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

Date: 3/30/21

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 3/30/21 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.

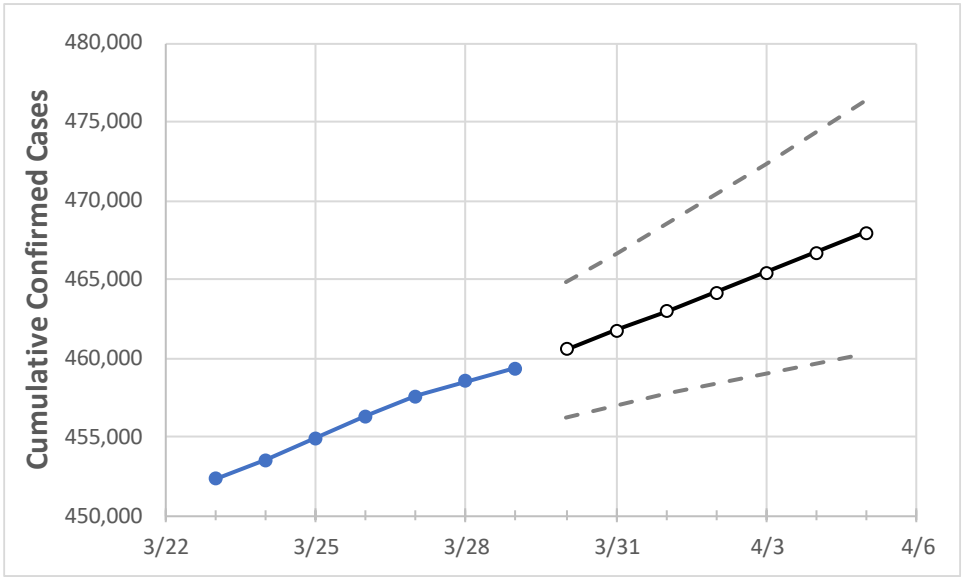
IEM's Modeling Lead

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:						
	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5
Colorado	456,302	457,597	458,554	459,361	460,546	461,747	462,965	464,175	465,419	466,692	467,986

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:						
	3/26	3/27	3/28	3/29	3/30	3/31	4/1	4/2	4/3	4/4	4/5
Adams	50,948	51,051	51,126	51,185	51,273	51,360	51,447	51,535	51,621	51,707	51,797
Arapahoe	51,352	51,482	51,603	51,685	51,797	51,910	52,023	52,139	52,254	52,367	52,486
Boulder	20,227	20,293	20,351	20,430	20,489	20,549	20,612	20,670	20,733	20,800	20,865
Denver	63,463	63,651	63,786	63,851	64,012	64,179	64,349	64,524	64,700	64,884	65,069
Douglas	23,362	23,467	23,527	23,575	23,656	23,739	23,822	23,907	23,994	24,081	24,170
Eagle	5,645	5,663	5,687	5,694	5,714	5,735	5,755	5,775	5,795	5,815	5,834
El Paso	55,757	55,931	56,086	56,201	56,369	56,540	56,710	56,879	57,053	57,236	57,409
Gunnison	1,232	1,238	1,240	1,241	1,242	1,243	1,245	1,246	1,247	1,248	1,250
Jefferson	39,925	40,037	40,108	40,162	40,263	40,367	40,472	40,573	40,678	40,784	40,891
Larimer	21,842	21,939	22,016	22,109	22,206	22,306	22,413	22,523	22,639	22,754	22,869
Pueblo	15,614	15,651	15,691	15,748	15,789	15,832	15,878	15,925	15,975	16,028	16,084
Weld	27,141	27,215	27,274	27,337	27,397	27,455	27,517	27,579	27,636	27,698	27,757

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:		
	3/26	3/27	3/28	3/29	3/31	4/2	4/4
Adams	50,948	51,051	51,126	51,185	51,360 (10,272) [2,465] {1,233}	51,535 (10,307) [2,474] {1,237}	51,707 (10,341) [2,482] {1,241}
Arapahoe	51,352	51,482	51,603	51,685	51,910 (10,382) [2,492] {1,246}	52,139 (10,428) [2,503] {1,251}	52,367 (10,473) [2,514] {1,257}
Boulder	20,227	20,293	20,351	20,430	20,549 (4,110) [986] {493}	20,670 (4,134) [992] {496}	20,800 (4,160) [998] {499}
Denver	63,463	63,651	63,786	63,851	64,179 (12,836) [3,081] {1,540}	64,524 (12,905) [3,097] {1,549}	64,884 (12,977) [3,114] {1,557}
Douglas	23,362	23,467	23,527	23,575	23,739 (4,748) [1,139] {570}	23,907 (4,781) [1,148] {574}	24,081 (4,816) [1,156] {578}
Eagle	5,645	5,663	5,687	5,694	5,735 (1,147) [275] {138}	5,775 (1,155) [277] {139}	5,815 (1,163) [279] {140}
El Paso	55,757	55,931	56,086	56,201	56,540 (11,308) [2,714] {1,357}	56,879 (11,376) [2,730] {1,365}	57,236 (11,447) [2,747] {1,374}
Gunnison	1,232	1,238	1,240	1,241	1,243 (249) [60] {30}	1,246 (249) [60] {30}	1,248 (250) [60] {30}
Jefferson	39,925	40,037	40,108	40,162	40,367 (8,073) [1,938] {969}	40,573 (8,115) [1,947] {974}	40,784 (8,157) [1,958] {979}
Larimer	21,842	21,939	22,016	22,109	22,306 (4,461) [1,071] {535}	22,523 (4,505) [1,081] {541}	22,754 (4,551) [1,092] {546}
Pueblo	15,614	15,651	15,691	15,748	15,832 (3,166) [760] {380}	15,925 (3,185) [764] {382}	16,028 (3,206) [769] {385}
Weld	27,141	27,215	27,274	27,337	27,455 (5,491) [1,318] {659}	27,579 (5,516) [1,324] {662}	27,698 (5,540) [1,330] {665}

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.