IEM's AI Modeling: Short-term COVID-19 Projections
Date: 5/4/21

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 5/4/21 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
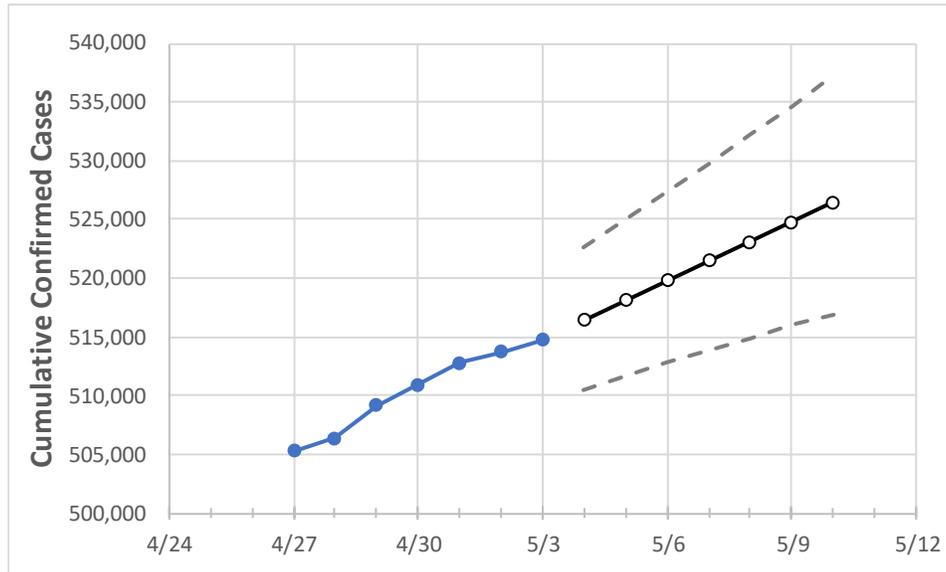
	Actual Confirmed Cases On:				Projected Cases For:						
	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10
Colorado	510,966	512,804	513,765	514,721	516,399	518,083	519,791	521,461	523,109	524,765	526,467

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:						
	4/30	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10
Adams	56,204	56,387	56,473	56,570	56,749	56,930	57,113	57,300	57,482	57,662	57,841
Arapahoe	57,632	57,834	57,947	58,050	58,261	58,470	58,679	58,885	59,095	59,308	59,522
Boulder	22,855	22,909	22,954	22,979	23,036	23,094	23,148	23,204	23,260	23,314	23,366
Denver	70,444	70,636	70,708	70,779	70,933	71,080	71,226	71,374	71,517	71,657	71,792
Douglas	27,809	27,891	27,960	28,018	28,129	28,242	28,355	28,462	28,568	28,673	28,775
Eagle	6,215	6,230	6,231	6,234	6,243	6,252	6,260	6,268	6,276	6,284	6,292
El Paso	63,886	64,179	64,366	64,565	64,843	65,122	65,405	65,693	65,990	66,283	66,592
Gunnison	1,322	1,324	1,324	1,324	1,326	1,328	1,330	1,332	1,334	1,336	1,338
Jefferson	45,079	45,266	45,356	45,453	45,625	45,793	45,960	46,125	46,302	46,474	46,643
Larimer	25,434	25,541	25,579	25,645	25,730	25,815	25,896	25,974	26,056	26,134	26,212
Pueblo	17,799	17,906	17,982	18,040	18,133	18,228	18,327	18,427	18,528	18,631	18,738
Weld	30,521	30,639	30,688	30,756	30,863	30,970	31,081	31,190	31,300	31,408	31,520

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: | | |
	4/30	5/1	5/2	5/3	5/5	5/7	5/9
Adams	56,204	56,387	56,473	56,570	56,930 (11,386) [2,733] {1,366}	57,300 (11,460) [2,750] {1,375}	57,662 (11,532) [2,768] {1,384}
Arapahoe	57,632	57,834	57,947	58,050	58,470 (11,694) [2,807] {1,403}	58,885 (11,777) [2,826] {1,413}	59,308 (11,862) [2,847] {1,423}
Boulder	22,855	22,909	22,954	22,979	23,094 (4,619) [1,108] {554}	23,204 (4,641) [1,114] {557}	23,314 (4,663) [1,119] {560}
Denver	70,444	70,636	70,708	70,779	71,080 (14,216) [3,412] {1,706}	71,374 (14,275) [3,426] {1,713}	71,657 (14,331) [3,440] {1,720}
Douglas	27,809	27,891	27,960	28,018	28,242 (5,648) [1,356] {678}	28,462 (5,692) [1,366] {683}	28,673 (5,735) [1,376] {688}
Eagle	6,215	6,230	6,231	6,234	6,252 (1,250) [300] {150}	6,268 (1,254) [301] {150}	6,284 (1,257) [302] {151}
El Paso	63,886	64,179	64,366	64,565	65,122 (13,024) [3,126] {1,563}	65,693 (13,139) [3,153] {1,577}	66,283 (13,257) [3,182] {1,591}
Gunnison	1,322	1,324	1,324	1,324	1,328 (266) [64] {32}	1,332 (266) [64] {32}	1,336 (267) [64] {32}
Jefferson	45,079	45,266	45,356	45,453	45,793 (9,159) [2,198] {1,099}	46,125 (9,225) [2,214] {1,107}	46,474 (9,295) [2,231] {1,115}
Larimer	25,434	25,541	25,579	25,645	25,815 (5,163) [1,239] {620}	25,974 (5,195) [1,247] {623}	26,134 (5,227) [1,254] {627}
Pueblo	17,799	17,906	17,982	18,040	18,228 (3,646) [875] {437}	18,427 (3,685) [885] {442}	18,631 (3,726) [894] {447}
Weld	30,521	30,639	30,688	30,756	30,970 (6,194) [1,487] {743}	31,190 (6,238) [1,497] {749}	31,408 (6,282) [1,508] {754}

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.