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

Date: 2/18/22

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 2/18/22 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.

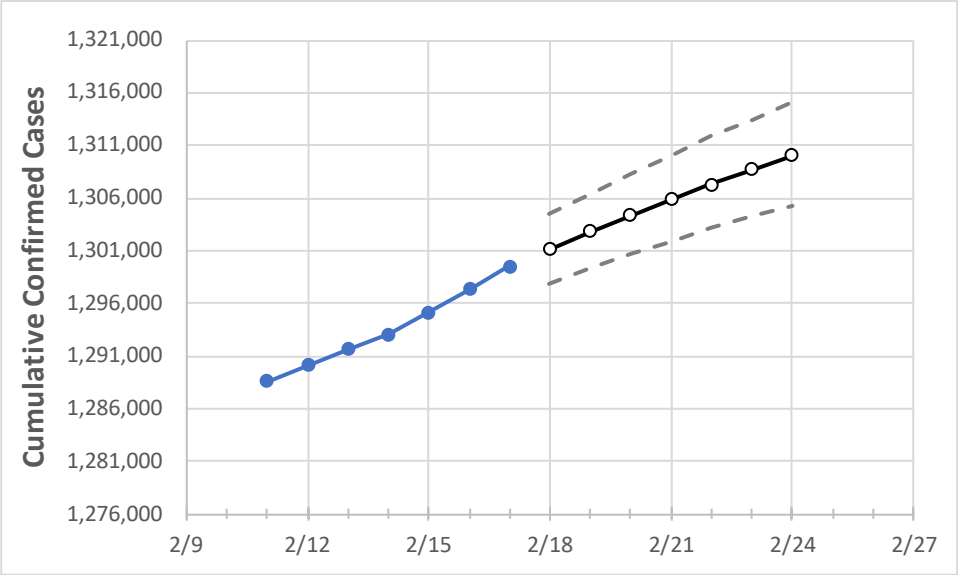
IEM's Modeling Lead

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:						
	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24
Colorado	1,293,094	1,295,177	1,297,330	1,299,468	1,301,154	1,302,829	1,304,346	1,305,850	1,307,330	1,308,714	1,310,044

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:						
	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24
Adams	127,273	127,420	127,596	127,768	127,891	128,011	128,123	128,233	128,336	128,440	128,535
Arapahoe	144,809	145,001	145,141	145,320	145,458	145,585	145,709	145,822	145,937	146,044	146,148
Boulder	59,678	59,806	59,911	60,001	60,089	60,175	60,254	60,333	60,410	60,485	60,554
Denver	162,441	162,646	162,792	163,016	163,176	163,327	163,475	163,612	163,749	163,877	163,999
Douglas	74,207	74,318	74,416	74,504	74,578	74,647	74,712	74,779	74,839	74,898	74,954
Eagle	15,445	15,451	15,495	15,519	15,536	15,551	15,566	15,580	15,595	15,608	15,620
El Paso	175,884	176,196	176,481	176,778	177,031	177,273	177,502	177,728	177,943	178,156	178,350
Gunnison	3,158	3,162	3,165	3,177	3,181	3,184	3,187	3,191	3,194	3,197	3,199
Jefferson	116,169	116,347	116,477	116,655	116,786	116,915	117,035	117,148	117,264	117,371	117,473
Larimer	72,117	72,268	72,462	72,639	72,770	72,898	73,016	73,134	73,248	73,361	73,462
Pueblo	43,271	43,345	43,431	43,519	43,585	43,648	43,708	43,767	43,822	43,876	43,929
Weld	79,267	79,383	79,489	79,626	79,729	79,826	79,920	80,010	80,097	80,183	80,258

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:		
	2/14	2/15	2/16	2/17	2/19	2/21	2/23
Adams	127,273	127,420	127,596	127,768	128,011 (25,602) [6,145] {3,072}	128,233 (25,647) [6,155] {3,078}	128,440 (25,688) [6,165] {3,083}
Arapahoe	144,809	145,001	145,141	145,320	145,585 (29,117) [6,988] {3,494}	145,822 (29,164) [6,999] {3,500}	146,044 (29,209) [7,010] {3,505}
Boulder	59,678	59,806	59,911	60,001	60,175 (12,035) [2,888] {1,444}	60,333 (12,067) [2,896] {1,448}	60,485 (12,097) [2,903] {1,452}
Denver	162,441	162,646	162,792	163,016	163,327 (32,665) [7,840] {3,920}	163,612 (32,722) [7,853] {3,927}	163,877 (32,775) [7,866] {3,933}
Douglas	74,207	74,318	74,416	74,504	74,647 (14,929) [3,583] {1,792}	74,779 (14,956) [3,589] {1,795}	74,898 (14,980) [3,595] {1,798}
Eagle	15,445	15,451	15,495	15,519	15,551 (3,110) [746] {373}	15,580 (3,116) [748] {374}	15,608 (3,122) [749] {375}
El Paso	175,884	176,196	176,481	176,778	177,273 (35,455) [8,509] {4,255}	177,728 (35,546) [8,531] {4,265}	178,156 (35,631) [8,551] {4,276}
Gunnison	3,158	3,162	3,165	3,177	3,184 (637) [153] {76}	3,191 (638) [153] {77}	3,197 (639) [153] {77}
Jefferson	116,169	116,347	116,477	116,655	116,915 (23,383) [5,612] {2,806}	117,148 (23,430) [5,623] {2,812}	117,371 (23,474) [5,634] {2,817}
Larimer	72,117	72,268	72,462	72,639	72,898 (14,580) [3,499] {1,750}	73,134 (14,627) [3,510] {1,755}	73,361 (14,672) [3,521] {1,761}
Pueblo	43,271	43,345	43,431	43,519	43,648 (8,730) [2,095] {1,048}	43,767 (8,753) [2,101] {1,050}	43,876 (8,775) [2,106] {1,053}
Weld	79,267	79,383	79,489	79,626	79,826 (15,965) [3,832] {1,916}	80,010 (16,002) [3,840] {1,920}	80,183 (16,037) [3,849] {1,924}

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.