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

Date: 3/16/21

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 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 3/16/21 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.

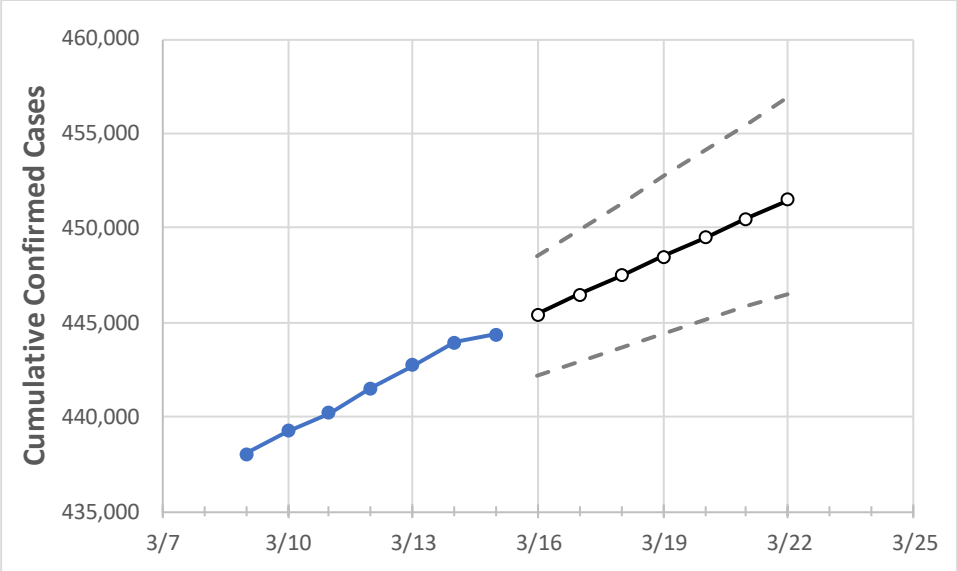
IEM's Modeling Lead

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:						
	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22
Colorado	441,511	442,753	443,968	444,390	445,437	446,455	447,468	448,485	449,491	450,504	451,503

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:						
	3/12	3/13	3/14	3/15	3/16	3/17	3/18	3/19	3/20	3/21	3/22
Adams	49,609	49,696	49,833	49,866	49,958	50,052	50,143	50,235	50,326	50,415	50,509
Arapahoe	49,844	49,974	50,099	50,153	50,260	50,366	50,473	50,582	50,687	50,794	50,902
Boulder	19,419	19,500	19,593	19,606	19,654	19,705	19,754	19,803	19,854	19,906	19,958
Denver	61,442	61,583	61,788	61,859	62,019	62,182	62,343	62,511	62,677	62,849	63,017
Douglas	22,312	22,408	22,495	22,517	22,593	22,670	22,745	22,822	22,897	22,973	23,047
Eagle	5,347	5,364	5,383	5,398	5,418	5,437	5,457	5,476	5,494	5,513	5,531
El Paso	53,625	53,825	53,985	54,026	54,153	54,278	54,400	54,527	54,649	54,771	54,896
Gunnison	1,222	1,225	1,226	1,226	1,227	1,228	1,229	1,231	1,232	1,233	1,234
Jefferson	38,482	38,602	38,724	38,761	38,868	38,974	39,079	39,186	39,292	39,401	39,509
Larimer	20,889	20,990	21,041	21,075	21,137	21,199	21,260	21,320	21,379	21,439	21,498
Pueblo	15,306	15,328	15,350	15,357	15,377	15,397	15,416	15,436	15,455	15,474	15,494
Weld	26,292	26,367	26,436	26,457	26,522	26,586	26,649	26,714	26,779	26,842	26,907

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:		
	3/12	3/13	3/14	3/15	3/17	3/19	3/21
Adams	49,609	49,696	49,833	49,866	50,052 (10,010) [2,402] {1,201}	50,235 (10,047) [2,411] {1,206}	50,415 (10,083) [2,420] {1,210}
Arapahoe	49,844	49,974	50,099	50,153	50,366 (10,073) [2,418] {1,209}	50,582 (10,116) [2,428] {1,214}	50,794 (10,159) [2,438] {1,219}
Boulder	19,419	19,500	19,593	19,606	19,705 (3,941) [946] {473}	19,803 (3,961) [951] {475}	19,906 (3,981) [955] {478}
Denver	61,442	61,583	61,788	61,859	62,182 (12,436) [2,985] {1,492}	62,511 (12,502) [3,001] {1,500}	62,849 (12,570) [3,017] {1,508}
Douglas	22,312	22,408	22,495	22,517	22,670 (4,534) [1,088] {544}	22,822 (4,564) [1,095] {548}	22,973 (4,595) [1,103] {551}
Eagle	5,347	5,364	5,383	5,398	5,437 (1,087) [261] {130}	5,476 (1,095) [263] {131}	5,513 (1,103) [265] {132}
El Paso	53,625	53,825	53,985	54,026	54,278 (10,856) [2,605] {1,303}	54,527 (10,905) [2,617] {1,309}	54,771 (10,954) [2,629] {1,315}
Gunnison	1,222	1,225	1,226	1,226	1,228 (246) [59] {29}	1,231 (246) [59] {30}	1,233 (247) [59] {30}
Jefferson	38,482	38,602	38,724	38,761	38,974 (7,795) [1,871] {935}	39,186 (7,837) [1,881] {940}	39,401 (7,880) [1,891] {946}
Larimer	20,889	20,990	21,041	21,075	21,199 (4,240) [1,018] {509}	21,320 (4,264) [1,023] {512}	21,439 (4,288) [1,029] {515}
Pueblo	15,306	15,328	15,350	15,357	15,397 (3,079) [739] {370}	15,436 (3,087) [741] {370}	15,474 (3,095) [743] {371}
Weld	26,292	26,367	26,436	26,457	26,586 (5,317) [1,276] {638}	26,714 (5,343) [1,282] {641}	26,842 (5,368) [1,288] {644}

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.