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

Date: 3/15/21

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 3/15/21 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.

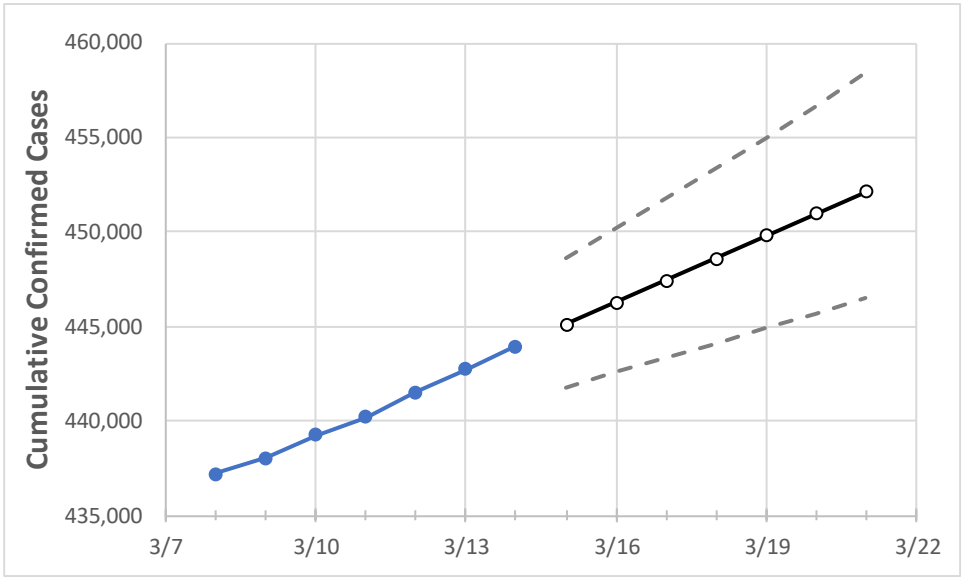
IEM's Modeling Lead

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:						
	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21
Colorado	440,220	441,511	442,753	443,968	445,116	446,271	447,423	448,607	449,795	450,961	452,109

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:						
	3/11	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21
Adams	49,520	49,609	49,696	49,833	49,934	50,035	50,137	50,239	50,341	50,441	50,542
Arapahoe	49,700	49,844	49,974	50,099	50,216	50,334	50,449	50,568	50,685	50,801	50,915
Boulder	19,351	19,419	19,500	19,593	19,651	19,711	19,772	19,833	19,897	19,959	20,023
Denver	61,246	61,442	61,583	61,788	61,955	62,135	62,313	62,495	62,678	62,866	63,048
Douglas	22,224	22,312	22,408	22,495	22,582	22,669	22,755	22,841	22,928	23,016	23,104
Eagle	5,323	5,347	5,364	5,383	5,404	5,426	5,447	5,467	5,488	5,508	5,527
El Paso	53,484	53,625	53,825	53,985	54,126	54,266	54,405	54,543	54,679	54,820	54,960
Gunnison	1,218	1,222	1,225	1,226	1,227	1,228	1,229	1,230	1,231	1,232	1,233
Jefferson	38,359	38,482	38,602	38,724	38,842	38,962	39,081	39,205	39,326	39,452	39,581
Larimer	20,798	20,889	20,990	21,041	21,108	21,175	21,241	21,308	21,375	21,440	21,506
Pueblo	15,279	15,306	15,328	15,350	15,373	15,396	15,418	15,440	15,461	15,482	15,504
Weld	26,223	26,292	26,367	26,436	26,506	26,578	26,650	26,722	26,796	26,868	26,940

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:		
	3/11	3/12	3/13	3/14	3/16	3/18	3/20
Adams	49,520	49,609	49,696	49,833	50,035 (10,007) [2,402] {1,201}	50,239 (10,048) [2,411] {1,206}	50,441 (10,088) [2,421] {1,211}
Arapahoe	49,700	49,844	49,974	50,099	50,334 (10,067) [2,416] {1,208}	50,568 (10,114) [2,427] {1,214}	50,801 (10,160) [2,438] {1,219}
Boulder	19,351	19,419	19,500	19,593	19,711 (3,942) [946] {473}	19,833 (3,967) [952] {476}	19,959 (3,992) [958] {479}
Denver	61,246	61,442	61,583	61,788	62,135 (12,427) [2,982] {1,491}	62,495 (12,499) [3,000] {1,500}	62,866 (12,573) [3,018] {1,509}
Douglas	22,224	22,312	22,408	22,495	22,669 (4,534) [1,088] {544}	22,841 (4,568) [1,096] {548}	23,016 (4,603) [1,105] {552}
Eagle	5,323	5,347	5,364	5,383	5,426 (1,085) [260] {130}	5,467 (1,093) [262] {131}	5,508 (1,102) [264] {132}
El Paso	53,484	53,625	53,825	53,985	54,266 (10,853) [2,605] {1,302}	54,543 (10,909) [2,618] {1,309}	54,820 (10,964) [2,631] {1,316}
Gunnison	1,218	1,222	1,225	1,226	1,228 (246) [59] {29}	1,230 (246) [59] {30}	1,232 (246) [59] {30}
Jefferson	38,359	38,482	38,602	38,724	38,962 (7,792) [1,870] {935}	39,205 (7,841) [1,882] {941}	39,452 (7,890) [1,894] {947}
Larimer	20,798	20,889	20,990	21,041	21,175 (4,235) [1,016] {508}	21,308 (4,262) [1,023] {511}	21,440 (4,288) [1,029] {515}
Pueblo	15,279	15,306	15,328	15,350	15,396 (3,079) [739] {370}	15,440 (3,088) [741] {371}	15,482 (3,096) [743] {372}
Weld	26,223	26,292	26,367	26,436	26,578 (5,316) [1,276] {638}	26,722 (5,344) [1,283] {641}	26,868 (5,374) [1,290] {645}

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.