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

Date: 1/10/22

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 1/10/22 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.

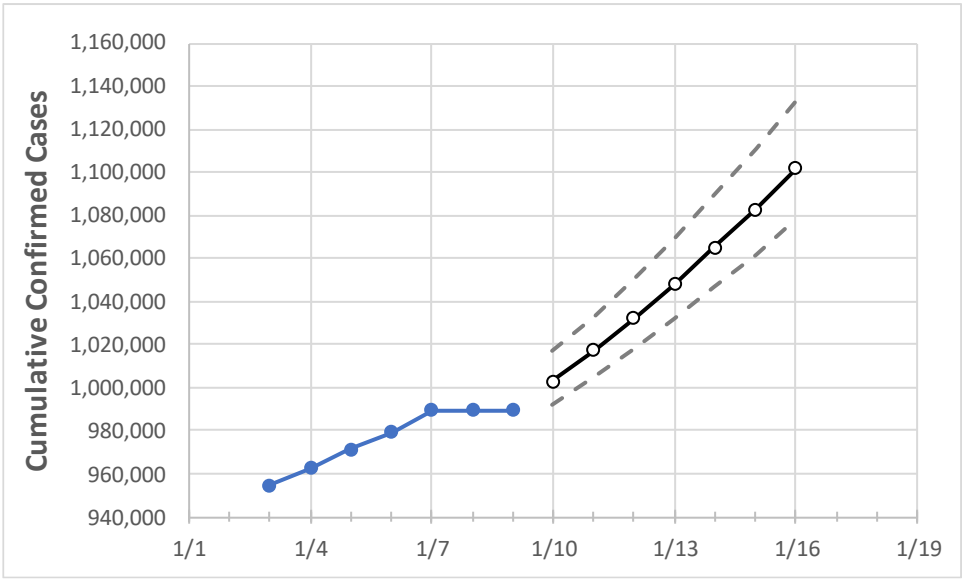
IEM's Modeling Lead

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:						
	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16
Colorado	979,437	989,409	989,409	989,409	1,002,923	1,017,329	1,032,243	1,048,141	1,065,192	1,083,015	1,101,800

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:						
	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16
Adams	98,891	99,831	99,831	99,831	101,138	102,519	103,981	105,489	107,107	108,841	110,682
Arapahoe	109,283	110,513	110,513	110,513	112,572	114,766	117,068	119,549	122,123	124,922	127,879
Boulder	41,982	42,822	42,822	42,822	43,518	44,293	45,109	45,952	46,879	47,860	48,871
Denver	125,497	126,727	126,727	126,727	129,047	131,462	134,001	136,670	139,557	142,599	145,782
Douglas	55,103	55,886	55,886	55,886	56,855	57,870	58,960	60,135	61,385	62,726	64,129
Eagle	12,523	12,713	12,713	12,713	13,017	13,317	13,657	13,998	14,356	14,733	15,139
El Paso	131,617	132,842	132,842	132,842	134,378	135,992	137,704	139,509	141,462	143,487	145,683
Gunnison	2,287	2,304	2,304	2,304	2,333	2,365	2,399	2,433	2,471	2,511	2,553
Jefferson	87,817	88,641	88,641	88,641	90,014	91,477	92,990	94,577	96,325	98,161	100,079
Larimer	52,613	53,277	53,277	53,277	53,923	54,596	55,310	56,057	56,847	57,688	58,561
Pueblo	32,646	32,885	32,885	32,885	33,122	33,367	33,627	33,898	34,188	34,499	34,812
Weld	60,064	60,582	60,582	60,582	61,102	61,659	62,247	62,847	63,489	64,161	64,867

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:		
	1/6	1/7	1/8	1/9	1/11	1/13	1/15
Adams	98,891	99,831	99,831	99,831	102,519 (20,504) [4,921] {2,460}	105,489 (21,098) [5,063] {2,532}	108,841 (21,768) [5,224] {2,612}
Arapahoe	109,283	110,513	110,513	110,513	114,766 (22,953) [5,509] {2,754}	119,549 (23,910) [5,738] {2,869}	124,922 (24,984) [5,996] {2,998}
Boulder	41,982	42,822	42,822	42,822	44,293 (8,859) [2,126] {1,063}	45,952 (9,190) [2,206] {1,103}	47,860 (9,572) [2,297] {1,149}
Denver	125,497	126,727	126,727	126,727	131,462 (26,292) [6,310] {3,155}	136,670 (27,334) [6,560] {3,280}	142,599 (28,520) [6,845] {3,422}
Douglas	55,103	55,886	55,886	55,886	57,870 (11,574) [2,778] {1,389}	60,135 (12,027) [2,886] {1,443}	62,726 (12,545) [3,011] {1,505}
Eagle	12,523	12,713	12,713	12,713	13,317 (2,663) [639] {320}	13,998 (2,800) [672] {336}	14,733 (2,947) [707] {354}
El Paso	131,617	132,842	132,842	132,842	135,992 (27,198) [6,528] {3,264}	139,509 (27,902) [6,696] {3,348}	143,487 (28,697) [6,887] {3,444}
Gunnison	2,287	2,304	2,304	2,304	2,365 (473) [114] {57}	2,433 (487) [117] {58}	2,511 (502) [121] {60}
Jefferson	87,817	88,641	88,641	88,641	91,477 (18,295) [4,391] {2,195}	94,577 (18,915) [4,540] {2,270}	98,161 (19,632) [4,712] {2,356}
Larimer	52,613	53,277	53,277	53,277	54,596 (10,919) [2,621] {1,310}	56,057 (11,211) [2,691] {1,345}	57,688 (11,538) [2,769] {1,385}
Pueblo	32,646	32,885	32,885	32,885	33,367 (6,673) [1,602] {801}	33,898 (6,780) [1,627] {814}	34,499 (6,900) [1,656] {828}
Weld	60,064	60,582	60,582	60,582	61,659 (12,332) [2,960] {1,480}	62,847 (12,569) [3,017] {1,508}	64,161 (12,832) [3,080] {1,540}

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.