IEM's AI Modeling: Short-term COVID-19 Projections

Date: 5/6/21

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 5/6/21 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.

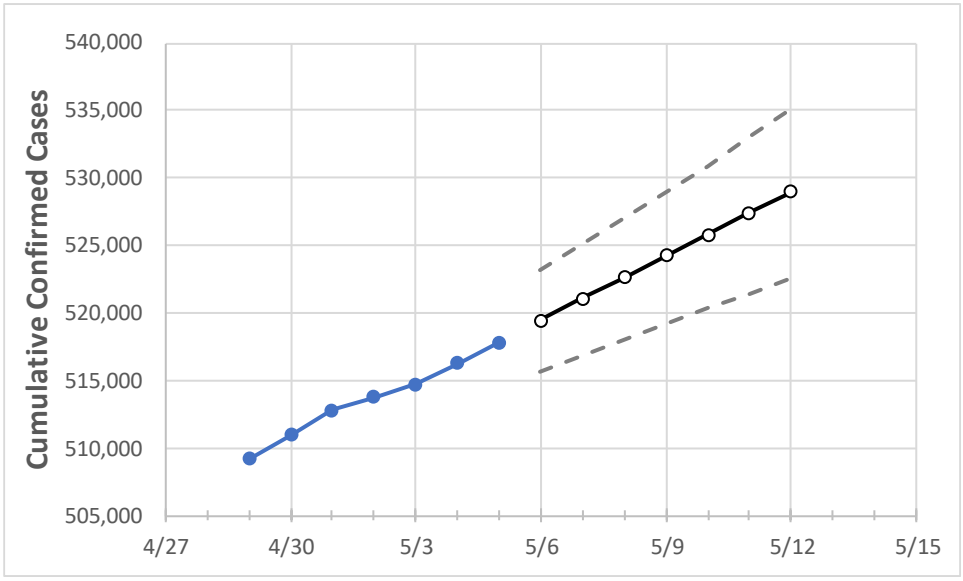
IEM's Modeling Lead

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:						
	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	5/12
Colorado	513,765	514,721	516,240	517,851	519,453	521,045	522,651	524,232	525,811	527,399	528,962

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:						
	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11	5/12
Adams	56,473	56,570	56,745	56,890	57,064	57,238	57,412	57,586	57,759	57,928	58,103
Arapahoe	57,947	58,050	58,193	58,394	58,579	58,764	58,948	59,130	59,309	59,495	59,674
Boulder	22,954	22,979	23,029	23,065	23,116	23,169	23,220	23,271	23,320	23,366	23,416
Denver	70,708	70,779	70,885	71,072	71,224	71,371	71,515	71,656	71,795	71,928	72,067
Douglas	27,960	28,018	28,109	28,229	28,341	28,447	28,553	28,660	28,768	28,875	28,979
Eagle	6,231	6,234	6,240	6,253	6,261	6,269	6,277	6,284	6,291	6,298	6,305
El Paso	64,366	64,565	64,849	65,156	65,435	65,720	66,008	66,301	66,591	66,889	67,190
Gunnison	1,325	1,325	1,326	1,327	1,328	1,330	1,331	1,332	1,334	1,335	1,336
Jefferson	45,356	45,453	45,620	45,755	45,919	46,082	46,242	46,404	46,567	46,736	46,895
Larimer	25,579	25,645	25,741	25,807	25,887	25,969	26,048	26,126	26,204	26,280	26,356
Pueblo	17,982	18,040	18,151	18,252	18,351	18,455	18,563	18,674	18,787	18,902	19,022
Weld	30,688	30,756	30,839	30,933	31,035	31,137	31,241	31,345	31,444	31,547	31,650

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:		
	5/2	5/3	5/4	5/5	5/7	5/9	5/11
Adams	56,473	56,570	56,745	56,890	57,238 (11,448) [2,747] {1,374}	57,586 (11,517) [2,764] {1,382}	57,928 (11,586) [2,781] {1,390}
Arapahoe	57,947	58,050	58,193	58,394	58,764 (11,753) [2,821] {1,410}	59,130 (11,826) [2,838] {1,419}	59,495 (11,899) [2,856] {1,428}
Boulder	22,954	22,979	23,029	23,065	23,169 (4,634) [1,112] {556}	23,271 (4,654) [1,117] {558}	23,366 (4,673) [1,122] {561}
Denver	70,708	70,779	70,885	71,072	71,371 (14,274) [3,426] {1,713}	71,656 (14,331) [3,439] {1,720}	71,928 (14,386) [3,453] {1,726}
Douglas	27,960	28,018	28,109	28,229	28,447 (5,689) [1,365] {683}	28,660 (5,732) [1,376] {688}	28,875 (5,775) [1,386] {693}
Eagle	6,231	6,234	6,240	6,253	6,269 (1,254) [301] {150}	6,284 (1,257) [302] {151}	6,298 (1,260) [302] {151}
El Paso	64,366	64,565	64,849	65,156	65,720 (13,144) [3,155] {1,577}	66,301 (13,260) [3,182] {1,591}	66,889 (13,378) [3,211] {1,605}
Gunnison	1,325	1,325	1,326	1,327	1,330 (266) [64] {32}	1,332 (266) [64] {32}	1,335 (267) [64] {32}
Jefferson	45,356	45,453	45,620	45,755	46,082 (9,216) [2,212] {1,106}	46,404 (9,281) [2,227] {1,114}	46,736 (9,347) [2,243] {1,122}
Larimer	25,579	25,645	25,741	25,807	25,969 (5,194) [1,247] {623}	26,126 (5,225) [1,254] {627}	26,280 (5,256) [1,261] {631}
Pueblo	17,982	18,040	18,151	18,252	18,455 (3,691) [886] {443}	18,674 (3,735) [896] {448}	18,902 (3,780) [907] {454}
Weld	30,688	30,756	30,839	30,933	31,137 (6,227) [1,495] {747}	31,345 (6,269) [1,505] {752}	31,547 (6,309) [1,514] {757}

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.