IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/29/21

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 1/29/21 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
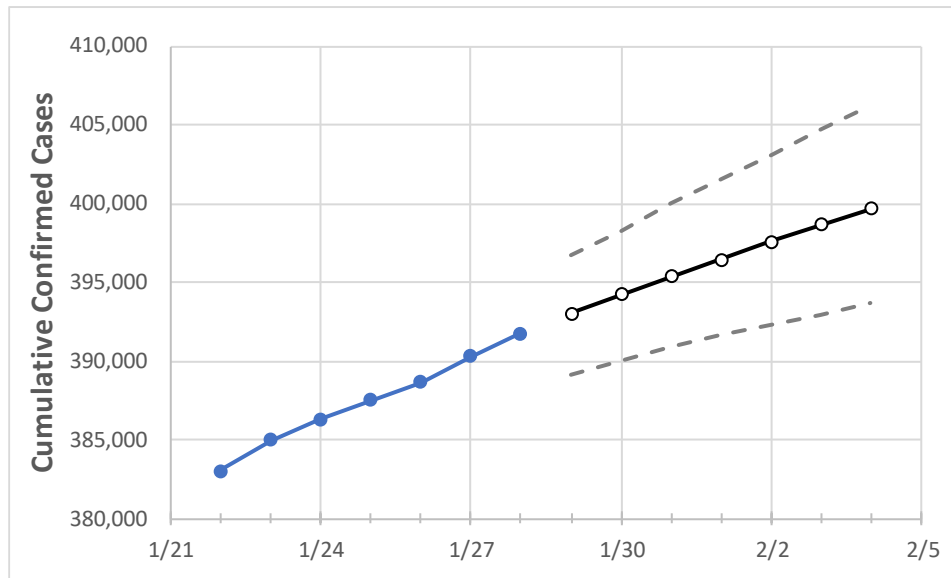
	Actual Confirmed Cases On:				Projected Cases For:						
	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4
Colorado	387,500	388,620	390,296	391,737	392,994	394,199	395,339	396,457	397,560	398,628	399,659

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:						
	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3	2/4
Adams	44,990	45,055	45,210	45,363	45,478	45,589	45,699	45,804	45,906	46,006	46,101
Arapahoe	44,054	44,150	44,346	44,513	44,653	44,788	44,921	45,047	45,170	45,286	45,400
Boulder	16,788	16,847	16,959	17,035	17,100	17,163	17,224	17,285	17,345	17,405	17,465
Denver	54,706	54,812	54,979	55,170	55,301	55,424	55,545	55,658	55,766	55,868	55,967
Douglas	18,426	18,478	18,604	18,666	18,728	18,789	18,850	18,907	18,963	19,015	19,066
Eagle	4,220	4,268	4,282	4,311	4,340	4,368	4,395	4,422	4,449	4,475	4,502
El Paso	46,914	47,069	47,240	47,327	47,438	47,544	47,645	47,744	47,838	47,926	48,013
Gunnison	994	1,014	1,029	1,034	1,048	1,062	1,076	1,090	1,104	1,118	1,132
Jefferson	33,877	33,960	34,087	34,228	34,325	34,422	34,511	34,605	34,694	34,778	34,860
Larimer	17,578	17,637	17,743	17,834	17,916	17,994	18,070	18,146	18,227	18,300	18,377
Pueblo	14,190	14,199	14,230	14,246	14,262	14,276	14,290	14,304	14,318	14,331	14,342
Weld	23,179	23,243	23,306	23,380	23,449	23,516	23,580	23,643	23,706	23,765	23,819

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:		
	1/25	1/26	1/27	1/28	1/30	2/1	2/3
Adams	44,990	45,055	45,210	45,363	45,589 (9,118) [2,188] {1,094}	45,804 (9,161) [2,199] {1,099}	46,006 (9,201) [2,208] {1,104}
Arapahoe	44,054	44,150	44,346	44,513	44,788 (8,958) [2,150] {1,075}	45,047 (9,009) [2,162] {1,081}	45,286 (9,057) [2,174] {1,087}
Boulder	16,788	16,847	16,959	17,035	17,163 (3,433) [824] {412}	17,285 (3,457) [830] {415}	17,405 (3,481) [835] {418}
Denver	54,706	54,812	54,979	55,170	55,424 (11,085) [2,660] {1,330}	55,658 (11,132) [2,672] {1,336}	55,868 (11,174) [2,682] {1,341}
Douglas	18,426	18,478	18,604	18,666	18,789 (3,758) [902] {451}	18,907 (3,781) [908] {454}	19,015 (3,803) [913] {456}
Eagle	4,220	4,268	4,282	4,311	4,368 (874) [210] {105}	4,422 (884) [212] {106}	4,475 (895) [215] {107}
El Paso	46,914	47,069	47,240	47,327	47,544 (9,509) [2,282] {1,141}	47,744 (9,549) [2,292] {1,146}	47,926 (9,585) [2,300] {1,150}
Gunnison	994	1,014	1,029	1,034	1,062 (212) [51] {25}	1,090 (218) [52] {26}	1,118 (224) [54] {27}
Jefferson	33,877	33,960	34,087	34,228	34,422 (6,884) [1,652] {826}	34,605 (6,921) [1,661] {831}	34,778 (6,956) [1,669] {835}
Larimer	17,578	17,637	17,743	17,834	17,994 (3,599) [864] {432}	18,146 (3,629) [871] {436}	18,300 (3,660) [878] {439}
Pueblo	14,190	14,199	14,230	14,246	14,276 (2,855) [685] {343}	14,304 (2,861) [687] {343}	14,331 (2,866) [688] {344}
Weld	23,179	23,243	23,306	23,380	23,516 (4,703) [1,129] {564}	23,643 (4,729) [1,135] {567}	23,765 (4,753) [1,141] {570}

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.