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

Date: 2/11/22

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 2/11/22 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.

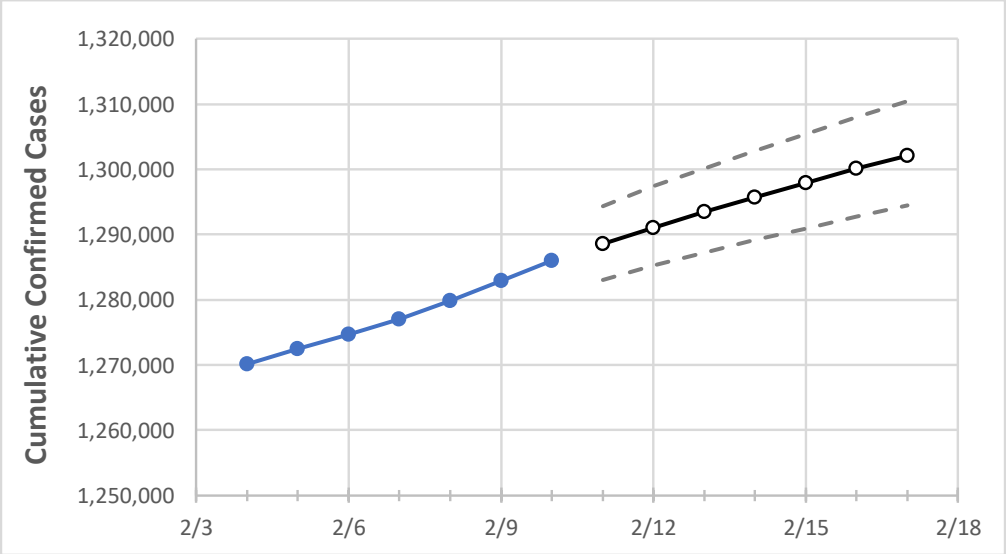
IEM's Modeling Lead

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:						
	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17
Colorado	1,276,978	1,279,858	1,282,919	1,285,987	1,288,615	1,291,065	1,293,440	1,295,738	1,297,959	1,300,081	1,302,066

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:						
	2/7	2/8	2/9	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17
Adams	126,123	126,317	126,514	126,742	126,920	127,096	127,260	127,409	127,561	127,701	127,828
Arapahoe	143,497	143,692	143,955	144,182	144,383	144,571	144,754	144,918	145,080	145,237	145,374
Boulder	58,785	58,949	59,122	59,295	59,434	59,566	59,696	59,820	59,933	60,050	60,157
Denver	160,912	161,196	161,473	161,761	161,999	162,224	162,439	162,637	162,839	163,024	163,193
Douglas	73,511	73,633	73,758	73,912	74,034	74,146	74,253	74,354	74,447	74,541	74,625
Eagle	15,289	15,324	15,359	15,386	15,412	15,435	15,458	15,479	15,500	15,520	15,539
El Paso	173,443	173,895	174,340	174,747	175,123	175,485	175,810	176,140	176,446	176,762	177,042
Gunnison	3,127	3,130	3,136	3,146	3,151	3,156	3,161	3,166	3,170	3,174	3,178
Jefferson	114,877	115,065	115,291	115,572	115,785	115,978	116,175	116,357	116,530	116,699	116,856
Larimer	70,940	71,109	71,346	71,579	71,784	71,985	72,175	72,358	72,542	72,713	72,881
Pueblo	42,672	42,761	42,869	42,970	43,070	43,165	43,256	43,345	43,427	43,507	43,582
Weld	78,186	78,382	78,599	78,795	78,978	79,144	79,306	79,456	79,612	79,752	79,891

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:		
	2/7	2/8	2/9	2/10	2/12	2/14	2/16
Adams	126,123	126,317	126,514	126,742	127,096 (25,419) [6,101] {3,050}	127,409 (25,482) [6,116] {3,058}	127,701 (25,540) [6,130] {3,065}
Arapahoe	143,497	143,692	143,955	144,182	144,571 (28,914) [6,939] {3,470}	144,918 (28,984) [6,956] {3,478}	145,237 (29,047) [6,971] {3,486}
Boulder	58,785	58,949	59,122	59,295	59,566 (11,913) [2,859] {1,430}	59,820 (11,964) [2,871] {1,436}	60,050 (12,010) [2,882] {1,441}
Denver	160,912	161,196	161,473	161,761	162,224 (32,445) [7,787] {3,893}	162,637 (32,527) [7,807] {3,903}	163,024 (32,605) [7,825] {3,913}
Douglas	73,511	73,633	73,758	73,912	74,146 (14,829) [3,559] {1,780}	74,354 (14,871) [3,569] {1,784}	74,541 (14,908) [3,578] {1,789}
Eagle	15,289	15,324	15,359	15,386	15,435 (3,087) [741] {370}	15,479 (3,096) [743] {372}	15,520 (3,104) [745] {372}
El Paso	173,443	173,895	174,340	174,747	175,485 (35,097) [8,423] {4,212}	176,140 (35,228) [8,455] {4,227}	176,762 (35,352) [8,485] {4,242}
Gunnison	3,127	3,130	3,136	3,146	3,156 (631) [151] {76}	3,166 (633) [152] {76}	3,174 (635) [152] {76}
Jefferson	114,877	115,065	115,291	115,572	115,978 (23,196) [5,567] {2,783}	116,357 (23,271) [5,585] {2,793}	116,699 (23,340) [5,602] {2,801}
Larimer	70,940	71,109	71,346	71,579	71,985 (14,397) [3,455] {1,728}	72,358 (14,472) [3,473] {1,737}	72,713 (14,543) [3,490] {1,745}
Pueblo	42,672	42,761	42,869	42,970	43,165 (8,633) [2,072] {1,036}	43,345 (8,669) [2,081] {1,040}	43,507 (8,701) [2,088] {1,044}
Weld	78,186	78,382	78,599	78,795	79,144 (15,829) [3,799] {1,899}	79,456 (15,891) [3,814] {1,907}	79,752 (15,950) [3,828] {1,914}

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.