IEM's AI Modeling: Short-term COVID-19 Projections
Date: 2/16/21

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 2/16/21 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
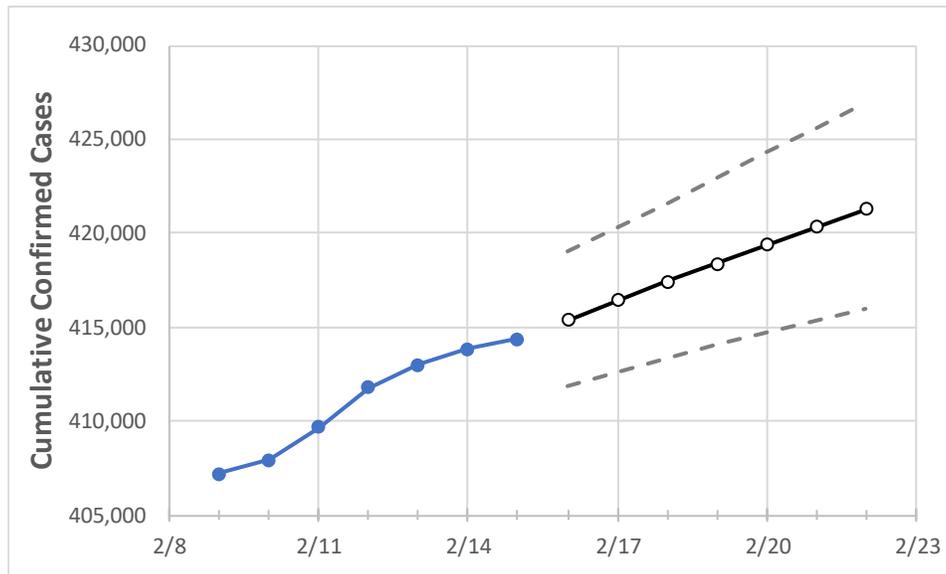
	Actual Confirmed Cases On:				Projected Cases For:						
	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22
Colorado	411,774	412,983	413,836	414,369	415,396	416,416	417,413	418,391	419,370	420,352	421,280

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:						
	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22
Adams	46,934	47,045	47,102	47,135	47,213	47,287	47,363	47,436	47,503	47,573	47,640
Arapahoe	46,704	46,808	46,924	46,988	47,099	47,212	47,325	47,431	47,536	47,637	47,735
Boulder	17,993	18,068	18,104	18,128	18,183	18,239	18,294	18,349	18,403	18,457	18,509
Denver	57,582	57,707	57,790	57,845	57,972	58,098	58,223	58,348	58,465	58,585	58,699
Douglas	20,113	20,191	20,257	20,307	20,395	20,482	20,569	20,656	20,740	20,829	20,916
Eagle	4,700	4,721	4,732	4,755	4,776	4,796	4,816	4,835	4,854	4,873	4,892
El Paso	49,674	49,853	49,978	50,029	50,175	50,318	50,461	50,600	50,742	50,882	51,020
Gunnison	1,138	1,159	1,175	1,175	1,185	1,194	1,204	1,213	1,223	1,233	1,242
Jefferson	35,803	35,913	36,010	36,057	36,144	36,230	36,312	36,396	36,476	36,558	36,637
Larimer	18,877	18,961	19,003	19,066	19,127	19,188	19,246	19,306	19,363	19,420	19,477
Pueblo	14,727	14,787	14,794	14,796	14,837	14,878	14,920	14,962	15,006	15,051	15,099
Weld	24,522	24,599	24,632	24,653	24,711	24,768	24,824	24,878	24,930	24,979	25,028

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:		
	2/12	2/13	2/14	2/15	2/17	2/19	2/21
Adams	46,934	47,045	47,102	47,135	47,287 (9,457) [2,270] {1,135}	47,436 (9,487) [2,277] {1,138}	47,573 (9,515) [2,284] {1,142}
Arapahoe	46,704	46,808	46,924	46,988	47,212 (9,442) [2,266] {1,133}	47,431 (9,486) [2,277] {1,138}	47,637 (9,527) [2,287] {1,143}
Boulder	17,993	18,068	18,104	18,128	18,239 (3,648) [875] {438}	18,349 (3,670) [881] {440}	18,457 (3,691) [886] {443}
Denver	57,582	57,707	57,790	57,845	58,098 (11,620) [2,789] {1,394}	58,348 (11,670) [2,801] {1,400}	58,585 (11,717) [2,812] {1,406}
Douglas	20,113	20,191	20,257	20,307	20,482 (4,096) [983] {492}	20,656 (4,131) [991] {496}	20,829 (4,166) [1,000] {500}
Eagle	4,700	4,721	4,732	4,755	4,796 (959) [230] {115}	4,835 (967) [232] {116}	4,873 (975) [234] {117}
El Paso	49,674	49,853	49,978	50,029	50,318 (10,064) [2,415] {1,208}	50,600 (10,120) [2,429] {1,214}	50,882 (10,176) [2,442] {1,221}
Gunnison	1,138	1,159	1,175	1,175	1,194 (239) [57] {29}	1,213 (243) [58] {29}	1,233 (247) [59] {30}
Jefferson	35,803	35,913	36,010	36,057	36,230 (7,246) [1,739] {870}	36,396 (7,279) [1,747] {874}	36,558 (7,312) [1,755] {877}
Larimer	18,877	18,961	19,003	19,066	19,188 (3,838) [921] {461}	19,306 (3,861) [927] {463}	19,420 (3,884) [932] {466}
Pueblo	14,727	14,787	14,794	14,796	14,878 (2,976) [714] {357}	14,962 (2,992) [718] {359}	15,051 (3,010) [722] {361}
Weld	24,522	24,599	24,632	24,653	24,768 (4,954) [1,189] {594}	24,878 (4,976) [1,194] {597}	24,979 (4,996) [1,199] {600}

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.