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

Date: 1/22/21

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 1/22/21 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.

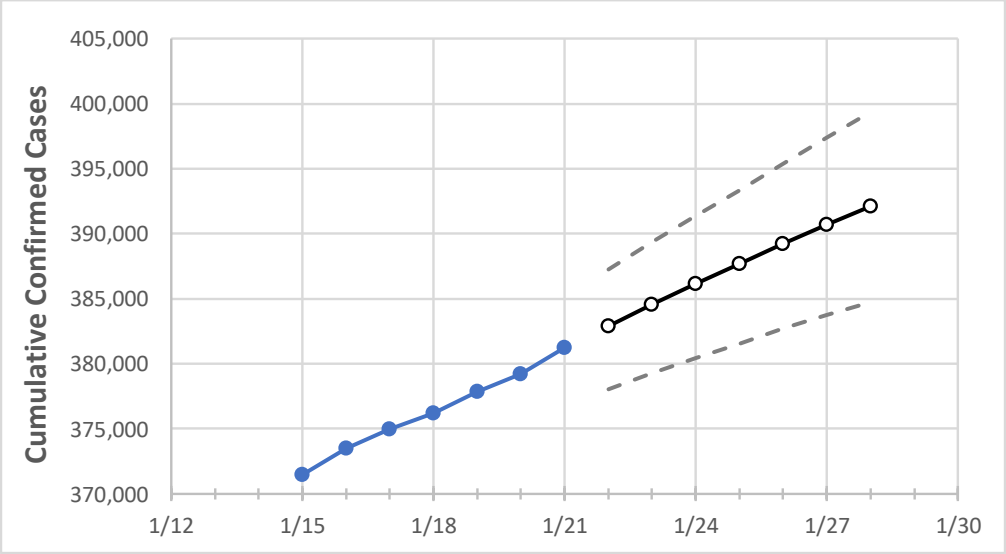
IEM's Modeling Lead

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:						
	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28
Colorado	376,171	377,856	379,227	381,210	382,920	384,534	386,151	387,698	389,234	390,693	392,135

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:						
	1/18	1/19	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28
Adams	43,988	44,144	44,256	44,442	44,576	44,707	44,834	44,952	45,067	45,178	45,290
Arapahoe	42,790	42,934	43,085	43,287	43,461	43,628	43,790	43,947	44,101	44,247	44,393
Boulder	16,307	16,393	16,444	16,514	16,576	16,637	16,697	16,756	16,813	16,870	16,925
Denver	53,460	53,625	53,758	53,998	54,193	54,380	54,558	54,735	54,910	55,078	55,241
Douglas	17,868	17,941	17,999	18,096	18,188	18,279	18,366	18,454	18,541	18,626	18,709
Eagle	4,000	4,022	4,063	4,121	4,162	4,205	4,248	4,292	4,336	4,384	4,430
El Paso	45,810	45,973	46,144	46,330	46,513	46,695	46,863	47,026	47,183	47,344	47,504
Gunnison	912	933	940	949	969	991	1,013	1,036	1,060	1,085	1,112
Jefferson	32,952	33,123	33,216	33,321	33,455	33,591	33,721	33,851	33,976	34,098	34,218
Larimer	16,968	17,040	17,130	17,259	17,351	17,445	17,536	17,631	17,722	17,814	17,906
Pueblo	14,024	14,046	14,086	14,113	14,135	14,156	14,176	14,194	14,211	14,227	14,244
Weld	22,471	22,632	22,723	22,832	22,933	23,031	23,129	23,224	23,316	23,404	23,489

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:		
	1/18	1/19	1/20	1/21	1/23	1/25	1/27
Adams	43,988	44,144	44,256	44,442	44,707 (8,941) [2,146] {1,073}	44,952 (8,990) [2,158] {1,079}	45,178 (9,036) [2,169] {1,084}
Arapahoe	42,790	42,934	43,085	43,287	43,628 (8,726) [2,094] {1,047}	43,947 (8,789) [2,109] {1,055}	44,247 (8,849) [2,124] {1,062}
Boulder	16,307	16,393	16,444	16,514	16,637 (3,327) [799] {399}	16,756 (3,351) [804] {402}	16,870 (3,374) [810] {405}
Denver	53,460	53,625	53,758	53,998	54,380 (10,876) [2,610] {1,305}	54,735 (10,947) [2,627] {1,314}	55,078 (11,016) [2,644] {1,322}
Douglas	17,868	17,941	17,999	18,096	18,279 (3,656) [877] {439}	18,454 (3,691) [886] {443}	18,626 (3,725) [894] {447}
Eagle	4,000	4,022	4,063	4,121	4,205 (841) [202] {101}	4,292 (858) [206] {103}	4,384 (877) [210] {105}
El Paso	45,810	45,973	46,144	46,330	46,695 (9,339) [2,241] {1,121}	47,026 (9,405) [2,257] {1,129}	47,344 (9,469) [2,273] {1,136}
Gunnison	912	933	940	949	991 (198) [48] {24}	1,036 (207) [50] {25}	1,085 (217) [52] {26}
Jefferson	32,952	33,123	33,216	33,321	33,591 (6,718) [1,612] {806}	33,851 (6,770) [1,625] {812}	34,098 (6,820) [1,637] {818}
Larimer	16,968	17,040	17,130	17,259	17,445 (3,489) [837] {419}	17,631 (3,526) [846] {423}	17,814 (3,563) [855] {428}
Pueblo	14,024	14,046	14,086	14,113	14,156 (2,831) [679] {340}	14,194 (2,839) [681] {341}	14,227 (2,845) [683] {341}
Weld	22,471	22,632	22,723	22,832	23,031 (4,606) [1,105] {553}	23,224 (4,645) [1,115] {557}	23,404 (4,681) [1,123] {562}

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.