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

Date: 7/23/21

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 7/23/21 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.

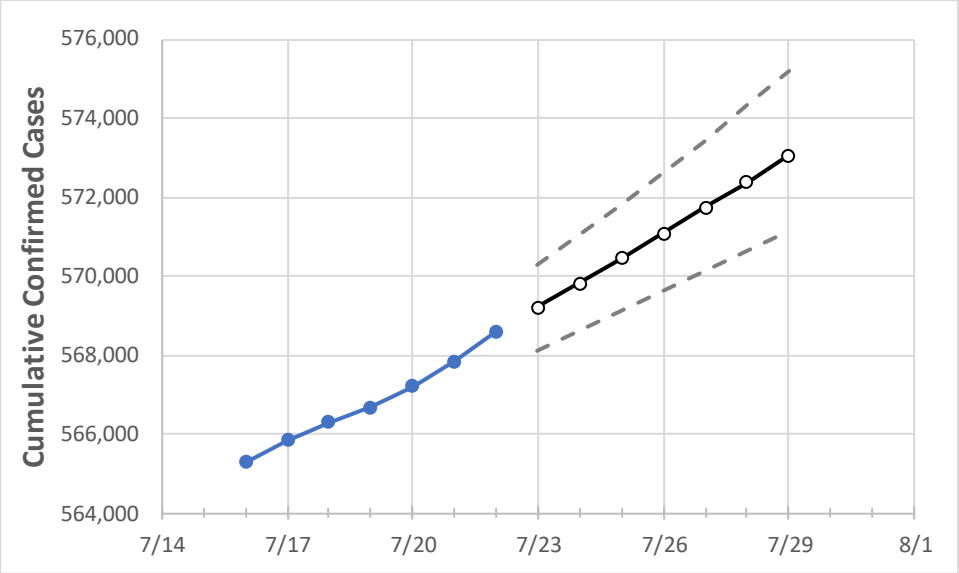
IEM's Modeling Lead

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:						
	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29
Colorado	566,670	567,215	567,838	568,597	569,201	569,827	570,447	571,077	571,727	572,379	573,053

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:						
	7/19	7/20	7/21	7/22	7/23	7/24	7/25	7/26	7/27	7/28	7/29
Adams	61,674	61,739	61,783	61,860	61,916	61,975	62,036	62,096	62,157	62,219	62,285
Arapahoe	63,620	63,669	63,711	63,792	63,849	63,906	63,963	64,023	64,083	64,145	64,208
Boulder	24,332	24,353	24,380	24,401	24,426	24,451	24,477	24,503	24,530	24,556	24,583
Denver	75,170	75,203	75,274	75,356	75,420	75,486	75,552	75,621	75,692	75,764	75,842
Douglas	30,958	30,992	31,006	31,048	31,074	31,099	31,125	31,151	31,177	31,204	31,231
Eagle	6,434	6,445	6,458	6,472	6,482	6,493	6,504	6,516	6,529	6,542	6,556
El Paso	74,816	74,927	75,043	75,193	75,298	75,406	75,516	75,628	75,743	75,860	75,982
Gunnison	1,408	1,409	1,409	1,409	1,410	1,410	1,411	1,412	1,413	1,413	1,414
Jefferson	49,480	49,514	49,557	49,615	49,657	49,699	49,743	49,789	49,834	49,881	49,930
Larimer	28,263	28,292	28,331	28,364	28,402	28,442	28,482	28,525	28,568	28,611	28,656
Pueblo	19,753	19,768	19,786	19,801	19,813	19,825	19,838	19,851	19,864	19,877	19,890
Weld	33,967	34,002	34,023	34,065	34,099	34,134	34,169	34,205	34,243	34,281	34,319

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:		
	7/19	7/20	7/21	7/22	7/24	7/26	7/28
Adams	61,674	61,739	61,783	61,860	61,975 (12,395) [2,975] {1,487}	62,096 (12,419) [2,981] {1,490}	62,219 (12,444) [2,987] {1,493}
Arapahoe	63,620	63,669	63,711	63,792	63,906 (12,781) [3,067] {1,534}	64,023 (12,805) [3,073] {1,537}	64,145 (12,829) [3,079] {1,539}
Boulder	24,332	24,353	24,380	24,401	24,451 (4,890) [1,174] {587}	24,503 (4,901) [1,176] {588}	24,556 (4,911) [1,179] {589}
Denver	75,170	75,203	75,274	75,356	75,486 (15,097) [3,623] {1,812}	75,621 (15,124) [3,630] {1,815}	75,764 (15,153) [3,637] {1,818}
Douglas	30,958	30,992	31,006	31,048	31,099 (6,220) [1,493] {746}	31,151 (6,230) [1,495] {748}	31,204 (6,241) [1,498] {749}
Eagle	6,434	6,445	6,458	6,472	6,493 (1,299) [312] {156}	6,516 (1,303) [313] {156}	6,542 (1,308) [314] {157}
El Paso	74,816	74,927	75,043	75,193	75,406 (15,081) [3,619] {1,810}	75,628 (15,126) [3,630] {1,815}	75,860 (15,172) [3,641] {1,821}
Gunnison	1,408	1,409	1,409	1,409	1,410 (282) [68] {34}	1,412 (282) [68] {34}	1,413 (283) [68] {34}
Jefferson	49,480	49,514	49,557	49,615	49,699 (9,940) [2,386] {1,193}	49,789 (9,958) [2,390] {1,195}	49,881 (9,976) [2,394] {1,197}
Larimer	28,263	28,292	28,331	28,364	28,442 (5,688) [1,365] {683}	28,525 (5,705) [1,369] {685}	28,611 (5,722) [1,373] {687}
Pueblo	19,753	19,768	19,786	19,801	19,825 (3,965) [952] {476}	19,851 (3,970) [953] {476}	19,877 (3,975) [954] {477}
Weld	33,967	34,002	34,023	34,065	34,134 (6,827) [1,638] {819}	34,205 (6,841) [1,642] {821}	34,281 (6,856) [1,645] {823}

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.