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

Date: 1/20/21

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 1/20/21 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.

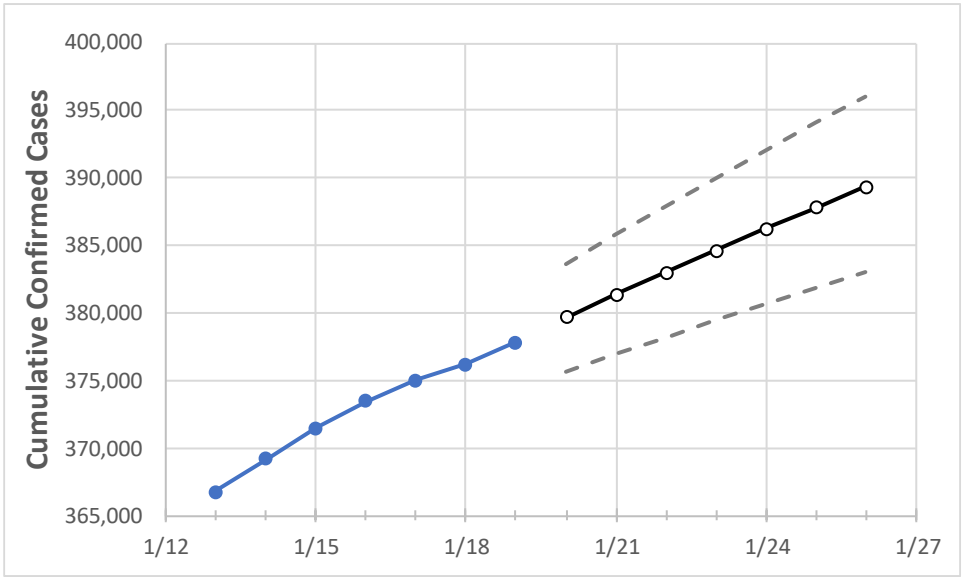
IEM's Modeling Lead

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:						
	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26
Colorado	373,483	374,981	376,171	377,856	379,639	381,361	383,022	384,650	386,260	387,822	389,310

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:						
	1/16	1/17	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26
Adams	43,743	43,876	43,988	44,144	44,291	44,432	44,570	44,701	44,827	44,949	45,070
Arapahoe	42,456	42,631	42,790	42,934	43,130	43,328	43,520	43,706	43,887	44,062	44,233
Boulder	16,196	16,276	16,307	16,393	16,463	16,533	16,601	16,668	16,733	16,798	16,859
Denver	53,121	53,319	53,460	53,625	53,841	54,052	54,265	54,467	54,653	54,844	55,028
Douglas	17,727	17,795	17,868	17,941	18,051	18,157	18,261	18,366	18,466	18,569	18,667
Eagle	3,951	3,976	4,000	4,022	4,059	4,098	4,135	4,174	4,213	4,254	4,293
El Paso	45,595	45,737	45,810	45,973	46,173	46,365	46,554	46,739	46,921	47,104	47,284
Gunnison	863	873	912	933	958	985	1,014	1,045	1,080	1,116	1,156
Jefferson	32,728	32,832	32,952	33,123	33,282	33,440	33,593	33,745	33,896	34,043	34,184
Larimer	16,809	16,902	16,968	17,040	17,139	17,236	17,334	17,432	17,528	17,627	17,725
Pueblo	13,991	14,009	14,024	14,046	14,070	14,092	14,113	14,132	14,149	14,166	14,182
Weld	22,331	22,408	22,471	22,632	22,740	22,846	22,951	23,052	23,149	23,244	23,335

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:		
	1/16	1/17	1/18	1/19	1/21	1/23	1/25
Adams	43,743	43,876	43,988	44,144	44,432 (8,886) [2,133] {1,066}	44,701 (8,940) [2,146] {1,073}	44,949 (8,990) [2,158] {1,079}
Arapahoe	42,456	42,631	42,790	42,934	43,328 (8,666) [2,080] {1,040}	43,706 (8,741) [2,098] {1,049}	44,062 (8,812) [2,115] {1,057}
Boulder	16,196	16,276	16,307	16,393	16,533 (3,307) [794] {397}	16,668 (3,334) [800] {400}	16,798 (3,360) [806] {403}
Denver	53,121	53,319	53,460	53,625	54,052 (10,810) [2,595] {1,297}	54,467 (10,893) [2,614] {1,307}	54,844 (10,969) [2,633] {1,316}
Douglas	17,727	17,795	17,868	17,941	18,157 (3,631) [872] {436}	18,366 (3,673) [882] {441}	18,569 (3,714) [891] {446}
Eagle	3,951	3,976	4,000	4,022	4,098 (820) [197] {98}	4,174 (835) [200] {100}	4,254 (851) [204] {102}
El Paso	45,595	45,737	45,810	45,973	46,365 (9,273) [2,226] {1,113}	46,739 (9,348) [2,243] {1,122}	47,104 (9,421) [2,261] {1,130}
Gunnison	863	873	912	933	985 (197) [47] {24}	1,045 (209) [50] {25}	1,116 (223) [54] {27}
Jefferson	32,728	32,832	32,952	33,123	33,440 (6,688) [1,605] {803}	33,745 (6,749) [1,620] {810}	34,043 (6,809) [1,634] {817}
Larimer	16,809	16,902	16,968	17,040	17,236 (3,447) [827] {414}	17,432 (3,486) [837] {418}	17,627 (3,525) [846] {423}
Pueblo	13,991	14,009	14,024	14,046	14,092 (2,818) [676] {338}	14,132 (2,826) [678] {339}	14,166 (2,833) [680] {340}
Weld	22,331	22,408	22,471	22,632	22,846 (4,569) [1,097] {548}	23,052 (4,610) [1,106] {553}	23,244 (4,649) [1,116] {558}

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.