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

Date: 5/10/21

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 5/10/21 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.

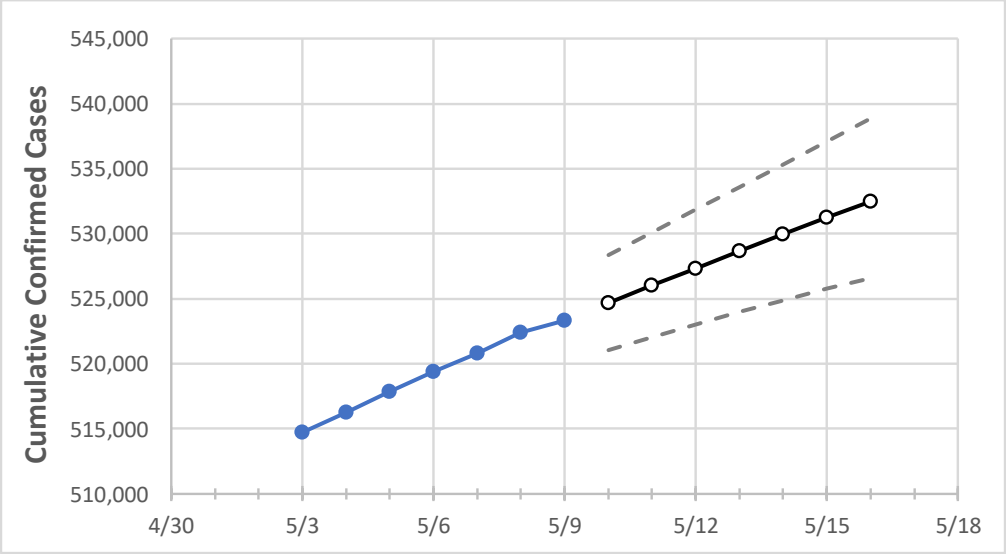
IEM's Modeling Lead

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:						
	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Colorado	519,414	520,816	522,382	523,309	524,646	526,019	527,327	528,655	529,965	531,247	532,469

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:						
	5/6	5/7	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Adams	57,130	57,286	57,492	57,574	57,734	57,893	58,047	58,203	58,359	58,510	58,665
Arapahoe	58,573	58,727	58,925	59,043	59,200	59,352	59,501	59,649	59,793	59,938	60,077
Boulder	23,110	23,147	23,206	23,229	23,264	23,299	23,334	23,368	23,401	23,434	23,465
Denver	71,211	71,357	71,512	71,613	71,742	71,869	71,987	72,107	72,220	72,334	72,443
Douglas	28,313	28,387	28,477	28,523	28,603	28,677	28,752	28,824	28,892	28,962	29,027
Eagle	6,261	6,269	6,269	6,268	6,274	6,281	6,287	6,293	6,298	6,304	6,309
El Paso	65,397	65,666	65,930	66,144	66,409	66,675	66,939	67,206	67,473	67,745	68,014
Gunnison	1,328	1,329	1,331	1,332	1,333	1,334	1,335	1,336	1,337	1,338	1,340
Jefferson	45,887	46,003	46,181	46,262	46,394	46,519	46,643	46,768	46,887	47,002	47,120
Larimer	25,885	25,964	26,030	26,078	26,145	26,211	26,277	26,340	26,402	26,463	26,521
Pueblo	18,331	18,397	18,457	18,498	18,578	18,657	18,736	18,817	18,897	18,976	19,055
Weld	31,037	31,117	31,199	31,272	31,353	31,435	31,512	31,591	31,668	31,744	31,817

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:		
	5/6	5/7	5/8	5/9	5/11	5/13	5/15
Adams	57,130	57,286	57,492	57,574	57,893 (11,579) [2,779] {1,389}	58,203 (11,641) [2,794] {1,397}	58,510 (11,702) [2,808] {1,404}
Arapahoe	58,573	58,727	58,925	59,043	59,352 (11,870) [2,849] {1,424}	59,649 (11,930) [2,863] {1,432}	59,938 (11,988) [2,877] {1,439}
Boulder	23,110	23,147	23,206	23,229	23,299 (4,660) [1,118] {559}	23,368 (4,674) [1,122] {561}	23,434 (4,687) [1,125] {562}
Denver	71,211	71,357	71,512	71,613	71,869 (14,374) [3,450] {1,725}	72,107 (14,421) [3,461] {1,731}	72,334 (14,467) [3,472] {1,736}
Douglas	28,313	28,387	28,477	28,523	28,677 (5,735) [1,377] {688}	28,824 (5,765) [1,384] {692}	28,962 (5,792) [1,390] {695}
Eagle	6,261	6,269	6,269	6,268	6,281 (1,256) [301] {151}	6,293 (1,259) [302] {151}	6,304 (1,261) [303] {151}
El Paso	65,397	65,666	65,930	66,144	66,675 (13,335) [3,200] {1,600}	67,206 (13,441) [3,226] {1,613}	67,745 (13,549) [3,252] {1,626}
Gunnison	1,328	1,329	1,331	1,332	1,334 (267) [64] {32}	1,336 (267) [64] {32}	1,338 (268) [64] {32}
Jefferson	45,887	46,003	46,181	46,262	46,519 (9,304) [2,233] {1,116}	46,768 (9,354) [2,245] {1,122}	47,002 (9,400) [2,256] {1,128}
Larimer	25,885	25,964	26,030	26,078	26,211 (5,242) [1,258] {629}	26,340 (5,268) [1,264] {632}	26,463 (5,293) [1,270] {635}
Pueblo	18,331	18,397	18,457	18,498	18,657 (3,731) [896] {448}	18,817 (3,763) [903] {452}	18,976 (3,795) [911] {455}
Weld	31,037	31,117	31,199	31,272	31,435 (6,287) [1,509] {754}	31,591 (6,318) [1,516] {758}	31,744 (6,349) [1,524] {762}

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.