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

Date: 2/16/22

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 2/16/22 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.

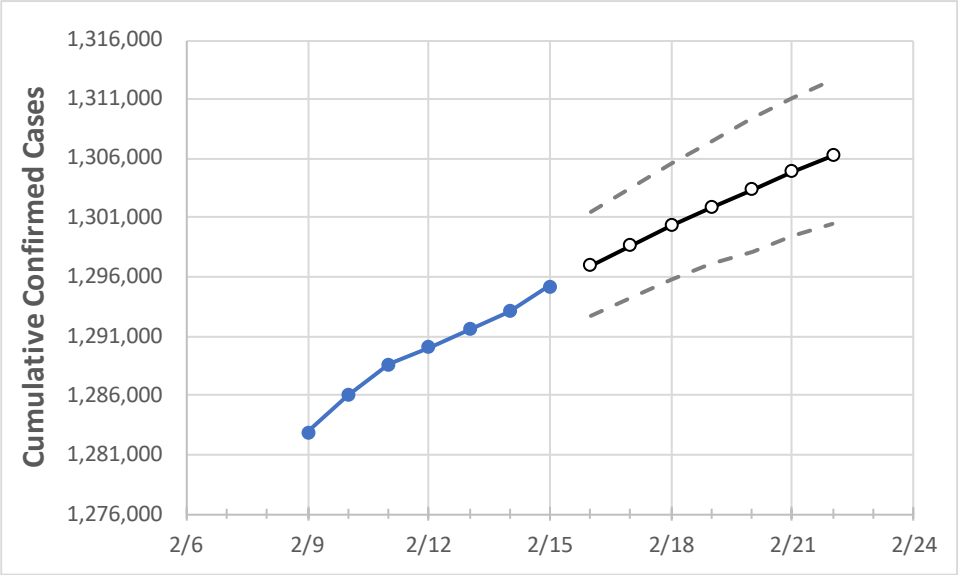
IEM's Modeling Lead

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:						
	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22
Colorado	1,290,098	1,291,596	1,293,094	1,295,177	1,296,961	1,298,636	1,300,367	1,301,877	1,303,403	1,304,896	1,306,233

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:						
	2/12	2/13	2/14	2/15	2/16	2/17	2/18	2/19	2/20	2/21	2/22
Adams	127,038	127,155	127,273	127,420	127,548	127,665	127,776	127,885	127,992	128,088	128,188
Arapahoe	144,537	144,673	144,809	145,001	145,147	145,281	145,416	145,539	145,660	145,775	145,878
Boulder	59,531	59,604	59,678	59,806	59,903	59,998	60,088	60,168	60,249	60,332	60,405
Denver	162,141	162,291	162,441	162,646	162,817	162,979	163,132	163,278	163,422	163,560	163,688
Douglas	74,075	74,141	74,207	74,318	74,400	74,477	74,547	74,615	74,680	74,741	74,801
Eagle	15,424	15,435	15,445	15,451	15,466	15,483	15,498	15,511	15,525	15,539	15,551
El Paso	175,369	175,627	175,884	176,196	176,458	176,711	176,939	177,164	177,383	177,586	177,788
Gunnison	3,153	3,155	3,158	3,162	3,166	3,169	3,172	3,176	3,178	3,181	3,185
Jefferson	115,902	116,036	116,169	116,347	116,486	116,626	116,756	116,881	117,002	117,115	117,223
Larimer	71,892	72,005	72,117	72,268	72,399	72,533	72,656	72,783	72,892	73,004	73,115
Pueblo	43,156	43,214	43,271	43,345	43,414	43,475	43,537	43,593	43,649	43,706	43,755
Weld	79,086	79,176	79,267	79,383	79,499	79,606	79,703	79,803	79,894	79,984	80,070

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:		
	2/12	2/13	2/14	2/15	2/17	2/19	2/21
Adams	127,038	127,155	127,273	127,420	127,665 (25,533) [6,128] {3,064}	127,885 (25,577) [6,138] {3,069}	128,088 (25,618) [6,148] {3,074}
Arapahoe	144,537	144,673	144,809	145,001	145,281 (29,056) [6,974] {3,487}	145,539 (29,108) [6,986] {3,493}	145,775 (29,155) [6,997] {3,499}
Boulder	59,531	59,604	59,678	59,806	59,998 (12,000) [2,880] {1,440}	60,168 (12,034) [2,888] {1,444}	60,332 (12,066) [2,896] {1,448}
Denver	162,141	162,291	162,441	162,646	162,979 (32,596) [7,823] {3,911}	163,278 (32,656) [7,837] {3,919}	163,560 (32,712) [7,851] {3,925}
Douglas	74,075	74,141	74,207	74,318	74,477 (14,895) [3,575] {1,787}	74,615 (14,923) [3,582] {1,791}	74,741 (14,948) [3,588] {1,794}
Eagle	15,424	15,435	15,445	15,451	15,483 (3,097) [743] {372}	15,511 (3,102) [745] {372}	15,539 (3,108) [746] {373}
El Paso	175,369	175,627	175,884	176,196	176,711 (35,342) [8,482] {4,241}	177,164 (35,433) [8,504] {4,252}	177,586 (35,517) [8,524] {4,262}
Gunnison	3,153	3,155	3,158	3,162	3,169 (634) [152] {76}	3,176 (635) [152] {76}	3,181 (636) [153] {76}
Jefferson	115,902	116,036	116,169	116,347	116,626 (23,325) [5,598] {2,799}	116,881 (23,376) [5,610] {2,805}	117,115 (23,423) [5,622] {2,811}
Larimer	71,892	72,005	72,117	72,268	72,533 (14,507) [3,482] {1,741}	72,783 (14,557) [3,494] {1,747}	73,004 (14,601) [3,504] {1,752}
Pueblo	43,156	43,214	43,271	43,345	43,475 (8,695) [2,087] {1,043}	43,593 (8,719) [2,092] {1,046}	43,706 (8,741) [2,098] {1,049}
Weld	79,086	79,176	79,267	79,383	79,606 (15,921) [3,821] {1,911}	79,803 (15,961) [3,831] {1,915}	79,984 (15,997) [3,839] {1,920}

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.