IEM's AI Modeling: Short-term COVID-19 Projections
Date: 4/16/21

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 4/16/21 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
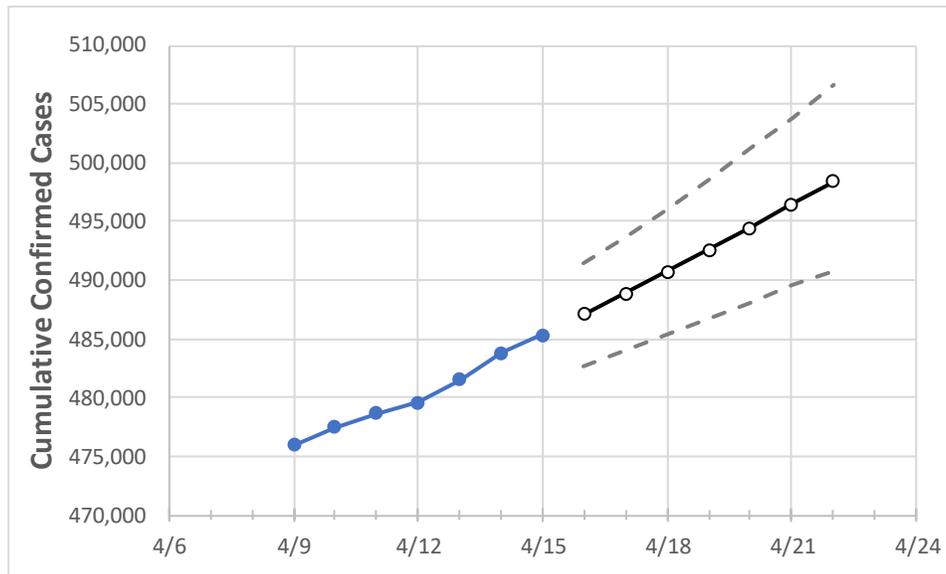
	Actual Confirmed Cases On:				Projected Cases For:						
	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22
Colorado	479,590	481,494	483,820	485,318	487,062	488,875	490,705	492,568	494,484	496,434	498,385

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:						
	4/12	4/13	4/14	4/15	4/16	4/17	4/18	4/19	4/20	4/21	4/22
Adams	52,997	53,153	53,338	53,483	53,649	53,816	53,990	54,163	54,345	54,529	54,716
Arapahoe	53,861	54,078	54,357	54,530	54,737	54,948	55,168	55,391	55,616	55,851	56,090
Boulder	21,518	21,643	21,723	21,772	21,855	21,939	22,022	22,105	22,187	22,272	22,356
Denver	66,592	66,826	67,387	67,641	67,914	68,191	68,472	68,768	69,072	69,384	69,710
Douglas	25,205	25,355	25,673	25,799	25,971	26,149	26,337	26,525	26,727	26,932	27,146
Eagle	5,961	5,988	6,009	6,018	6,036	6,054	6,072	6,091	6,109	6,128	6,147
El Paso	59,168	59,499	59,784	59,979	60,221	60,472	60,718	60,971	61,227	61,489	61,756
Gunnison	1,276	1,276	1,285	1,288	1,290	1,293	1,295	1,298	1,301	1,303	1,306
Jefferson	41,987	42,136	42,314	42,496	42,650	42,809	42,975	43,139	43,309	43,483	43,658
Larimer	23,647	23,757	23,863	23,929	24,046	24,169	24,292	24,415	24,538	24,663	24,791
Pueblo	16,449	16,540	16,607	16,640	16,709	16,782	16,856	16,935	17,015	17,097	17,182
Weld	28,538	28,656	28,742	28,819	28,920	29,020	29,125	29,232	29,335	29,441	29,550

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:		
	4/12	4/13	4/14	4/15	4/17	4/19	4/21
Adams	52,997	53,153	53,338	53,483	53,816 (10,763) [2,583] {1,292}	54,163 (10,833) [2,600] {1,300}	54,529 (10,906) [2,617] {1,309}
Arapahoe	53,861	54,078	54,357	54,530	54,948 (10,990) [2,637] {1,319}	55,391 (11,078) [2,659] {1,329}	55,851 (11,170) [2,681] {1,340}
Boulder	21,518	21,643	21,723	21,772	21,939 (4,388) [1,053] {527}	22,105 (4,421) [1,061] {531}	22,272 (4,454) [1,069] {535}
Denver	66,592	66,826	67,387	67,641	68,191 (13,638) [3,273] {1,637}	68,768 (13,754) [3,301] {1,650}	69,384 (13,877) [3,330] {1,665}
Douglas	25,205	25,355	25,673	25,799	26,149 (5,230) [1,255] {628}	26,525 (5,305) [1,273] {637}	26,932 (5,386) [1,293] {646}
Eagle	5,961	5,988	6,009	6,018	6,054 (1,211) [291] {145}	6,091 (1,218) [292] {146}	6,128 (1,226) [294] {147}
El Paso	59,168	59,499	59,784	59,979	60,472 (12,094) [2,903] {1,451}	60,971 (12,194) [2,927] {1,463}	61,489 (12,298) [2,951] {1,476}
Gunnison	1,276	1,276	1,285	1,288	1,293 (259) [62] {31}	1,298 (260) [62] {31}	1,303 (261) [63] {31}
Jefferson	41,987	42,136	42,314	42,496	42,809 (8,562) [2,055] {1,027}	43,139 (8,628) [2,071] {1,035}	43,483 (8,697) [2,087] {1,044}
Larimer	23,647	23,757	23,863	23,929	24,169 (4,834) [1,160] {580}	24,415 (4,883) [1,172] {586}	24,663 (4,933) [1,184] {592}
Pueblo	16,449	16,540	16,607	16,640	16,782 (3,356) [806] {403}	16,935 (3,387) [813] {406}	17,097 (3,419) [821] {410}
Weld	28,538	28,656	28,742	28,819	29,020 (5,804) [1,393] {696}	29,232 (5,846) [1,403] {702}	29,441 (5,888) [1,413] {707}

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.