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

Date: 7/2/21

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 7/2/21 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.

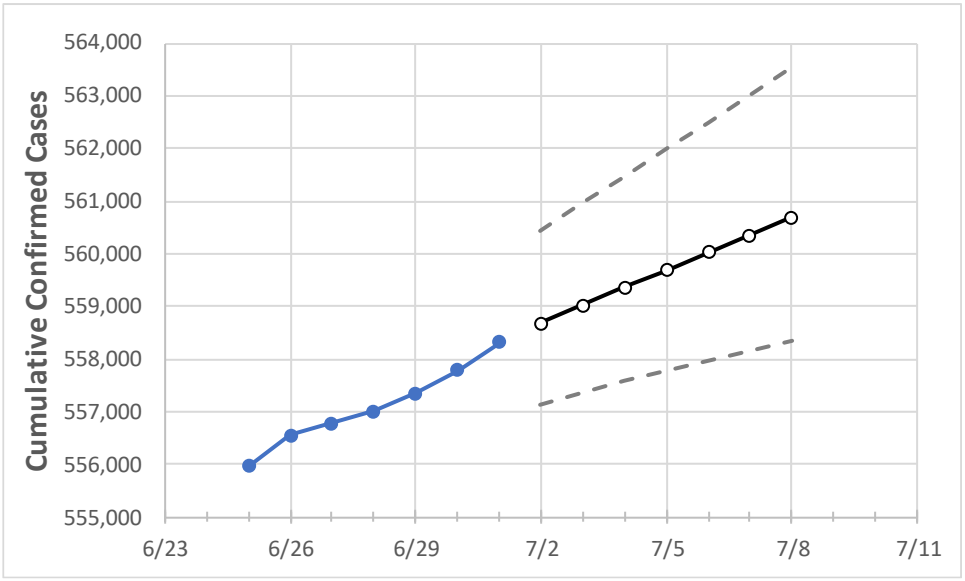
IEM's Modeling Lead

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:						
	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8
Colorado	557,004	557,347	557,791	558,321	558,672	559,017	559,355	559,689	560,032	560,347	560,689

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:						
	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8
Adams	60,838	60,867	60,888	60,926	60,950	60,974	60,996	61,019	61,041	61,062	61,083
Arapahoe	62,721	62,750	62,799	62,849	62,884	62,918	62,952	62,986	63,020	63,055	63,089
Boulder	23,968	23,982	23,993	24,008	24,018	24,029	24,040	24,050	24,062	24,073	24,084
Denver	74,297	74,315	74,367	74,392	74,413	74,433	74,452	74,471	74,489	74,506	74,523
Douglas	30,473	30,491	30,512	30,538	30,560	30,582	30,604	30,625	30,646	30,667	30,688
Eagle	6,353	6,354	6,359	6,360	6,362	6,363	6,365	6,366	6,368	6,369	6,371
El Paso	73,229	73,296	73,368	73,451	73,507	73,560	73,613	73,664	73,715	73,763	73,811
Gunnison	1,392	1,392	1,396	1,397	1,399	1,401	1,402	1,404	1,406	1,408	1,410
Jefferson	48,867	48,892	48,913	48,950	48,974	48,997	49,021	49,044	49,066	49,089	49,112
Larimer	27,659	27,676	27,706	27,728	27,748	27,766	27,786	27,805	27,824	27,843	27,862
Pueblo	19,573	19,581	19,588	19,599	19,607	19,616	19,624	19,632	19,639	19,646	19,653
Weld	33,430	33,451	33,462	33,498	33,518	33,538	33,558	33,577	33,596	33,614	33,633

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:		
	6/28	6/29	6/30	7/1	7/3	7/5	7/7
Adams	60,838	60,867	60,888	60,926	60,974 (12,195) [2,927] {1,463}	61,019 (12,204) [2,929] {1,464}	61,062 (12,212) [2,931] {1,465}
Arapahoe	62,721	62,750	62,799	62,849	62,918 (12,584) [3,020] {1,510}	62,986 (12,597) [3,023] {1,512}	63,055 (12,611) [3,027] {1,513}
Boulder	23,968	23,982	23,993	24,008	24,029 (4,806) [1,153] {577}	24,050 (4,810) [1,154] {577}	24,073 (4,815) [1,156] {578}
Denver	74,297	74,315	74,367	74,392	74,433 (14,887) [3,573] {1,786}	74,471 (14,894) [3,575] {1,787}	74,506 (14,901) [3,576] {1,788}
Douglas	30,473	30,491	30,512	30,538	30,582 (6,116) [1,468] {734}	30,625 (6,125) [1,470] {735}	30,667 (6,133) [1,472] {736}
Eagle	6,353	6,354	6,359	6,360	6,363 (1,273) [305] {153}	6,366 (1,273) [306] {153}	6,369 (1,274) [306] {153}
El Paso	73,229	73,296	73,368	73,451	73,560 (14,712) [3,531] {1,765}	73,664 (14,733) [3,536] {1,768}	73,763 (14,753) [3,541] {1,770}
Gunnison	1,392	1,392	1,396	1,397	1,401 (280) [67] {34}	1,404 (281) [67] {34}	1,408 (282) [68] {34}
Jefferson	48,867	48,892	48,913	48,950	48,997 (9,799) [2,352] {1,176}	49,044 (9,809) [2,354] {1,177}	49,089 (9,818) [2,356] {1,178}
Larimer	27,659	27,676	27,706	27,728	27,766 (5,553) [1,333] {666}	27,805 (5,561) [1,335] {667}	27,843 (5,569) [1,336] {668}
Pueblo	19,573	19,581	19,588	19,599	19,616 (3,923) [942] {471}	19,632 (3,926) [942] {471}	19,646 (3,929) [943] {471}
Weld	33,430	33,451	33,462	33,498	33,538 (6,708) [1,610] {805}	33,577 (6,715) [1,612] {806}	33,614 (6,723) [1,613] {807}

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.