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

Date: 11/24/20

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 11/24/20 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.

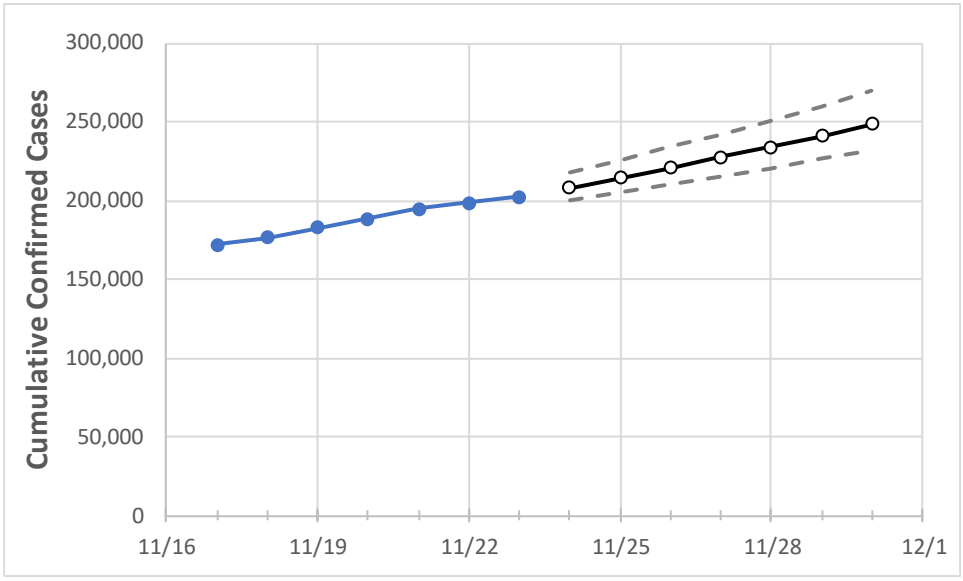
IEM's Modeling Lead

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:						
	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30
Colorado	188,566	194,679	198,600	202,289	208,290	214,472	220,839	227,398	234,153	241,110	248,273

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 20%, and are often within 10%, of actual confirmed cases.

Colorado Counties

	Actual Confirmed Cases On:				Projected Cases For:						
	11/20	11/21	11/22	11/23	11/24	11/25	11/26	11/27	11/28	11/29	11/30
Adams	25,092	25,696	26,129	26,474	27,093	27,723	28,366	29,020	29,686	30,364	31,055
Arapahoe	22,728	23,394	23,795	24,172	24,842	25,533	26,245	26,979	27,735	28,514	29,316
Boulder	9,503	9,731	9,847	10,011	10,262	10,519	10,784	11,056	11,335	11,622	11,917
Denver	31,073	32,087	32,533	33,019	33,790	34,579	35,388	36,217	37,067	37,937	38,828
Douglas	8,457	8,750	9,007	9,244	9,580	9,931	10,295	10,673	11,068	11,477	11,903
Eagle	2,012	2,028	2,051	2,066	2,091	2,117	2,143	2,168	2,195	2,221	2,248
El Paso	21,308	22,039	22,560	23,030	23,767	24,530	25,318	26,132	26,974	27,843	28,741
Gunnison	429	438	439	446	449	452	456	459	463	466	470
Jefferson	16,811	17,333	17,684	18,001	18,503	19,015	19,536	20,069	20,612	21,166	21,731
Larimer	8,174	8,451	8,651	8,786	9,083	9,391	9,711	10,043	10,388	10,747	11,118
Pueblo	6,110	6,450	6,738	7,028	7,435	7,868	8,328	8,816	9,335	9,885	10,468
Weld	11,368	11,761	12,018	12,229	12,605	12,995	13,399	13,818	14,252	14,703	15,169

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:		
	11/20	11/21	11/22	11/23	11/25	11/27	11/29
Adams	25,092	25,696	26,129	26,474	27,723 (5,545) [1,331] {665}	29,020 (5,804) [1,393] {696}	30,364 (6,073) [1,457] {729}
Arapahoe	22,728	23,394	23,795	24,172	25,533 (5,107) [1,226] {613}	26,979 (5,396) [1,295] {647}	28,514 (5,703) [1,369] {684}
Boulder	9,503	9,731	9,847	10,011	10,519 (2,104) [505] {252}	11,056 (2,211) [531] {265}	11,622 (2,324) [558] {279}
Denver	31,073	32,087	32,533	33,019	34,579 (6,916) [1,660] {830}	36,217 (7,243) [1,738] {869}	37,937 (7,587) [1,821] {910}
Douglas	8,457	8,750	9,007	9,244	9,931 (1,986) [477] {238}	10,673 (2,135) [512] {256}	11,477 (2,295) [551] {275}
Eagle	2,012	2,028	2,051	2,066	2,117 (423) [102] {51}	2,168 (434) [104] {52}	2,221 (444) [107] {53}
El Paso	21,308	22,039	22,560	23,030	24,530 (4,906) [1,177] {589}	26,132 (5,226) [1,254] {627}	27,843 (5,569) [1,336] {668}
Gunnison	429	438	439	446	452 (90) [22] {11}	459 (92) [22] {11}	466 (93) [22] {11}
Jefferson	16,811	17,333	17,684	18,001	19,015 (3,803) [913] {456}	20,069 (4,014) [963] {482}	21,166 (4,233) [1,016] {508}
Larimer	8,174	8,451	8,651	8,786	9,391 (1,878) [451] {225}	10,043 (2,009) [482] {241}	10,747 (2,149) [516] {258}
Pueblo	6,110	6,450	6,738	7,028	7,868 (1,574) [378] {189}	8,816 (1,763) [423] {212}	9,885 (1,977) [474] {237}
Weld	11,368	11,761	12,018	12,229	12,995 (2,599) [624] {312}	13,818 (2,764) [663] {332}	14,703 (2,941) [706] {353}

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.