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

Date: 1/11/21

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 1/11/21 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.

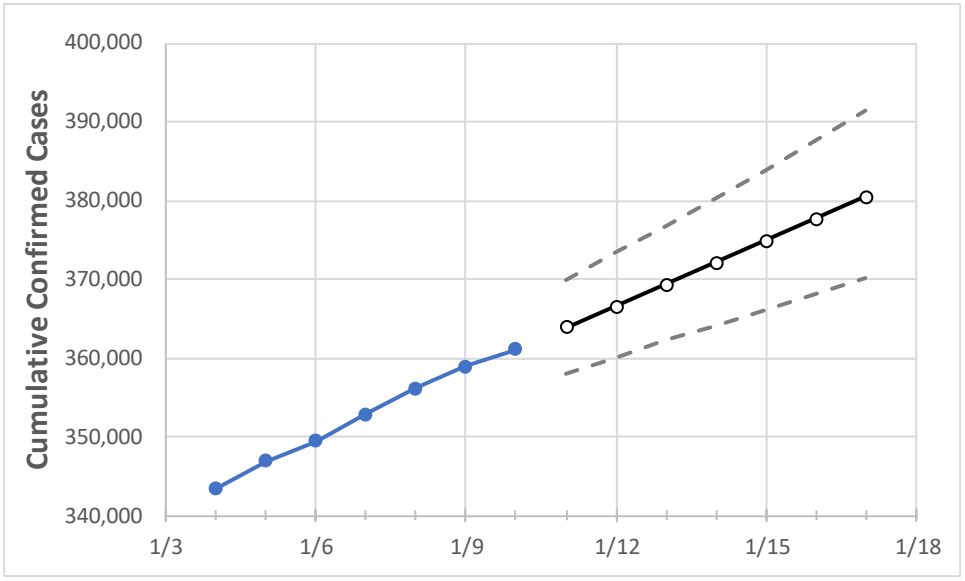
IEM's Modeling Lead

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:						
	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17
Colorado	352,923	356,110	358,947	361,148	363,821	366,524	369,310	372,074	374,852	377,684	380,503

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:						
	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17
Adams	41,979	42,174	42,490	42,730	43,017	43,303	43,587	43,879	44,171	44,459	44,748
Arapahoe	40,172	40,502	40,831	41,092	41,402	41,715	42,031	42,345	42,676	42,990	43,317
Boulder	15,443	15,516	15,644	15,741	15,857	15,974	16,091	16,213	16,334	16,458	16,581
Denver	50,556	50,957	51,286	51,608	52,013	52,421	52,822	53,242	53,671	54,106	54,551
Douglas	16,600	16,779	16,905	17,047	17,189	17,333	17,478	17,629	17,779	17,930	18,081
Eagle	3,579	3,635	3,665	3,692	3,727	3,762	3,800	3,836	3,873	3,910	3,952
El Paso	43,156	43,540	43,957	44,205	44,489	44,772	45,050	45,338	45,620	45,902	46,172
Gunnison	742	752	771	787	797	807	818	828	840	852	864
Jefferson	31,096	31,305	31,516	31,685	31,891	32,099	32,310	32,520	32,732	32,940	33,151
Larimer	15,884	16,029	16,146	16,204	16,314	16,425	16,536	16,648	16,764	16,878	16,993
Pueblo	13,634	13,679	13,763	13,802	13,844	13,882	13,916	13,951	13,984	14,018	14,050
Weld	21,170	21,360	21,471	21,620	21,798	21,979	22,159	22,343	22,525	22,713	22,899

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:		
	1/7	1/8	1/9	1/10	1/12	1/14	1/16
Adams	41,979	42,174	42,490	42,730	43,303 (8,661) [2,079] {1,039}	43,879 (8,776) [2,106] {1,053}	44,459 (8,892) [2,134] {1,067}
Arapahoe	40,172	40,502	40,831	41,092	41,715 (8,343) [2,002] {1,001}	42,345 (8,469) [2,033] {1,016}	42,990 (8,598) [2,064] {1,032}
Boulder	15,443	15,516	15,644	15,741	15,974 (3,195) [767] {383}	16,213 (3,243) [778] {389}	16,458 (3,292) [790] {395}
Denver	50,556	50,957	51,286	51,608	52,421 (10,484) [2,516] {1,258}	53,242 (10,648) [2,556] {1,278}	54,106 (10,821) [2,597] {1,299}
Douglas	16,600	16,779	16,905	17,047	17,333 (3,467) [832] {416}	17,629 (3,526) [846] {423}	17,930 (3,586) [861] {430}
Eagle	3,579	3,635	3,665	3,692	3,762 (752) [181] {90}	3,836 (767) [184] {92}	3,910 (782) [188] {94}
El Paso	43,156	43,540	43,957	44,205	44,772 (8,954) [2,149] {1,075}	45,338 (9,068) [2,176] {1,088}	45,902 (9,180) [2,203] {1,102}
Gunnison	742	752	771	787	807 (161) [39] {19}	828 (166) [40] {20}	852 (170) [41] {20}
Jefferson	31,096	31,305	31,516	31,685	32,099 (6,420) [1,541] {770}	32,520 (6,504) [1,561] {780}	32,940 (6,588) [1,581] {791}
Larimer	15,884	16,029	16,146	16,204	16,425 (3,285) [788] {394}	16,648 (3,330) [799] {400}	16,878 (3,376) [810] {405}
Pueblo	13,634	13,679	13,763	13,802	13,882 (2,776) [666] {333}	13,951 (2,790) [670] {335}	14,018 (2,804) [673] {336}
Weld	21,170	21,360	21,471	21,620	21,979 (4,396) [1,055] {527}	22,343 (4,469) [1,072] {536}	22,713 (4,543) [1,090] {545}

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.