IEM's AI Modeling: Short-term COVID-19 Projections
Date: 3/18/21

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 not 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 3/18/21 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
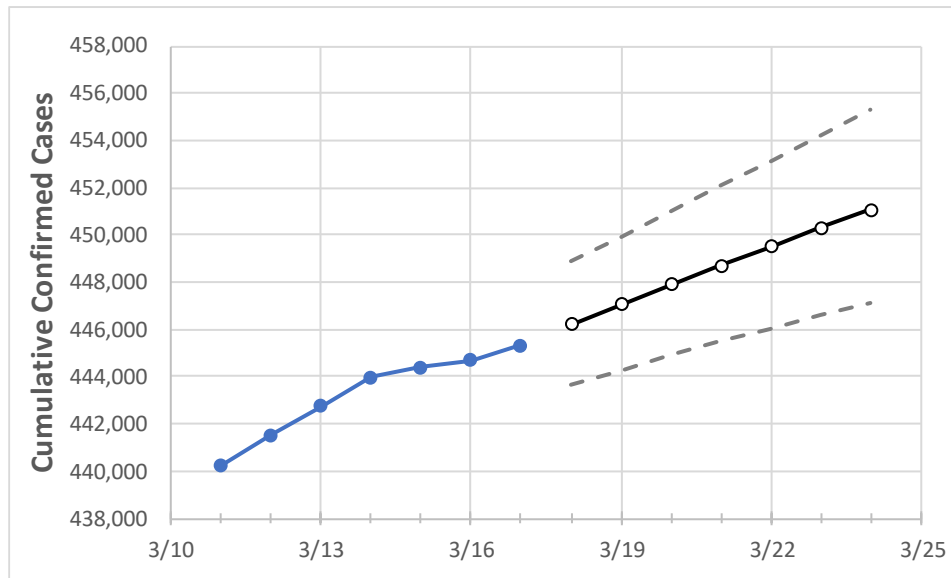
	Actual Confirmed Cases On:				Projected Cases For:						
	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24
Colorado	443,968	444,390	444,712	445,338	446,207	447,057	447,897	448,718	449,503	450,311	451,085

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:						
	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22	3/23	3/24
Adams	49,833	49,866	49,895	49,978	50,056	50,133	50,209	50,285	50,359	50,431	50,503
Arapahoe	50,099	50,153	50,170	50,227	50,318	50,409	50,495	50,582	50,665	50,748	50,831
Boulder	19,593	19,606	19,616	19,641	19,683	19,726	19,766	19,810	19,854	19,895	19,937
Denver	61,788	61,859	61,880	61,899	62,024	62,149	62,276	62,405	62,532	62,658	62,788
Douglas	22,495	22,517	22,523	22,545	22,607	22,667	22,727	22,787	22,844	22,899	22,954
Eagle	5,383	5,398	5,415	5,431	5,450	5,468	5,486	5,504	5,521	5,538	5,555
El Paso	53,985	54,026	54,101	54,233	54,354	54,476	54,590	54,705	54,819	54,935	55,048
Gunnison	1,226	1,226	1,225	1,224	1,225	1,226	1,227	1,228	1,230	1,230	1,231
Jefferson	38,724	38,761	38,778	38,837	38,927	39,014	39,103	39,191	39,278	39,361	39,444
Larimer	21,041	21,075	21,080	21,096	21,147	21,198	21,247	21,296	21,343	21,391	21,435
Pueblo	15,350	15,357	15,364	15,399	15,419	15,438	15,458	15,477	15,496	15,515	15,533
Weld	26,436	26,457	26,474	26,514	26,565	26,619	26,671	26,722	26,772	26,821	26,869

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: | | |
	3/14	3/15	3/16	3/17	3/19	3/21	3/23
Adams	49,833	49,866	49,895	49,978	50,133 (10,027) [2,406] {1,203}	50,285 (10,057) [2,414] {1,207}	50,431 (10,086) [2,421] {1,210}
Arapahoe	50,099	50,153	50,170	50,227	50,409 (10,082) [2,420] {1,210}	50,582 (10,116) [2,428] {1,214}	50,748 (10,150) [2,436] {1,218}
Boulder	19,593	19,606	19,616	19,641	19,726 (3,945) [947] {473}	19,810 (3,962) [951] {475}	19,895 (3,979) [955] {477}
Denver	61,788	61,859	61,880	61,899	62,149 (12,430) [2,983] {1,492}	62,405 (12,481) [2,995] {1,498}	62,658 (12,532) [3,008] {1,504}
Douglas	22,495	22,517	22,523	22,545	22,667 (4,533) [1,088] {544}	22,787 (4,557) [1,094] {547}	22,899 (4,580) [1,099] {550}
Eagle	5,383	5,398	5,415	5,431	5,468 (1,094) [262] {131}	5,504 (1,101) [264] {132}	5,538 (1,108) [266] {133}
El Paso	53,985	54,026	54,101	54,233	54,476 (10,895) [2,615] {1,307}	54,705 (10,941) [2,626] {1,313}	54,935 (10,987) [2,637] {1,318}
Gunnison	1,226	1,226	1,225	1,224	1,226 (245) [59] {29}	1,228 (246) [59] {29}	1,230 (246) [59] {30}
Jefferson	38,724	38,761	38,778	38,837	39,014 (7,803) [1,873] {936}	39,191 (7,838) [1,881] {941}	39,361 (7,872) [1,889] {945}
Larimer	21,041	21,075	21,080	21,096	21,198 (4,240) [1,017] {509}	21,296 (4,259) [1,022] {511}	21,391 (4,278) [1,027] {513}
Pueblo	15,350	15,357	15,364	15,399	15,438 (3,088) [741] {371}	15,477 (3,095) [743] {371}	15,515 (3,103) [745] {372}
Weld	26,436	26,457	26,474	26,514	26,619 (5,324) [1,278] {639}	26,722 (5,344) [1,283] {641}	26,821 (5,364) [1,287] {644}

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.