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

Date: 1/24/22

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 1/24/22 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.

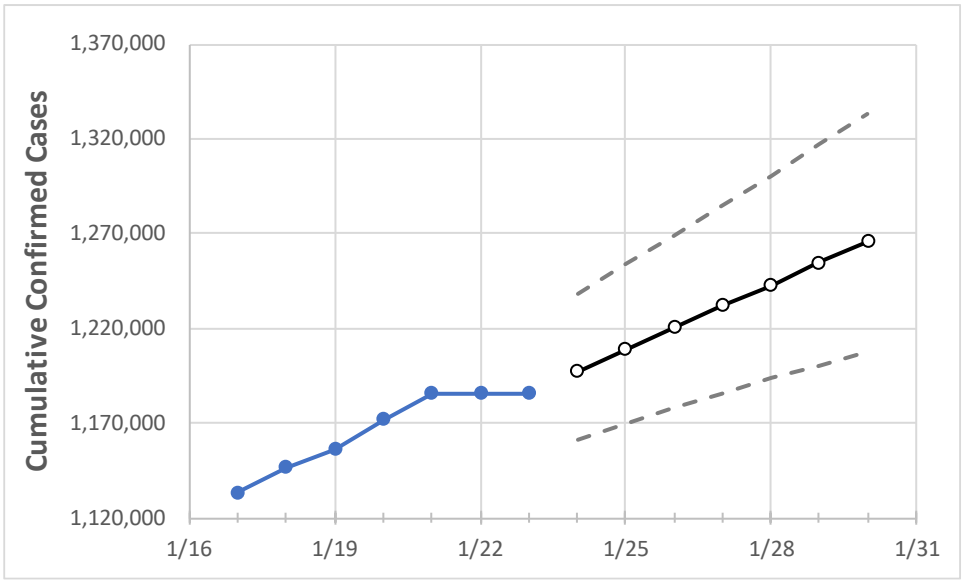
IEM's Modeling Lead

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:						
	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30
Colorado	1,171,789	1,185,862	1,185,867	1,185,867	1,197,408	1,209,063	1,220,462	1,232,131	1,242,931	1,254,668	1,265,893

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:						
	1/20	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30
Adams	117,553	118,899	118,899	118,899	120,079	121,277	122,425	123,539	124,686	125,922	127,026
Arapahoe	133,375	134,793	134,793	134,793	136,214	137,670	139,071	140,463	141,786	143,248	144,633
Boulder	52,675	53,871	53,871	53,871	54,684	55,521	56,322	57,142	57,977	58,828	59,704
Denver	150,245	151,854	151,854	151,854	153,281	154,630	155,981	157,340	158,607	159,969	161,217
Douglas	67,647	68,572	68,572	68,572	69,430	70,259	71,123	71,943	72,786	73,644	74,479
Eagle	14,413	14,491	14,491	14,491	14,565	14,630	14,692	14,755	14,814	14,869	14,925
El Paso	158,444	160,065	160,065	160,065	162,089	164,097	166,170	168,245	170,278	172,440	174,498
Gunnison	2,914	2,955	2,955	2,955	2,989	3,023	3,057	3,090	3,123	3,156	3,188
Jefferson	105,272	106,859	106,859	106,859	107,985	109,108	110,201	111,339	112,482	113,551	114,684
Larimer	63,857	64,693	64,693	64,693	65,543	66,417	67,292	68,153	69,025	69,966	70,870
Pueblo	38,733	39,121	39,121	39,121	39,667	40,206	40,760	41,328	41,902	42,510	43,099
Weld	71,183	72,047	72,047	72,047	72,944	73,851	74,755	75,695	76,636	77,586	78,519

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:		
	1/20	1/21	1/22	1/23	1/25	1/27	1/29
Adams	117,553	118,899	118,899	118,899	121,277 (24,255) [5,821] {2,911}	123,539 (24,708) [5,930] {2,965}	125,922 (25,184) [6,044] {3,022}
Arapahoe	133,375	134,793	134,793	134,793	137,670 (27,534) [6,608] {3,304}	140,463 (28,093) [6,742] {3,371}	143,248 (28,650) [6,876] {3,438}
Boulder	52,675	53,871	53,871	53,871	55,521 (11,104) [2,665] {1,332}	57,142 (11,428) [2,743] {1,371}	58,828 (11,766) [2,824] {1,412}
Denver	150,245	151,854	151,854	151,854	154,630 (30,926) [7,422] {3,711}	157,340 (31,468) [7,552] {3,776}	159,969 (31,994) [7,679] {3,839}
Douglas	67,647	68,572	68,572	68,572	70,259 (14,052) [3,372] {1,686}	71,943 (14,389) [3,453] {1,727}	73,644 (14,729) [3,535] {1,767}
Eagle	14,413	14,491	14,491	14,491	14,630 (2,926) [702] {351}	14,755 (2,951) [708] {354}	14,869 (2,974) [714] {357}
El Paso	158,444	160,065	160,065	160,065	164,097 (32,819) [7,877] {3,938}	168,245 (33,649) [8,076] {4,038}	172,440 (34,488) [8,277] {4,139}
Gunnison	2,914	2,955	2,955	2,955	3,023 (605) [145] {73}	3,090 (618) [148] {74}	3,156 (631) [152] {76}
Jefferson	105,272	106,859	106,859	106,859	109,108 (21,822) [5,237] {2,619}	111,339 (22,268) [5,344] {2,672}	113,551 (22,710) [5,450] {2,725}
Larimer	63,857	64,693	64,693	64,693	66,417 (13,283) [3,188] {1,594}	68,153 (13,631) [3,271] {1,636}	69,966 (13,993) [3,358] {1,679}
Pueblo	38,733	39,121	39,121	39,121	40,206 (8,041) [1,930] {965}	41,328 (8,266) [1,984] {992}	42,510 (8,502) [2,040] {1,020}
Weld	71,183	72,047	72,047	72,047	73,851 (14,770) [3,545] {1,772}	75,695 (15,139) [3,633] {1,817}	77,586 (15,517) [3,724] {1,862}

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.