IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/21/21

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 6/21/21 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
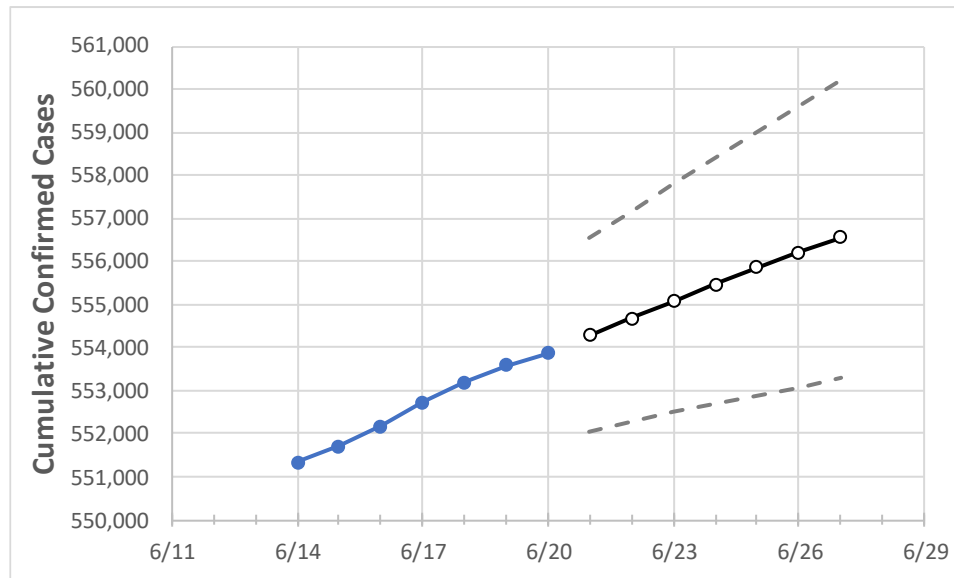
	Actual Confirmed Cases On:				Projected Cases For:						
	6/17	6/18	6/19	6/20	6/21	6/22	6/23	6/24	6/25	6/26	6/27
Colorado	552,726	553,200	553,596	553,868	554,276	554,684	555,076	555,481	555,866	556,212	556,565

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:						
	6/17	6/18	6/19	6/20	6/21	6/22	6/23	6/24	6/25	6/26	6/27
Adams	60,520	60,543	60,581	60,591	60,623	60,655	60,686	60,717	60,746	60,775	60,804
Arapahoe	62,338	62,378	62,407	62,434	62,469	62,503	62,536	62,569	62,601	62,633	62,664
Boulder	23,866	23,876	23,879	23,881	23,889	23,896	23,903	23,910	23,917	23,924	23,930
Denver	73,991	74,041	74,068	74,081	74,120	74,158	74,197	74,234	74,270	74,306	74,341
Douglas	30,162	30,216	30,231	30,244	30,273	30,301	30,329	30,356	30,382	30,409	30,435
Eagle	6,342	6,342	6,342	6,342	6,345	6,348	6,351	6,354	6,357	6,360	6,363
El Paso	72,486	72,570	72,635	72,694	72,777	72,859	72,938	73,012	73,086	73,157	73,229
Gunnison	1,375	1,376	1,377	1,377	1,378	1,379	1,381	1,382	1,383	1,385	1,386
Jefferson	48,589	48,615	48,650	48,666	48,692	48,718	48,742	48,767	48,792	48,815	48,838
Larimer	27,434	27,461	27,485	27,501	27,524	27,547	27,570	27,592	27,614	27,635	27,656
Pueblo	19,425	19,447	19,484	19,495	19,519	19,543	19,568	19,592	19,617	19,642	19,667
Weld	33,169	33,186	33,208	33,223	33,245	33,265	33,285	33,304	33,322	33,340	33,357

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:		
	6/17	6/18	6/19	6/20	6/22	6/24	6/26
Adams	60,520	60,543	60,581	60,591	60,655 (12,131) [2,911] {1,456}	60,717 (12,143) [2,914] {1,457}	60,775 (12,155) [2,917] {1,459}
Arapahoe	62,338	62,378	62,407	62,434	62,503 (12,501) [3,000] {1,500}	62,569 (12,514) [3,003] {1,502}	62,633 (12,527) [3,006] {1,503}
Boulder	23,866	23,876	23,879	23,881	23,896 (4,779) [1,147] {574}	23,910 (4,782) [1,148] {574}	23,924 (4,785) [1,148] {574}
Denver	73,991	74,041	74,068	74,081	74,158 (14,832) [3,560] {1,780}	74,234 (14,847) [3,563] {1,782}	74,306 (14,861) [3,567] {1,783}
Douglas	30,162	30,216	30,231	30,244	30,301 (6,060) [1,454] {727}	30,356 (6,071) [1,457] {729}	30,409 (6,082) [1,460] {730}
Eagle	6,342	6,342	6,342	6,342	6,348 (1,270) [305] {152}	6,354 (1,271) [305] {152}	6,360 (1,272) [305] {153}
El Paso	72,486	72,570	72,635	72,694	72,859 (14,572) [3,497] {1,749}	73,012 (14,602) [3,505] {1,752}	73,157 (14,631) [3,512] {1,756}
Gunnison	1,375	1,376	1,377	1,377	1,379 (276) [66] {33}	1,382 (276) [66] {33}	1,385 (277) [66] {33}
Jefferson	48,589	48,615	48,650	48,666	48,718 (9,744) [2,338] {1,169}	48,767 (9,753) [2,341] {1,170}	48,815 (9,763) [2,343] {1,172}
Larimer	27,434	27,461	27,485	27,501	27,547 (5,509) [1,322] {661}	27,592 (5,518) [1,324] {662}	27,635 (5,527) [1,326] {663}
Pueblo	19,425	19,447	19,484	19,495	19,543 (3,909) [938] {469}	19,592 (3,918) [940] {470}	19,642 (3,928) [943] {471}
Weld	33,169	33,186	33,208	33,223	33,265 (6,653) [1,597] {798}	33,304 (6,661) [1,599] {799}	33,340 (6,668) [1,600] {800}

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.