IEM's AI Modeling: Short-term COVID-19 Projections
Date: 7/16/21

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 <u>not</u> 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 7/16/21 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
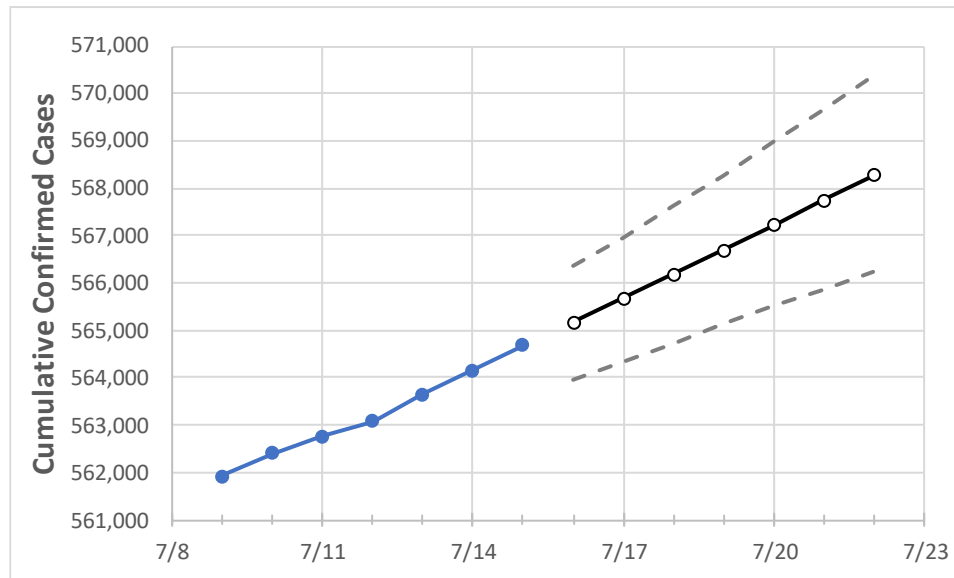
	Actual Confirmed Cases On:				Projected Cases For:						
	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22
Colorado	563,086	563,642	564,164	564,686	565,181	565,684	566,185	566,689	567,214	567,739	568,268

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:						
	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22
Adams	61,365	61,393	61,433	61,472	61,510	61,547	61,583	61,621	61,658	61,696	61,734
Arapahoe	63,290	63,333	63,379	63,430	63,474	63,520	63,567	63,613	63,660	63,707	63,753
Boulder	24,191	24,213	24,233	24,260	24,285	24,311	24,337	24,364	24,391	24,421	24,452
Denver	74,823	74,889	74,924	74,963	75,008	75,055	75,102	75,149	75,200	75,249	75,299
Douglas	30,800	30,835	30,867	30,894	30,923	30,951	30,981	31,011	31,041	31,072	31,103
Eagle	6,399	6,404	6,412	6,420	6,425	6,430	6,436	6,442	6,448	6,454	6,461
El Paso	74,223	74,353	74,434	74,502	74,577	74,651	74,725	74,798	74,873	74,948	75,023
Gunnison	1,408	1,407	1,407	1,406	1,407	1,409	1,410	1,412	1,413	1,414	1,416
Jefferson	49,246	49,280	49,323	49,361	49,395	49,431	49,466	49,502	49,539	49,578	49,618
Larimer	28,007	28,034	28,066	28,093	28,119	28,146	28,172	28,199	28,227	28,254	28,281
Pueblo	19,680	19,693	19,702	19,715	19,722	19,729	19,736	19,743	19,750	19,757	19,763
Weld	33,740	33,766	33,801	33,820	33,843	33,866	33,889	33,912	33,936	33,959	33,983

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:		
	7/12	7/13	7/14	7/15	7/17	7/19	7/21
Adams	61,365	61,393	61,433	61,472	61,547 (12,309) [2,954] {1,477}	61,621 (12,324) [2,958] {1,479}	61,696 (12,339) [2,961] {1,481}
Arapahoe	63,290	63,333	63,379	63,430	63,520 (12,704) [3,049] {1,524}	63,613 (12,723) [3,053] {1,527}	63,707 (12,741) [3,058] {1,529}
Boulder	24,191	24,213	24,233	24,260	24,311 (4,862) [1,167] {583}	24,364 (4,873) [1,169] {585}	24,421 (4,884) [1,172] {586}
Denver	74,823	74,889	74,924	74,963	75,055 (15,011) [3,603] {1,801}	75,149 (15,030) [3,607] {1,804}	75,249 (15,050) [3,612] {1,806}
Douglas	30,800	30,835	30,867	30,894	30,951 (6,190) [1,486] {743}	31,011 (6,202) [1,489] {744}	31,072 (6,214) [1,491] {746}
Eagle	6,399	6,404	6,412	6,420	6,430 (1,286) [309] {154}	6,442 (1,288) [309] {155}	6,454 (1,291) [310] {155}
El Paso	74,223	74,353	74,434	74,502	74,651 (14,930) [3,583] {1,792}	74,798 (14,960) [3,590] {1,795}	74,948 (14,990) [3,598] {1,799}
Gunnison	1,408	1,407	1,407	1,406	1,409 (282) [68] {34}	1,412 (282) [68] {34}	1,414 (283) [68] {34}
Jefferson	49,246	49,280	49,323	49,361	49,431 (9,886) [2,373] {1,186}	49,502 (9,900) [2,376] {1,188}	49,578 (9,916) [2,380] {1,190}
Larimer	28,007	28,034	28,066	28,093	28,146 (5,629) [1,351] {676}	28,199 (5,640) [1,354] {677}	28,254 (5,651) [1,356] {678}
Pueblo	19,680	19,693	19,702	19,715	19,729 (3,946) [947] {474}	19,743 (3,949) [948] {474}	19,757 (3,951) [948] {474}
Weld	33,740	33,766	33,801	33,820	33,866 (6,773) [1,626] {813}	33,912 (6,782) [1,628] {814}	33,959 (6,792) [1,630] {815}

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.