IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/29/21

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 3/29/21 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
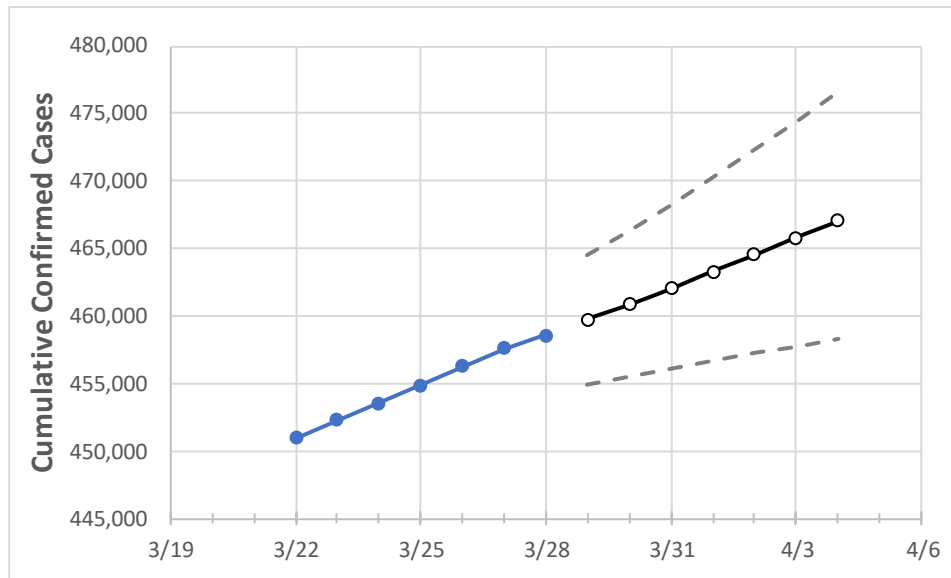
	Actual Confirmed Cases On:				Projected Cases For:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Colorado	454,893	456,302	457,597	458,554	459,713	460,874	462,045	463,290	464,573	465,800	467,065

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:						
	3/25	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4
Adams	50,812	50,948	51,051	51,126	51,220	51,317	51,417	51,515	51,621	51,718	51,824
Arapahoe	51,234	51,352	51,482	51,603	51,723	51,846	51,969	52,094	52,218	52,346	52,476
Boulder	20,150	20,227	20,293	20,351	20,406	20,462	20,518	20,575	20,631	20,691	20,753
Denver	63,306	63,463	63,651	63,786	63,957	64,139	64,325	64,516	64,705	64,909	65,108
Douglas	23,275	23,362	23,467	23,527	23,610	23,697	23,782	23,869	23,962	24,050	24,143
Eagle	5,612	5,645	5,663	5,687	5,711	5,737	5,762	5,787	5,813	5,839	5,864
El Paso	55,561	55,757	55,931	56,086	56,260	56,435	56,614	56,798	56,985	57,179	57,373
Gunnison	1,230	1,232	1,238	1,240	1,241	1,243	1,244	1,246	1,247	1,248	1,250
Jefferson	39,806	39,925	40,037	40,108	40,218	40,326	40,434	40,546	40,667	40,783	40,902
Larimer	21,729	21,842	21,939	22,016	22,107	22,199	22,299	22,401	22,508	22,617	22,729
Pueblo	15,578	15,614	15,651	15,691	15,725	15,759	15,795	15,833	15,872	15,913	15,955
Weld	27,064	27,141	27,215	27,274	27,337	27,398	27,460	27,525	27,589	27,652	27,717

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:		
	3/25	3/26	3/27	3/28	3/30	4/1	4/3
Adams	50,812	50,948	51,051	51,126	51,317 (10,263) [2,463] {1,232}	51,515 (10,303) [2,473] {1,236}	51,718 (10,344) [2,482] {1,241}
Arapahoe	51,234	51,352	51,482	51,603	51,846 (10,369) [2,489] {1,244}	52,094 (10,419) [2,501] {1,250}	52,346 (10,469) [2,513] {1,256}
Boulder	20,150	20,227	20,293	20,351	20,462 (4,092) [982] {491}	20,575 (4,115) [988] {494}	20,691 (4,138) [993] {497}
Denver	63,306	63,463	63,651	63,786	64,139 (12,828) [3,079] {1,539}	64,516 (12,903) [3,097] {1,548}	64,909 (12,982) [3,116] {1,558}
Douglas	23,275	23,362	23,467	23,527	23,697 (4,739) [1,137] {569}	23,869 (4,774) [1,146] {573}	24,050 (4,810) [1,154] {577}
Eagle	5,612	5,645	5,663	5,687	5,737 (1,147) [275] {138}	5,787 (1,157) [278] {139}	5,839 (1,168) [280] {140}
El Paso	55,561	55,757	55,931	56,086	56,435 (11,287) [2,709] {1,354}	56,798 (11,360) [2,726] {1,363}	57,179 (11,436) [2,745] {1,372}
Gunnison	1,230	1,232	1,238	1,240	1,243 (249) [60] {30}	1,246 (249) [60] {30}	1,248 (250) [60] {30}
Jefferson	39,806	39,925	40,037	40,108	40,326 (8,065) [1,936] {968}	40,546 (8,109) [1,946] {973}	40,783 (8,157) [1,958] {979}
Larimer	21,729	21,842	21,939	22,016	22,199 (4,440) [1,066] {533}	22,401 (4,480) [1,075] {538}	22,617 (4,523) [1,086] {543}
Pueblo	15,578	15,614	15,651	15,691	15,759 (3,152) [756] {378}	15,833 (3,167) [760] {380}	15,913 (3,183) [764] {382}
Weld	27,064	27,141	27,215	27,274	27,398 (5,480) [1,315] {658}	27,525 (5,505) [1,321] {661}	27,652 (5,530) [1,327] {664}

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.