	68,169	68,370
Boulder	25,652	25,714	25,714	25,714	25,775	25,837	25,899	25,965	26,029	26,096	26,164
Denver	78,791	78,976	78,976	78,976	79,160	79,343	79,534	79,724	79,922	80,126	80,333
Douglas	32,802	32,899	32,899	32,899	33,000	33,105	33,212	33,327	33,440	33,559	33,679
Eagle	6,929	6,971	6,971	6,971	7,014	7,059	7,107	7,156	7,210	7,265	7,323
El Paso	79,746	79,952	79,952	79,952	80,162	80,373	80,584	80,798	81,015	81,242	81,465
Gunnison	1,477	1,484	1,484	1,484	1,488	1,493	1,497	1,502	1,507	1,512	1,517
Jefferson	52,096	52,230	52,230	52,230	52,361	52,491	52,622	52,759	52,897	53,043	53,185
Larimer	30,277	30,411	30,411	30,411	30,533	30,659	30,787	30,920	31,060	31,202	31,351
Pueblo	20,412	20,442	20,442	20,442	20,476	20,510	20,545	20,582	20,619	20,658	20,697
Weld	36,007	36,133	36,133	36,133	36,258	36,387	36,519	36,660	36,801	36,950	37,101

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:		
	8/19	8/20	8/21	8/22	8/24	8/26	8/28
Adams	64,449	64,649	64,649	64,649	64,949 (12,990) [3,118] {1,559}	65,265 (13,053) [3,133] {1,566}	65,598 (13,120) [3,149] {1,574}
Arapahoe	66,886	67,044	67,044	67,044	67,400 (13,480) [3,235] {1,618}	67,772 (13,554) [3,253] {1,627}	68,169 (13,634) [3,272] {1,636}
Boulder	25,652	25,714	25,714	25,714	25,837 (5,167) [1,240] {620}	25,965 (5,193) [1,246] {623}	26,096 (5,219) [1,253] {626}
Denver	78,791	78,976	78,976	78,976	79,343 (15,869) [3,808] {1,904}	79,724 (15,945) [3,827] {1,913}	80,126 (16,025) [3,846] {1,923}
Douglas	32,802	32,899	32,899	32,899	33,105 (6,621) [1,589] {795}	33,327 (6,665) [1,600] {800}	33,559 (6,712) [1,611] {805}
Eagle	6,929	6,971	6,971	6,971	7,059 (1,412) [339] {169}	7,156 (1,431) [343] {172}	7,265 (1,453) [349] {174}
El Paso	79,746	79,952	79,952	79,952	80,373 (16,075) [3,858] {1,929}	80,798 (16,160) [3,878] {1,939}	81,242 (16,248) [3,900] {1,950}
Gunnison	1,477	1,484	1,484	1,484	1,493 (299) [72] {36}	1,502 (300) [72] {36}	1,512 (302) [73] {36}
Jefferson	52,096	52,230	52,230	52,230	52,491 (10,498) [2,520] {1,260}	52,759 (10,552) [2,532] {1,266}	53,043 (10,609) [2,546] {1,273}
Larimer	30,277	30,411	30,411	30,411	30,659 (6,132) [1,472] {736}	30,920 (6,184) [1,484] {742}	31,202 (6,240) [1,498] {749}
Pueblo	20,412	20,442	20,442	20,442	20,510 (4,102) [985] {492}	20,582 (4,116) [988] {494}	20,658 (4,132) [992] {496}
Weld	36,007	36,133	36,133	36,133	36,387 (7,277) [1,747] {873}	36,660 (7,332) [1,760] {880}	36,950 (7,390) [1,774] {887}

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.