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

Date: 1/28/22

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 1/28/22 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.

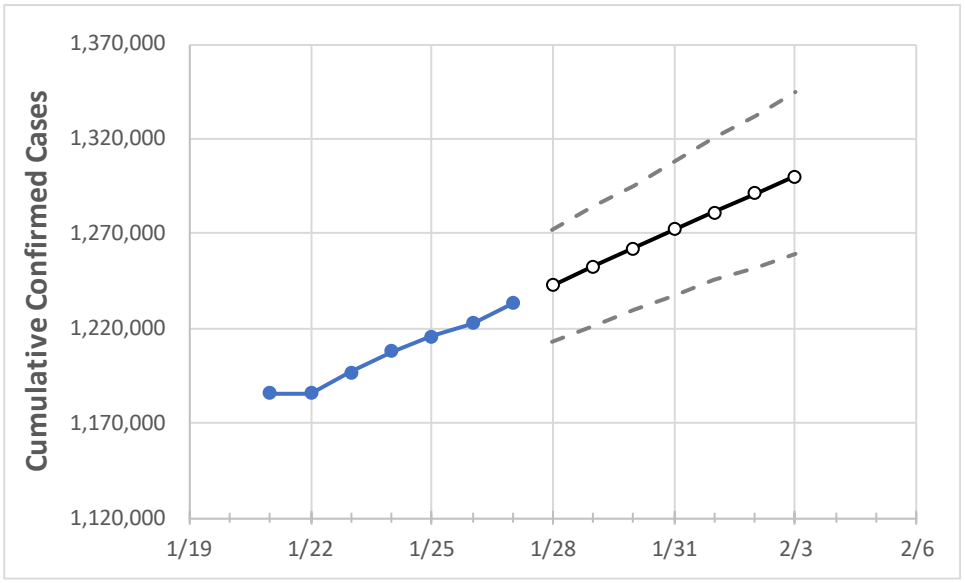
IEM's Modeling Lead

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:						
	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3
Colorado	1,208,072	1,215,931	1,222,893	1,233,278	1,242,941	1,252,603	1,262,508	1,272,210	1,281,081	1,291,271	1,300,417

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:						
	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1	2/2	2/3
Adams	120,856	121,504	121,983	122,767	123,534	124,296	125,053	125,774	126,496	127,207	127,873
Arapahoe	137,111	137,864	138,622	139,678	140,625	141,556	142,455	143,333	144,183	145,021	145,837
Boulder	55,123	55,560	55,812	56,450	57,045	57,598	58,156	58,751	59,273	59,848	60,406
Denver	153,846	154,810	155,688	156,772	157,737	158,655	159,563	160,436	161,302	162,207	162,985
Douglas	69,968	70,423	70,730	71,288	71,854	72,410	72,951	73,488	74,011	74,551	75,050
Eagle	14,689	14,739	14,852	14,935	14,997	15,056	15,114	15,171	15,224	15,280	15,328
El Paso	163,517	164,718	165,389	167,130	168,603	170,060	171,555	173,009	174,448	175,892	177,320
Gunnison	3,002	3,019	3,029	3,038	3,057	3,077	3,095	3,113	3,130	3,148	3,165
Jefferson	108,745	109,565	110,315	111,049	111,875	112,703	113,495	114,312	115,093	115,899	116,638
Larimer	66,175	66,585	66,957	67,741	68,406	69,065	69,714	70,364	71,017	71,674	72,305
Pueblo	40,270	40,442	40,640	40,989	41,420	41,856	42,292	42,730	43,160	43,613	44,056
Weld	73,636	74,084	74,502	75,145	75,799	76,445	77,076	77,729	78,355	79,014	79,639

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:		
	1/24	1/25	1/26	1/27	1/29	1/31	2/2
Adams	120,856	121,504	121,983	122,767	124,296 (24,859) [5,966] {2,983}	125,774 (25,155) [6,037] {3,019}	127,207 (25,441) [6,106] {3,053}
Arapahoe	137,111	137,864	138,622	139,678	141,556 (28,311) [6,795] {3,397}	143,333 (28,667) [6,880] {3,440}	145,021 (29,004) [6,961] {3,481}
Boulder	55,123	55,560	55,812	56,450	57,598 (11,520) [2,765] {1,382}	58,751 (11,750) [2,820] {1,410}	59,848 (11,970) [2,873] {1,436}
Denver	153,846	154,810	155,688	156,772	158,655 (31,731) [7,615] {3,808}	160,436 (32,087) [7,701] {3,850}	162,207 (32,441) [7,786] {3,893}
Douglas	69,968	70,423	70,730	71,288	72,410 (14,482) [3,476] {1,738}	73,488 (14,698) [3,527] {1,764}	74,551 (14,910) [3,578] {1,789}
Eagle	14,689	14,739	14,852	14,935	15,056 (3,011) [723] {361}	15,171 (3,034) [728] {364}	15,280 (3,056) [733] {367}
El Paso	163,517	164,718	165,389	167,130	170,060 (34,012) [8,163] {4,081}	173,009 (34,602) [8,304] {4,152}	175,892 (35,178) [8,443] {4,221}
Gunnison	3,002	3,019	3,029	3,038	3,077 (615) [148] {74}	3,113 (623) [149] {75}	3,148 (630) [151] {76}
Jefferson	108,745	109,565	110,315	111,049	112,703 (22,541) [5,410] {2,705}	114,312 (22,862) [5,487] {2,743}	115,899 (23,180) [5,563] {2,782}
Larimer	66,175	66,585	66,957	67,741	69,065 (13,813) [3,315] {1,658}	70,364 (14,073) [3,377] {1,689}	71,674 (14,335) [3,440] {1,720}
Pueblo	40,270	40,442	40,640	40,989	41,856 (8,371) [2,009] {1,005}	42,730 (8,546) [2,051] {1,026}	43,613 (8,723) [2,093] {1,047}
Weld	73,636	74,084	74,502	75,145	76,445 (15,289) [3,669] {1,835}	77,729 (15,546) [3,731] {1,866}	79,014 (15,803) [3,793] {1,896}

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.