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

Date: 12/17/21

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 12/17/21 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.

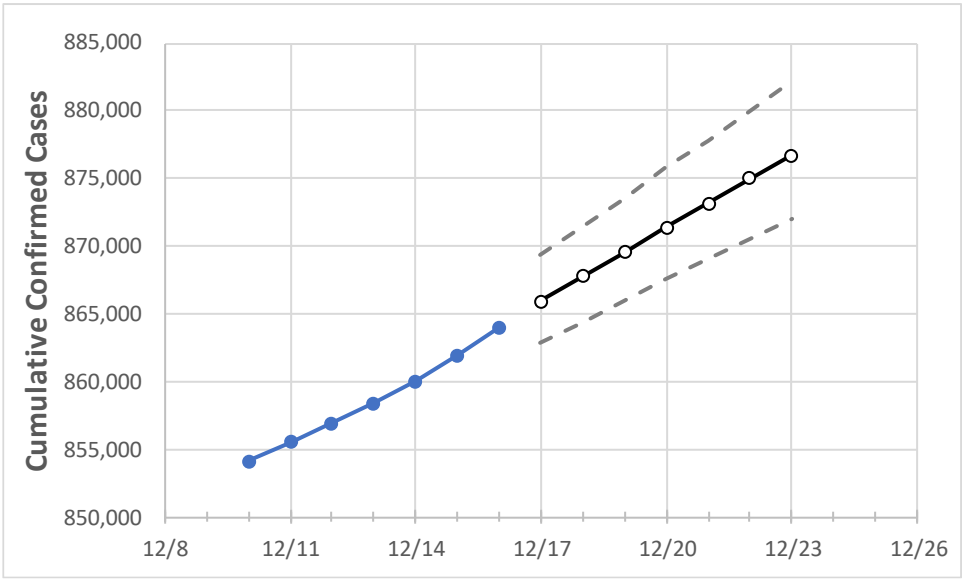
IEM's Modeling Lead

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:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Colorado	858,382	860,004	861,940	864,039	865,943	867,736	869,554	871,376	873,166	874,987	876,742

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:						
	12/13	12/14	12/15	12/16	12/17	12/18	12/19	12/20	12/21	12/22	12/23
Adams	87,343	87,518	87,695	87,878	88,076	88,275	88,468	88,663	88,851	89,048	89,240
Arapahoe	92,324	92,483	92,686	92,921	93,134	93,344	93,546	93,754	93,957	94,159	94,358
Boulder	35,807	35,882	35,943	36,075	36,163	36,249	36,335	36,423	36,510	36,598	36,686
Denver	105,104	105,288	105,492	105,721	105,921	106,125	106,325	106,517	106,716	106,909	107,100
Douglas	47,238	47,331	47,405	47,506	47,603	47,697	47,790	47,886	47,971	48,064	48,153
Eagle	9,429	9,457	9,486	9,530	9,546	9,563	9,578	9,594	9,610	9,627	9,641
El Paso	118,247	118,518	118,806	119,116	119,364	119,613	119,860	120,098	120,335	120,572	120,809
Gunnison	2,062	2,065	2,067	2,069	2,074	2,079	2,084	2,089	2,094	2,099	2,104
Jefferson	75,689	75,824	75,955	76,134	76,309	76,483	76,652	76,823	76,990	77,155	77,318
Larimer	46,752	46,830	46,964	47,094	47,211	47,329	47,443	47,558	47,673	47,792	47,905
Pueblo	30,421	30,460	30,545	30,615	30,675	30,733	30,792	30,847	30,905	30,962	31,019
Weld	54,800	54,903	55,007	55,151	55,288	55,424	55,562	55,697	55,831	55,967	56,105

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:		
	12/13	12/14	12/15	12/16	12/18	12/20	12/22
Adams	87,343	87,518	87,695	87,878	88,275 (17,655) [4,237] {2,119}	88,663 (17,733) [4,256] {2,128}	89,048 (17,810) [4,274] {2,137}
Arapahoe	92,324	92,483	92,686	92,921	93,344 (18,669) [4,481] {2,240}	93,754 (18,751) [4,500] {2,250}	94,159 (18,832) [4,520] {2,260}
Boulder	35,807	35,882	35,943	36,075	36,249 (7,250) [1,740] {870}	36,423 (7,285) [1,748] {874}	36,598 (7,320) [1,757] {878}
Denver	105,104	105,288	105,492	105,721	106,125 (21,225) [5,094] {2,547}	106,517 (21,303) [5,113] {2,556}	106,909 (21,382) [5,132] {2,566}
Douglas	47,238	47,331	47,405	47,506	47,697 (9,539) [2,289] {1,145}	47,886 (9,577) [2,299] {1,149}	48,064 (9,613) [2,307] {1,154}
Eagle	9,429	9,457	9,486	9,530	9,563 (1,913) [459] {230}	9,594 (1,919) [461] {230}	9,627 (1,925) [462] {231}
El Paso	118,247	118,518	118,806	119,116	119,613 (23,923) [5,741] {2,871}	120,098 (24,020) [5,765] {2,882}	120,572 (24,114) [5,787] {2,894}
Gunnison	2,062	2,065	2,067	2,069	2,079 (416) [100] {50}	2,089 (418) [100] {50}	2,099 (420) [101] {50}
Jefferson	75,689	75,824	75,955	76,134	76,483 (15,297) [3,671] {1,836}	76,823 (15,365) [3,687] {1,844}	77,155 (15,431) [3,703] {1,852}
Larimer	46,752	46,830	46,964	47,094	47,329 (9,466) [2,272] {1,136}	47,558 (9,512) [2,283] {1,141}	47,792 (9,558) [2,294] {1,147}
Pueblo	30,421	30,460	30,545	30,615	30,733 (6,147) [1,475] {738}	30,847 (6,169) [1,481] {740}	30,962 (6,192) [1,486] {743}
Weld	54,800	54,903	55,007	55,151	55,424 (11,085) [2,660] {1,330}	55,697 (11,139) [2,673] {1,337}	55,967 (11,193) [2,686] {1,343}

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.