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

Date: 12/22/20

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 12/22/20 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.

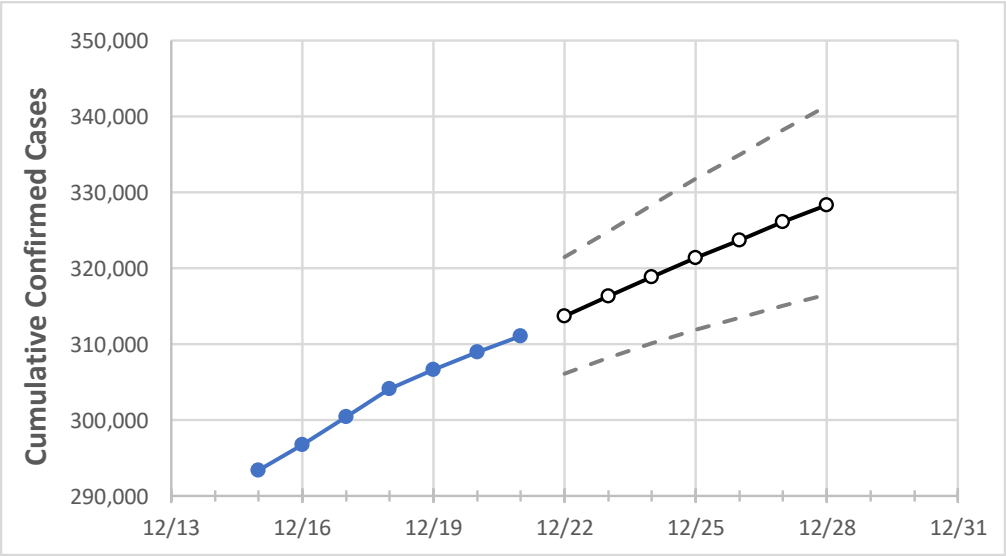
IEM's Modeling Lead

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:						
	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28
Colorado	304,107	306,598	308,890	311,036	313,720	316,329	318,867	321,335	323,735	326,069	328,339

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:						
	12/18	12/19	12/20	12/21	12/22	12/23	12/24	12/25	12/26	12/27	12/28
Adams	36,782	36,997	37,203	37,499	37,763	38,019	38,268	38,511	38,746	38,975	39,198
Arapahoe	34,651	34,934	35,187	35,449	35,736	36,016	36,288	36,554	36,813	37,066	37,312
Boulder	13,508	13,568	13,643	13,730	13,811	13,889	13,965	14,038	14,109	14,178	14,244
Denver	44,197	44,489	44,748	44,975	45,237	45,491	45,738	45,978	46,210	46,435	46,654
Douglas	14,180	14,271	14,381	14,489	14,598	14,703	14,804	14,900	14,993	15,081	15,166
Eagle	3,030	3,070	3,082	3,097	3,128	3,159	3,189	3,219	3,249	3,278	3,307
El Paso	37,225	37,552	37,815	38,073	38,403	38,720	39,026	39,322	39,606	39,881	40,145
Gunnison	583	599	602	604	611	618	626	634	641	649	658
Jefferson	27,074	27,254	27,481	27,673	27,874	28,068	28,255	28,435	28,608	28,775	28,936
Larimer	13,782	13,922	14,031	14,099	14,219	14,335	14,447	14,555	14,659	14,760	14,858
Pueblo	12,150	12,236	12,320	12,407	12,512	12,613	12,709	12,800	12,888	12,971	13,051
Weld	18,088	18,259	18,390	18,497	18,636	18,770	18,900	19,025	19,146	19,263	19,375

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:		
	12/18	12/19	12/20	12/21	12/23	12/25	12/27
Adams	36,782	36,997	37,203	37,499	38,019 (7,604) [1,825] {912}	38,511 (7,702) [1,849] {924}	38,975 (7,795) [1,871] {935}
Arapahoe	34,651	34,934	35,187	35,449	36,016 (7,203) [1,729] {864}	36,554 (7,311) [1,755] {877}	37,066 (7,413) [1,779] {890}
Boulder	13,508	13,568	13,643	13,730	13,889 (2,778) [667] {333}	14,038 (2,808) [674] {337}	14,178 (2,836) [681] {340}
Denver	44,197	44,489	44,748	44,975	45,491 (9,098) [2,184] {1,092}	45,978 (9,196) [2,207] {1,103}	46,435 (9,287) [2,229] {1,114}
Douglas	14,180	14,271	14,381	14,489	14,703 (2,941) [706] {353}	14,900 (2,980) [715] {358}	15,081 (3,016) [724] {362}
Eagle	3,030	3,070	3,082	3,097	3,159 (632) [152] {76}	3,219 (644) [155] {77}	3,278 (656) [157] {79}
El Paso	37,225	37,552	37,815	38,073	38,720 (7,744) [1,859] {929}	39,322 (7,864) [1,887] {944}	39,881 (7,976) [1,914] {957}
Gunnison	583	599	602	604	618 (124) [30] {15}	634 (127) [30] {15}	649 (130) [31] {16}
Jefferson	27,074	27,254	27,481	27,673	28,068 (5,614) [1,347] {674}	28,435 (5,687) [1,365] {682}	28,775 (5,755) [1,381] {691}
Larimer	13,782	13,922	14,031	14,099	14,335 (2,867) [688] {344}	14,555 (2,911) [699] {349}	14,760 (2,952) [709] {354}
Pueblo	12,150	12,236	12,320	12,407	12,613 (2,523) [605] {303}	12,800 (2,560) [614] {307}	12,971 (2,594) [623] {311}
Weld	18,088	18,259	18,390	18,497	18,770 (3,754) [901] {450}	19,025 (3,805) [913] {457}	19,263 (3,853) [925] {462}

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.