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

Date: 7/19/21

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 7/19/21 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.

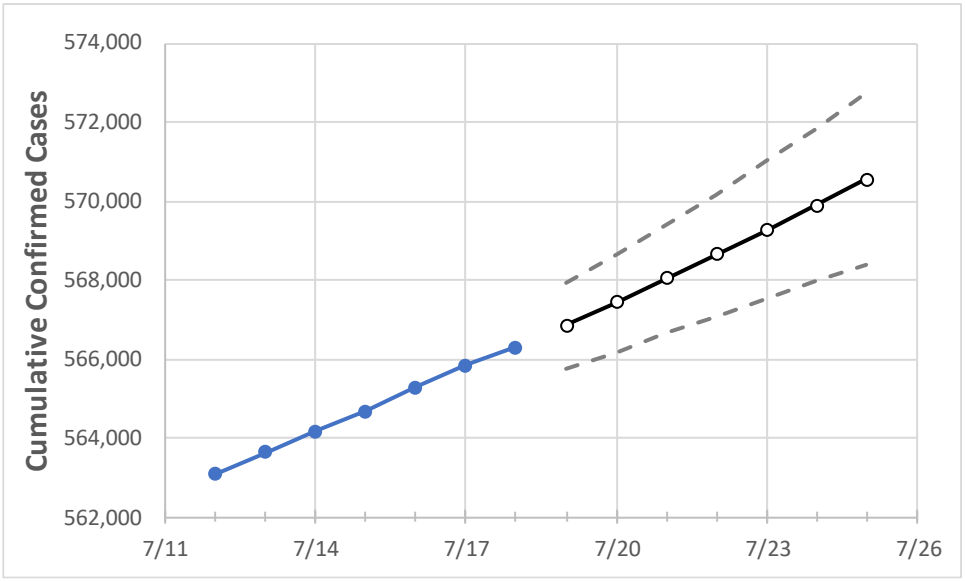
IEM's Modeling Lead

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:						
	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25
Colorado	564,686	565,294	565,829	566,289	566,858	567,443	568,036	568,644	569,264	569,898	570,538

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:						
	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25
Adams	61,472	61,552	61,610	61,646	61,697	61,750	61,803	61,857	61,913	61,970	62,030
Arapahoe	63,430	63,486	63,545	63,589	63,643	63,700	63,757	63,818	63,879	63,940	64,004
Boulder	24,260	24,286	24,305	24,318	24,345	24,373	24,401	24,431	24,461	24,494	24,528
Denver	74,963	75,016	75,068	75,146	75,208	75,273	75,340	75,410	75,482	75,558	75,638
Douglas	30,894	30,905	30,926	30,937	30,962	30,987	31,012	31,037	31,062	31,088	31,113
Eagle	6,420	6,426	6,429	6,433	6,438	6,444	6,450	6,456	6,463	6,470	6,477
El Paso	74,502	74,598	74,677	74,732	74,815	74,903	74,988	75,074	75,162	75,250	75,339
Gunnison	1,406	1,407	1,408	1,408	1,409	1,410	1,411	1,412	1,413	1,414	1,415
Jefferson	49,361	49,393	49,435	49,454	49,492	49,531	49,570	49,611	49,652	49,697	49,741
Larimer	28,093	28,117	28,145	28,209	28,240	28,274	28,307	28,340	28,374	28,410	28,446
Pueblo	19,715	19,723	19,737	19,747	19,756	19,764	19,773	19,782	19,791	19,800	19,809
Weld	33,820	33,863	33,903	33,946	33,982	34,018	34,057	34,097	34,137	34,179	34,222

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:		
	7/15	7/16	7/17	7/18	7/20	7/22	7/24
Adams	61,472	61,552	61,610	61,646	61,750 (12,350) [2,964] {1,482}	61,857 (12,371) [2,969] {1,485}	61,970 (12,394) [2,975] {1,487}
Arapahoe	63,430	63,486	63,545	63,589	63,700 (12,740) [3,058] {1,529}	63,818 (12,764) [3,063] {1,532}	63,940 (12,788) [3,069] {1,535}
Boulder	24,260	24,286	24,305	24,318	24,373 (4,875) [1,170] {585}	24,431 (4,886) [1,173] {586}	24,494 (4,899) [1,176] {588}
Denver	74,963	75,016	75,068	75,146	75,273 (15,055) [3,613] {1,807}	75,410 (15,082) [3,620] {1,810}	75,558 (15,112) [3,627] {1,813}
Douglas	30,894	30,905	30,926	30,937	30,987 (6,197) [1,487] {744}	31,037 (6,207) [1,490] {745}	31,088 (6,218) [1,492] {746}
Eagle	6,420	6,426	6,429	6,433	6,444 (1,289) [309] {155}	6,456 (1,291) [310] {155}	6,470 (1,294) [311] {155}
El Paso	74,502	74,598	74,677	74,732	74,903 (14,981) [3,595] {1,798}	75,074 (15,015) [3,604] {1,802}	75,250 (15,050) [3,612] {1,806}
Gunnison	1,406	1,407	1,408	1,408	1,410 (282) [68] {34}	1,412 (282) [68] {34}	1,414 (283) [68] {34}
Jefferson	49,361	49,393	49,435	49,454	49,531 (9,906) [2,377] {1,189}	49,611 (9,922) [2,381] {1,191}	49,697 (9,939) [2,385] {1,193}
Larimer	28,093	28,117	28,145	28,209	28,274 (5,655) [1,357] {679}	28,340 (5,668) [1,360] {680}	28,410 (5,682) [1,364] {682}
Pueblo	19,715	19,723	19,737	19,747	19,764 (3,953) [949] {474}	19,782 (3,956) [950] {475}	19,800 (3,960) [950] {475}
Weld	33,820	33,863	33,903	33,946	34,018 (6,804) [1,633] {816}	34,097 (6,819) [1,637] {818}	34,179 (6,836) [1,641] {820}

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.