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

Date: 214/22

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 2/14/22 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.

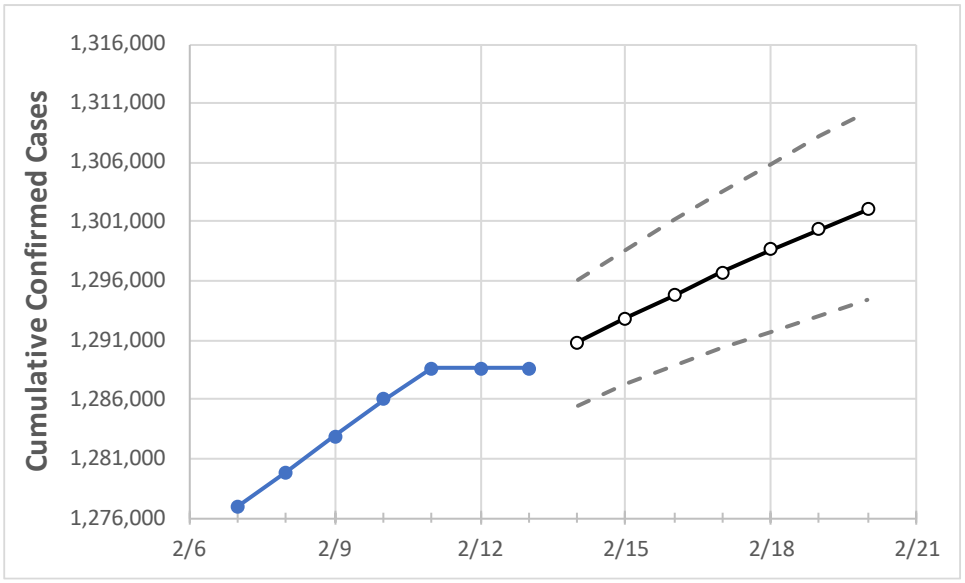
IEM's Modeling Lead

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:						
	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20
Colorado	1,285,987	1,288,600	1,288,600	1,288,600	1,290,792	1,292,864	1,294,832	1,296,707	1,298,648	1,300,378	1,302,041

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:						
	2/10	2/11	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20
Adams	126,742	126,920	126,920	126,920	127,070	127,208	127,335	127,463	127,587	127,699	127,802
Arapahoe	144,182	144,401	144,401	144,401	144,569	144,728	144,872	145,012	145,140	145,275	145,392
Boulder	59,295	59,457	59,457	59,457	59,574	59,682	59,785	59,887	59,986	60,081	60,169
Denver	161,761	161,991	161,991	161,991	162,194	162,387	162,575	162,758	162,933	163,097	163,254
Douglas	73,912	74,009	74,009	74,009	74,102	74,191	74,274	74,351	74,430	74,504	74,566
Eagle	15,386	15,414	15,414	15,414	15,432	15,451	15,469	15,486	15,504	15,518	15,534
El Paso	174,747	175,112	175,112	175,112	175,400	175,683	175,953	176,209	176,461	176,697	176,931
Gunnison	3,146	3,150	3,150	3,150	3,154	3,159	3,162	3,166	3,169	3,173	3,176
Jefferson	115,572	115,769	115,769	115,769	115,929	116,085	116,230	116,370	116,510	116,639	116,756
Larimer	71,579	71,780	71,780	71,780	71,934	72,084	72,228	72,359	72,491	72,625	72,745
Pueblo	42,970	43,099	43,099	43,099	43,178	43,254	43,325	43,394	43,462	43,528	43,587
Weld	78,795	78,995	78,995	78,995	79,130	79,261	79,388	79,510	79,624	79,739	79,845

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:		
	2/10	2/11	2/12	2/13	2/15	2/17	2/19
Adams	126,742	126,920	126,920	126,920	127,208 (25,442) [6,106] {3,053}	127,463 (25,493) [6,118] {3,059}	127,699 (25,540) [6,130] {3,065}
Arapahoe	144,182	144,401	144,401	144,401	144,728 (28,946) [6,947] {3,473}	145,012 (29,002) [6,961] {3,480}	145,275 (29,055) [6,973] {3,487}
Boulder	59,295	59,457	59,457	59,457	59,682 (11,936) [2,865] {1,432}	59,887 (11,977) [2,875] {1,437}	60,081 (12,016) [2,884] {1,442}
Denver	161,761	161,991	161,991	161,991	162,387 (32,477) [7,795] {3,897}	162,758 (32,552) [7,812] {3,906}	163,097 (32,619) [7,829] {3,914}
Douglas	73,912	74,009	74,009	74,009	74,191 (14,838) [3,561] {1,781}	74,351 (14,870) [3,569] {1,784}	74,504 (14,901) [3,576] {1,788}
Eagle	15,386	15,414	15,414	15,414	15,451 (3,090) [742] {371}	15,486 (3,097) [743] {372}	15,518 (3,104) [745] {372}
El Paso	174,747	175,112	175,112	175,112	175,683 (35,137) [8,433] {4,216}	176,209 (35,242) [8,458] {4,229}	176,697 (35,339) [8,481] {4,241}
Gunnison	3,146	3,150	3,150	3,150	3,159 (632) [152] {76}	3,166 (633) [152] {76}	3,173 (635) [152] {76}
Jefferson	115,572	115,769	115,769	115,769	116,085 (23,217) [5,572] {2,786}	116,370 (23,274) [5,586] {2,793}	116,639 (23,328) [5,599] {2,799}
Larimer	71,579	71,780	71,780	71,780	72,084 (14,417) [3,460] {1,730}	72,359 (14,472) [3,473] {1,737}	72,625 (14,525) [3,486] {1,743}
Pueblo	42,970	43,099	43,099	43,099	43,254 (8,651) [2,076] {1,038}	43,394 (8,679) [2,083] {1,041}	43,528 (8,706) [2,089] {1,045}
Weld	78,795	78,995	78,995	78,995	79,261 (15,852) [3,805] {1,902}	79,510 (15,902) [3,817] {1,908}	79,739 (15,948) [3,827] {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.