IEM's AI Modeling: Short-term COVID-19 Projections
Date: 6/11/21

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 6/11/21 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
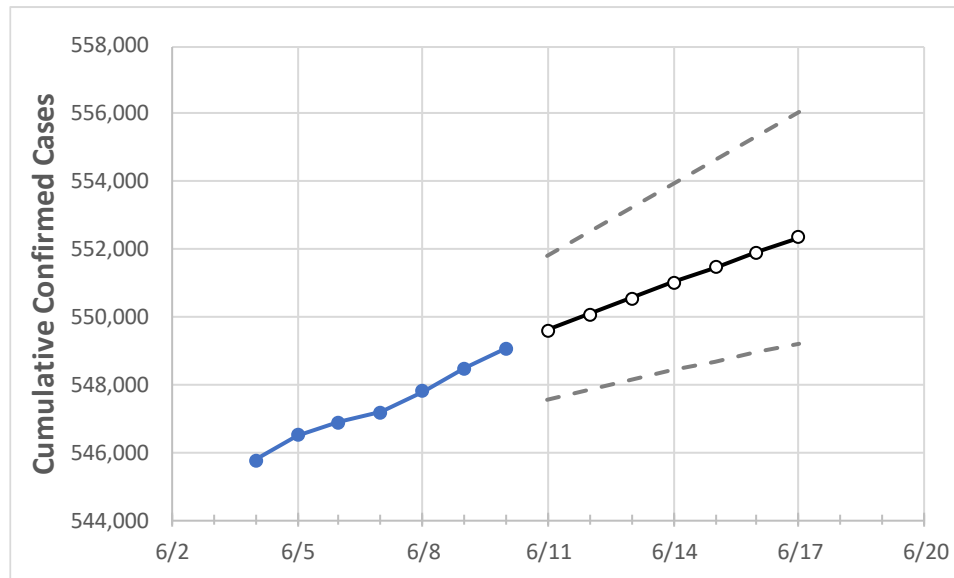
	Actual Confirmed Cases On:				Projected Cases For:						
	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16	6/17
Colorado	547,191	547,791	548,488	549,084	549,594	550,086	550,559	551,024	551,475	551,908	552,347

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:						
	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16	6/17
Adams	60,059	60,116	60,158	60,189	60,218	60,245	60,270	60,294	60,318	60,342	60,365
Arapahoe	61,831	61,890	61,952	62,005	62,047	62,088	62,128	62,166	62,205	62,240	62,275
Boulder	23,767	23,776	23,792	23,811	23,824	23,836	23,848	23,860	23,872	23,883	23,894
Denver	73,456	73,509	73,564	73,619	73,662	73,704	73,746	73,786	73,827	73,866	73,906
Douglas	29,793	29,853	29,925	29,956	29,992	30,028	30,063	30,097	30,131	30,166	30,200
Eagle	6,325	6,325	6,330	6,334	6,335	6,337	6,338	6,340	6,341	6,342	6,344
El Paso	71,302	71,422	71,565	71,698	71,806	71,913	72,016	72,112	72,206	72,301	72,393
Gunnison	1,360	1,361	1,366	1,368	1,370	1,372	1,374	1,376	1,378	1,380	1,382
Jefferson	48,216	48,259	48,303	48,351	48,378	48,406	48,432	48,458	48,484	48,510	48,531
Larimer	27,155	27,182	27,225	27,253	27,275	27,296	27,317	27,338	27,358	27,378	27,397
Pueblo	19,211	19,218	19,241	19,264	19,278	19,292	19,305	19,318	19,330	19,342	19,354
Weld	32,855	32,897	32,929	32,956	32,988	33,019	33,049	33,078	33,108	33,138	33,165

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:		
	6/7	6/8	6/9	6/10	6/12	6/14	6/16
Adams	60,059	60,116	60,158	60,189	60,245 (12,049) [2,892] {1,446}	60,294 (12,059) [2,894] {1,447}	60,342 (12,068) [2,896] {1,448}
Arapahoe	61,831	61,890	61,952	62,005	62,088 (12,418) [2,980] {1,490}	62,166 (12,433) [2,984] {1,492}	62,240 (12,448) [2,988] {1,494}
Boulder	23,767	23,776	23,792	23,811	23,836 (4,767) [1,144] {572}	23,860 (4,772) [1,145] {573}	23,883 (4,777) [1,146] {573}
Denver	73,456	73,509	73,564	73,619	73,704 (14,741) [3,538] {1,769}	73,786 (14,757) [3,542] {1,771}	73,866 (14,773) [3,546] {1,773}
Douglas	29,793	29,853	29,925	29,956	30,028 (6,006) [1,441] {721}	30,097 (6,019) [1,445] {722}	30,166 (6,033) [1,448] {724}
Eagle	6,325	6,325	6,330	6,334	6,337 (1,267) [304] {152}	6,340 (1,268) [304] {152}	6,342 (1,268) [304] {152}
El Paso	71,302	71,422	71,565	71,698	71,913 (14,383) [3,452] {1,726}	72,112 (14,422) [3,461] {1,731}	72,301 (14,460) [3,470] {1,735}
Gunnison	1,360	1,361	1,366	1,368	1,372 (274) [66] {33}	1,376 (275) [66] {33}	1,380 (276) [66] {33}
Jefferson	48,216	48,259	48,303	48,351	48,406 (9,681) [2,323] {1,162}	48,458 (9,692) [2,326] {1,163}	48,510 (9,702) [2,328] {1,164}
Larimer	27,155	27,182	27,225	27,253	27,296 (5,459) [1,310] {655}	27,338 (5,468) [1,312] {656}	27,378 (5,476) [1,314] {657}
Pueblo	19,211	19,218	19,241	19,264	19,292 (3,858) [926] {463}	19,318 (3,864) [927] {464}	19,342 (3,868) [928] {464}
Weld	32,855	32,897	32,929	32,956	33,019 (6,604) [1,585] {792}	33,078 (6,616) [1,588] {794}	33,138 (6,628) [1,591] {795}

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.