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

Date: 5/12/21

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 5/12/21 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.

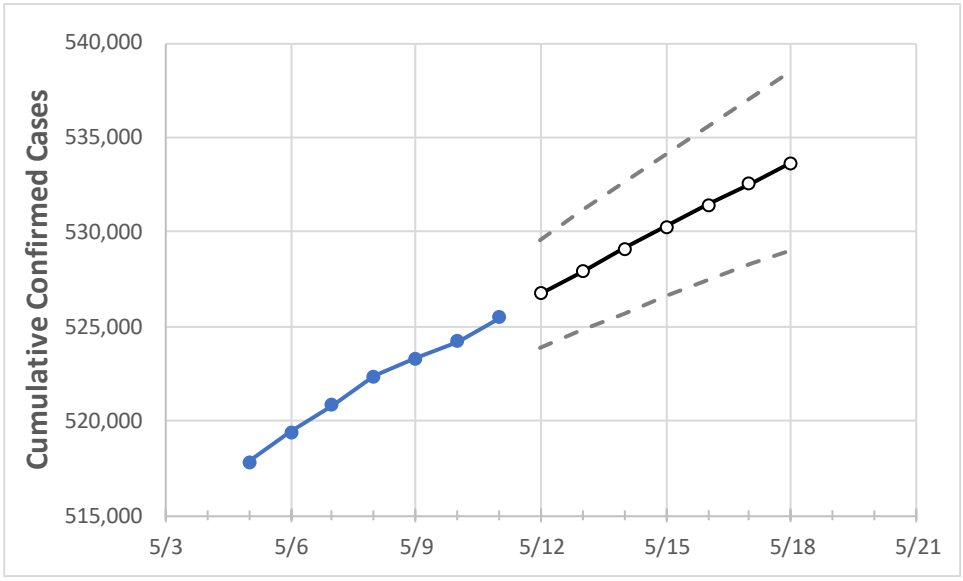
IEM's Modeling Lead

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:						
	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
Colorado	522,382	523,309	524,190	525,474	526,721	527,919	529,120	530,282	531,426	532,552	533,647

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:						
	5/8	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16	5/17	5/18
Adams	57,492	57,574	57,676	57,906	58,065	58,221	58,378	58,533	58,687	58,843	58,998
Arapahoe	58,925	59,043	59,127	59,358	59,506	59,654	59,798	59,941	60,082	60,222	60,359
Boulder	23,206	23,229	23,255	23,275	23,308	23,340	23,369	23,398	23,425	23,453	23,480
Denver	71,512	71,613	71,672	71,793	71,901	72,007	72,106	72,204	72,304	72,397	72,490
Douglas	28,477	28,523	28,581	28,646	28,713	28,776	28,839	28,899	28,960	29,016	29,070
Eagle	6,269	6,268	6,274	6,279	6,285	6,291	6,296	6,302	6,307	6,312	6,317
El Paso	65,930	66,144	66,374	66,538	66,789	67,032	67,271	67,517	67,757	68,004	68,248
Gunnison	1,331	1,332	1,333	1,333	1,334	1,335	1,336	1,337	1,338	1,340	1,341
Jefferson	46,181	46,262	46,336	46,500	46,624	46,741	46,861	46,979	47,099	47,215	47,321
Larimer	26,030	26,078	26,123	26,171	26,231	26,289	26,348	26,404	26,459	26,511	26,565
Pueblo	18,457	18,498	18,534	18,566	18,630	18,696	18,761	18,823	18,885	18,948	19,007
Weld	31,199	31,272	31,336	31,395	31,473	31,549	31,624	31,698	31,769	31,836	31,908

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:		
	5/8	5/9	5/10	5/11	5/13	5/15	5/17
Adams	57,492	57,574	57,676	57,906	58,221 (11,644) [2,795] {1,397}	58,533 (11,707) [2,810] {1,405}	58,843 (11,769) [2,824] {1,412}
Arapahoe	58,925	59,043	59,127	59,358	59,654 (11,931) [2,863] {1,432}	59,941 (11,988) [2,877] {1,439}	60,222 (12,044) [2,891] {1,445}
Boulder	23,206	23,229	23,255	23,275	23,340 (4,668) [1,120] {560}	23,398 (4,680) [1,123] {562}	23,453 (4,691) [1,126] {563}
Denver	71,512	71,613	71,672	71,793	72,007 (14,401) [3,456] {1,728}	72,204 (14,441) [3,466] {1,733}	72,397 (14,479) [3,475] {1,738}
Douglas	28,477	28,523	28,581	28,646	28,776 (5,755) [1,381] {691}	28,899 (5,780) [1,387] {694}	29,016 (5,803) [1,393] {696}
Eagle	6,269	6,268	6,274	6,279	6,291 (1,258) [302] {151}	6,302 (1,260) [302] {151}	6,312 (1,262) [303] {151}
El Paso	65,930	66,144	66,374	66,538	67,032 (13,406) [3,218] {1,609}	67,517 (13,503) [3,241] {1,620}	68,004 (13,601) [3,264] {1,632}
Gunnison	1,331	1,332	1,333	1,333	1,335 (267) [64] {32}	1,337 (267) [64] {32}	1,340 (268) [64] {32}
Jefferson	46,181	46,262	46,336	46,500	46,741 (9,348) [2,244] {1,122}	46,979 (9,396) [2,255] {1,128}	47,215 (9,443) [2,266] {1,133}
Larimer	26,030	26,078	26,123	26,171	26,289 (5,258) [1,262] {631}	26,404 (5,281) [1,267] {634}	26,511 (5,302) [1,273] {636}
Pueblo	18,457	18,498	18,534	18,566	18,696 (3,739) [897] {449}	18,823 (3,765) [904] {452}	18,948 (3,790) [910] {455}
Weld	31,199	31,272	31,336	31,395	31,549 (6,310) [1,514] {757}	31,698 (6,340) [1,521] {761}	31,836 (6,367) [1,528] {764}

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.