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

Date: 5/5/21

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 5/5/21 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.

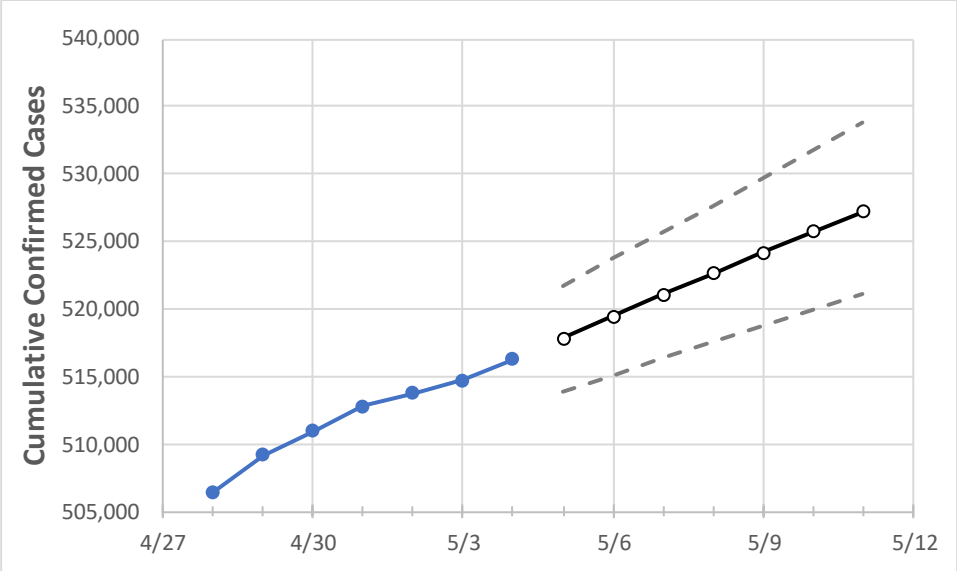
IEM's Modeling Lead

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:						
	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11
Colorado	512,804	513,765	514,721	516,240	517,857	519,449	521,038	522,590	524,172	525,713	527,213

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:						
	5/1	5/2	5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10	5/11
Adams	56,387	56,473	56,570	56,745	56,921	57,096	57,276	57,458	57,638	57,813	57,993
Arapahoe	57,834	57,947	58,050	58,193	58,384	58,569	58,753	58,938	59,127	59,310	59,494
Boulder	22,909	22,954	22,979	23,029	23,083	23,138	23,192	23,243	23,294	23,346	23,398
Denver	70,636	70,708	70,779	70,885	71,027	71,167	71,308	71,446	71,583	71,720	71,855
Douglas	27,891	27,960	28,018	28,109	28,212	28,318	28,423	28,524	28,622	28,723	28,823
Eagle	6,230	6,231	6,234	6,240	6,248	6,256	6,263	6,271	6,278	6,285	6,291
El Paso	64,179	64,366	64,565	64,849	65,128	65,405	65,696	65,981	66,278	66,567	66,862
Gunnison	1,324	1,325	1,325	1,326	1,327	1,329	1,330	1,331	1,333	1,334	1,335
Jefferson	45,266	45,356	45,453	45,620	45,788	45,955	46,121	46,286	46,454	46,623	46,798
Larimer	25,541	25,579	25,645	25,741	25,827	25,910	25,992	26,072	26,154	26,236	26,315
Pueblo	17,906	17,982	18,040	18,151	18,252	18,353	18,460	18,569	18,679	18,791	18,909
Weld	30,639	30,688	30,756	30,839	30,947	31,050	31,160	31,268	31,378	31,488	31,598

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:		
	5/1	5/2	5/3	5/4	5/6	5/8	5/10
Adams	56,387	56,473	56,570	56,745	57,096 (11,419) [2,741] {1,370}	57,458 (11,492) [2,758] {1,379}	57,813 (11,563) [2,775] {1,388}
Arapahoe	57,834	57,947	58,050	58,193	58,569 (11,714) [2,811] {1,406}	58,938 (11,788) [2,829] {1,415}	59,310 (11,862) [2,847] {1,423}
Boulder	22,909	22,954	22,979	23,029	23,138 (4,628) [1,111] {555}	23,243 (4,649) [1,116] {558}	23,346 (4,669) [1,121] {560}
Denver	70,636	70,708	70,779	70,885	71,167 (14,233) [3,416] {1,708}	71,446 (14,289) [3,429] {1,715}	71,720 (14,344) [3,443] {1,721}
Douglas	27,891	27,960	28,018	28,109	28,318 (5,664) [1,359] {680}	28,524 (5,705) [1,369] {685}	28,723 (5,745) [1,379] {689}
Eagle	6,230	6,231	6,234	6,240	6,256 (1,251) [300] {150}	6,271 (1,254) [301] {150}	6,285 (1,257) [302] {151}
El Paso	64,179	64,366	64,565	64,849	65,405 (13,081) [3,139] {1,570}	65,981 (13,196) [3,167] {1,584}	66,567 (13,313) [3,195] {1,598}
Gunnison	1,324	1,325	1,325	1,326	1,329 (266) [64] {32}	1,331 (266) [64] {32}	1,334 (267) [64] {32}
Jefferson	45,266	45,356	45,453	45,620	45,955 (9,191) [2,206] {1,103}	46,286 (9,257) [2,222] {1,111}	46,623 (9,325) [2,238] {1,119}
Larimer	25,541	25,579	25,645	25,741	25,910 (5,182) [1,244] {622}	26,072 (5,214) [1,251] {626}	26,236 (5,247) [1,259] {630}
Pueblo	17,906	17,982	18,040	18,151	18,353 (3,671) [881] {440}	18,569 (3,714) [891] {446}	18,791 (3,758) [902] {451}
Weld	30,639	30,688	30,756	30,839	31,050 (6,210) [1,490] {745}	31,268 (6,254) [1,501] {750}	31,488 (6,298) [1,511] {756}

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.