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

Date: 12/6/21

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 12/6/21 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.

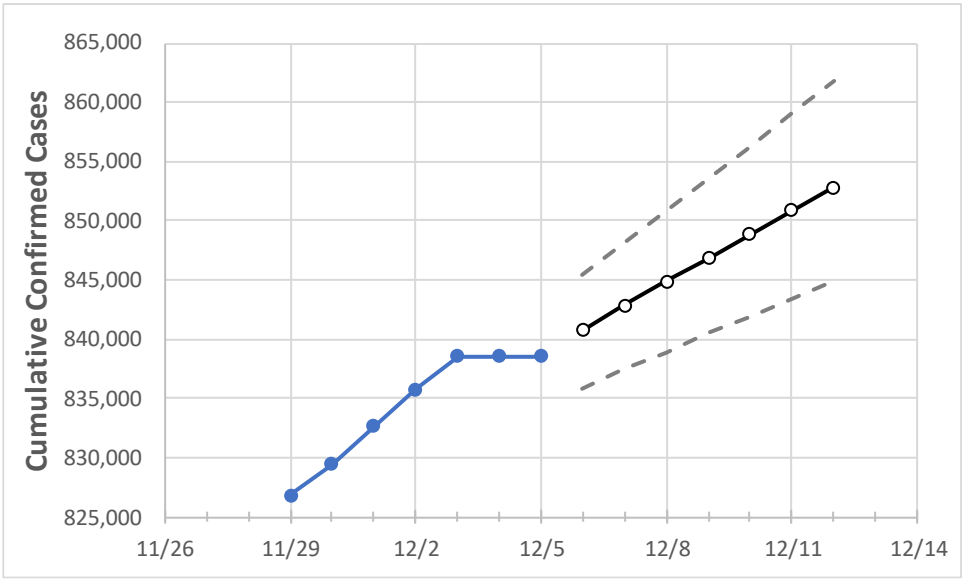
IEM's Modeling Lead

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:						
	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12
Colorado	835,738	838,587	838,587	838,587	840,718	842,839	844,883	846,827	848,832	850,904	852,817

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:						
	12/2	12/3	12/4	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12
Adams	84,995	85,276	85,276	85,276	85,486	85,692	85,893	86,100	86,303	86,507	86,704
Arapahoe	89,760	90,063	90,063	90,063	90,310	90,556	90,805	91,063	91,301	91,553	91,799
Boulder	34,848	34,954	34,954	34,954	35,035	35,118	35,196	35,276	35,357	35,437	35,509
Denver	102,605	102,879	102,879	102,879	103,120	103,356	103,592	103,828	104,057	104,293	104,513
Douglas	45,996	46,173	46,173	46,173	46,297	46,421	46,540	46,662	46,782	46,903	47,018
Eagle	9,304	9,322	9,322	9,322	9,337	9,352	9,368	9,382	9,397	9,411	9,426
El Paso	115,397	115,802	115,802	115,802	116,111	116,412	116,696	116,994	117,287	117,586	117,871
Gunnison	2,000	2,003	2,003	2,003	2,006	2,009	2,012	2,015	2,018	2,021	2,024
Jefferson	73,440	73,686	73,686	73,686	73,897	74,099	74,300	74,499	74,704	74,900	75,097
Larimer	45,425	45,611	45,611	45,611	45,712	45,819	45,923	46,026	46,123	46,223	46,318
Pueblo	29,695	29,805	29,805	29,805	29,874	29,942	30,004	30,070	30,132	30,198	30,260
Weld	53,191	53,361	53,361	53,361	53,493	53,629	53,760	53,896	54,023	54,158	54,284

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:		
	12/2	12/3	12/4	12/5	12/7	12/9	12/11
Adams	84,995	85,276	85,276	85,276	85,692 (17,138) [4,113] {2,057}	86,100 (17,220) [4,133] {2,066}	86,507 (17,301) [4,152] {2,076}
Arapahoe	89,760	90,063	90,063	90,063	90,556 (18,111) [4,347] {2,173}	91,063 (18,213) [4,371] {2,186}	91,553 (18,311) [4,395] {2,197}
Boulder	34,848	34,954	34,954	34,954	35,118 (7,024) [1,686] {843}	35,276 (7,055) [1,693] {847}	35,437 (7,087) [1,701] {850}
Denver	102,605	102,879	102,879	102,879	103,356 (20,671) [4,961] {2,481}	103,828 (20,766) [4,984] {2,492}	104,293 (20,859) [5,006] {2,503}
Douglas	45,996	46,173	46,173	46,173	46,421 (9,284) [2,228] {1,114}	46,662 (9,332) [2,240] {1,120}	46,903 (9,381) [2,251] {1,126}
Eagle	9,304	9,322	9,322	9,322	9,352 (1,870) [449] {224}	9,382 (1,876) [450] {225}	9,411 (1,882) [452] {226}
El Paso	115,397	115,802	115,802	115,802	116,412 (23,282) [5,588] {2,794}	116,994 (23,399) [5,616] {2,808}	117,586 (23,517) [5,644] {2,822}
Gunnison	2,000	2,003	2,003	2,003	2,009 (402) [96] {48}	2,015 (403) [97] {48}	2,021 (404) [97] {49}
Jefferson	73,440	73,686	73,686	73,686	74,099 (14,820) [3,557] {1,778}	74,499 (14,900) [3,576] {1,788}	74,900 (14,980) [3,595] {1,798}
Larimer	45,425	45,611	45,611	45,611	45,819 (9,164) [2,199] {1,100}	46,026 (9,205) [2,209] {1,105}	46,223 (9,245) [2,219] {1,109}
Pueblo	29,695	29,805	29,805	29,805	29,942 (5,988) [1,437] {719}	30,070 (6,014) [1,443] {722}	30,198 (6,040) [1,450] {725}
Weld	53,191	53,361	53,361	53,361	53,629 (10,726) [2,574] {1,287}	53,896 (10,779) [2,587] {1,294}	54,158 (10,832) [2,600] {1,300}

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.