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

Date: 7/1/21

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 7/1/21 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.

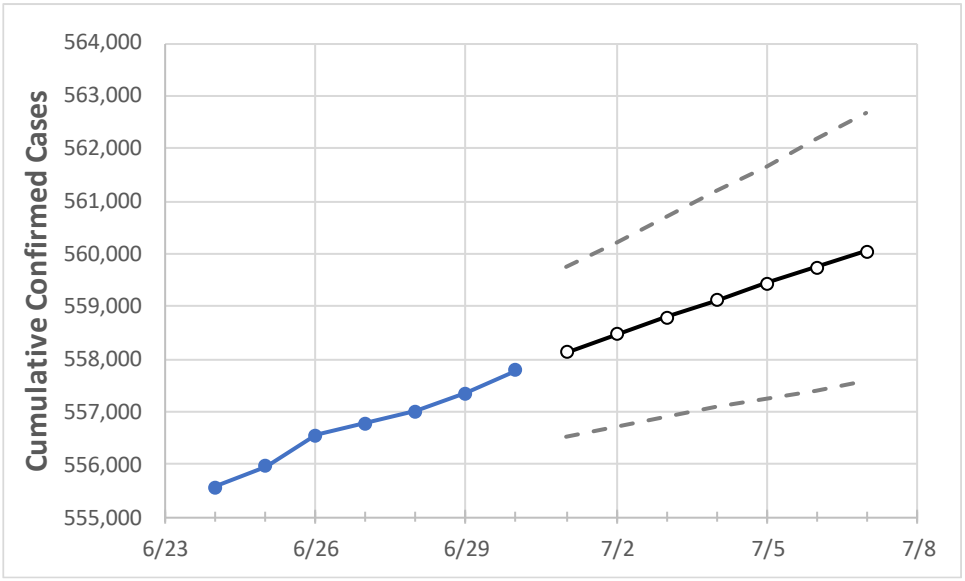
IEM's Modeling Lead

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:						
	6/27	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7
Colorado	556,775	557,004	557,347	557,791	558,133	558,472	558,789	559,116	559,430	559,736	560,042

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:						
	6/27	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7
Adams	60,821	60,838	60,867	60,888	60,911	60,934	60,956	60,978	61,000	61,020	61,039
Arapahoe	62,694	62,721	62,750	62,799	62,831	62,863	62,894	62,925	62,955	62,986	63,015
Boulder	23,961	23,968	23,982	23,993	24,003	24,012	24,021	24,031	24,040	24,049	24,059
Denver	74,288	74,297	74,315	74,367	74,388	74,409	74,428	74,448	74,467	74,483	74,501
Douglas	30,459	30,473	30,491	30,512	30,535	30,558	30,580	30,602	30,625	30,646	30,667
Eagle	6,353	6,353	6,354	6,359	6,361	6,362	6,364	6,366	6,367	6,369	6,371
El Paso	73,176	73,229	73,296	73,368	73,424	73,478	73,530	73,580	73,627	73,674	73,719
Gunnison	1,391	1,392	1,392	1,396	1,398	1,400	1,402	1,405	1,407	1,410	1,412
Jefferson	48,850	48,867	48,892	48,913	48,936	48,957	48,979	49,000	49,021	49,041	49,062
Larimer	27,646	27,659	27,676	27,706	27,725	27,744	27,762	27,780	27,798	27,816	27,833
Pueblo	19,571	19,573	19,581	19,588	19,597	19,606	19,615	19,623	19,631	19,638	19,646
Weld	33,418	33,430	33,451	33,462	33,481	33,500	33,518	33,536	33,553	33,570	33,588

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:		
	6/27	6/28	6/29	6/30	7/2	7/4	7/6
Adams	60,821	60,838	60,867	60,888	60,934 (12,187) [2,925] {1,462}	60,978 (12,196) [2,927] {1,463}	61,020 (12,204) [2,929] {1,464}
Arapahoe	62,694	62,721	62,750	62,799	62,863 (12,573) [3,017] {1,509}	62,925 (12,585) [3,020] {1,510}	62,986 (12,597) [3,023] {1,512}
Boulder	23,961	23,968	23,982	23,993	24,012 (4,802) [1,153] {576}	24,031 (4,806) [1,153] {577}	24,049 (4,810) [1,154] {577}
Denver	74,288	74,297	74,315	74,367	74,409 (14,882) [3,572] {1,786}	74,448 (14,890) [3,574] {1,787}	74,483 (14,897) [3,575] {1,788}
Douglas	30,459	30,473	30,491	30,512	30,558 (6,112) [1,467] {733}	30,602 (6,120) [1,469] {734}	30,646 (6,129) [1,471] {736}
Eagle	6,353	6,353	6,354	6,359	6,362 (1,272) [305] {153}	6,366 (1,273) [306] {153}	6,369 (1,274) [306] {153}
El Paso	73,176	73,229	73,296	73,368	73,478 (14,696) [3,527] {1,763}	73,580 (14,716) [3,532] {1,766}	73,674 (14,735) [3,536] {1,768}
Gunnison	1,391	1,392	1,392	1,396	1,400 (280) [67] {34}	1,405 (281) [67] {34}	1,410 (282) [68] {34}
Jefferson	48,850	48,867	48,892	48,913	48,957 (9,791) [2,350] {1,175}	49,000 (9,800) [2,352] {1,176}	49,041 (9,808) [2,354] {1,177}
Larimer	27,646	27,659	27,676	27,706	27,744 (5,549) [1,332] {666}	27,780 (5,556) [1,333] {667}	27,816 (5,563) [1,335] {668}
Pueblo	19,571	19,573	19,581	19,588	19,606 (3,921) [941] {471}	19,623 (3,925) [942] {471}	19,638 (3,928) [943] {471}
Weld	33,418	33,430	33,451	33,462	33,500 (6,700) [1,608] {804}	33,536 (6,707) [1,610] {805}	33,570 (6,714) [1,611] {806}

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.