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

Date: 6/8/21

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 6/8/21 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.

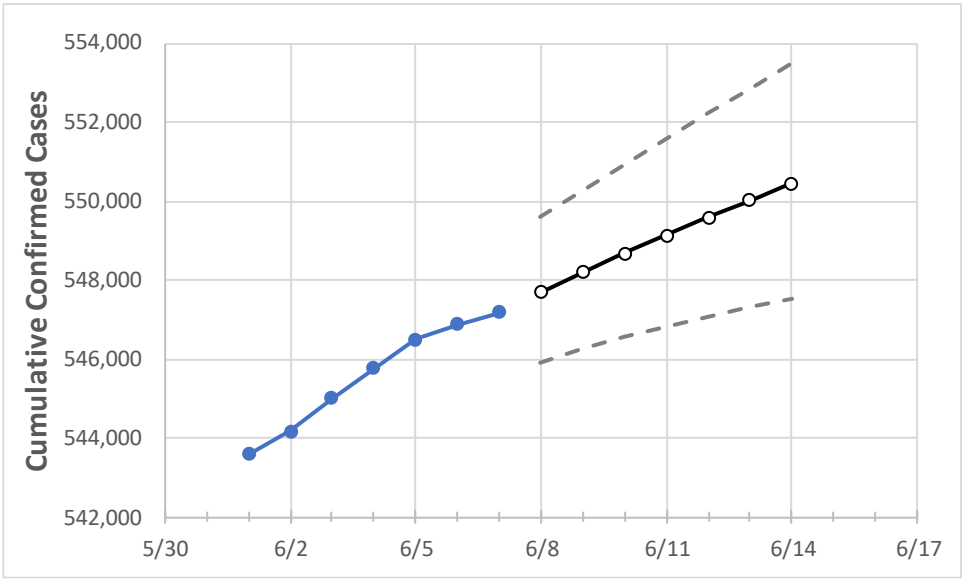
IEM's Modeling Lead

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:						
	6/4	6/5	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14
Colorado	545,769	546,500	546,874	547,191	547,700	548,195	548,674	549,144	549,587	550,019	550,442

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:						
	6/4	6/5	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14
Adams	59,951	60,017	60,049	60,059	60,090	60,118	60,145	60,171	60,196	60,218	60,240
Arapahoe	61,706	61,768	61,794	61,831	61,873	61,913	61,951	61,988	62,025	62,059	62,092
Boulder	23,734	23,753	23,763	23,767	23,781	23,794	23,806	23,819	23,831	23,843	23,854
Denver	73,310	73,389	73,437	73,456	73,499	73,541	73,582	73,622	73,660	73,699	73,737
Douglas	29,712	29,763	29,774	29,793	29,824	29,852	29,882	29,910	29,938	29,965	29,993
Eagle	6,324	6,324	6,324	6,324	6,326	6,328	6,329	6,331	6,333	6,335	6,336
El Paso	70,987	71,132	71,206	71,302	71,417	71,522	71,624	71,726	71,820	71,914	72,001
Gunnison	1,354	1,354	1,358	1,358	1,359	1,360	1,361	1,362	1,363	1,364	1,365
Jefferson	48,125	48,190	48,209	48,216	48,245	48,273	48,300	48,326	48,352	48,375	48,397
Larimer	27,100	27,131	27,143	27,155	27,176	27,197	27,217	27,237	27,256	27,274	27,292
Pueblo	19,174	19,190	19,202	19,211	19,226	19,239	19,253	19,265	19,278	19,291	19,304
Weld	32,758	32,801	32,824	32,855	32,890	32,923	32,956	32,988	33,020	33,051	33,081

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:		
	6/4	6/5	6/6	6/7	6/9	6/11	6/13
Adams	59,951	60,017	60,049	60,059	60,118 (12,024) [2,886] {1,443}	60,171 (12,034) [2,888] {1,444}	60,218 (12,044) [2,890] {1,445}
Arapahoe	61,706	61,768	61,794	61,831	61,913 (12,383) [2,972] {1,486}	61,988 (12,398) [2,975] {1,488}	62,059 (12,412) [2,979] {1,489}
Boulder	23,734	23,753	23,763	23,767	23,794 (4,759) [1,142] {571}	23,819 (4,764) [1,143] {572}	23,843 (4,769) [1,144] {572}
Denver	73,310	73,389	73,437	73,456	73,541 (14,708) [3,530] {1,765}	73,622 (14,724) [3,534] {1,767}	73,699 (14,740) [3,538] {1,769}
Douglas	29,712	29,763	29,774	29,793	29,852 (5,970) [1,433] {716}	29,910 (5,982) [1,436] {718}	29,965 (5,993) [1,438] {719}
Eagle	6,324	6,324	6,324	6,324	6,328 (1,266) [304] {152}	6,331 (1,266) [304] {152}	6,335 (1,267) [304] {152}
El Paso	70,987	71,132	71,206	71,302	71,522 (14,304) [3,433] {1,717}	71,726 (14,345) [3,443] {1,721}	71,914 (14,383) [3,452] {1,726}
Gunnison	1,354	1,354	1,358	1,358	1,360 (272) [65] {33}	1,362 (272) [65] {33}	1,364 (273) [65] {33}
Jefferson	48,125	48,190	48,209	48,216	48,273 (9,655) [2,317] {1,159}	48,326 (9,665) [2,320] {1,160}	48,375 (9,675) [2,322] {1,161}
Larimer	27,100	27,131	27,143	27,155	27,197 (5,439) [1,305] {653}	27,237 (5,447) [1,307] {654}	27,274 (5,455) [1,309] {655}
Pueblo	19,174	19,190	19,202	19,211	19,239 (3,848) [923] {462}	19,265 (3,853) [925] {462}	19,291 (3,858) [926] {463}
Weld	32,758	32,801	32,824	32,855	32,923 (6,585) [1,580] {790}	32,988 (6,598) [1,583] {792}	33,051 (6,610) [1,586] {793}

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.