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

Date: 12/9/20

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 12/9/20 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.

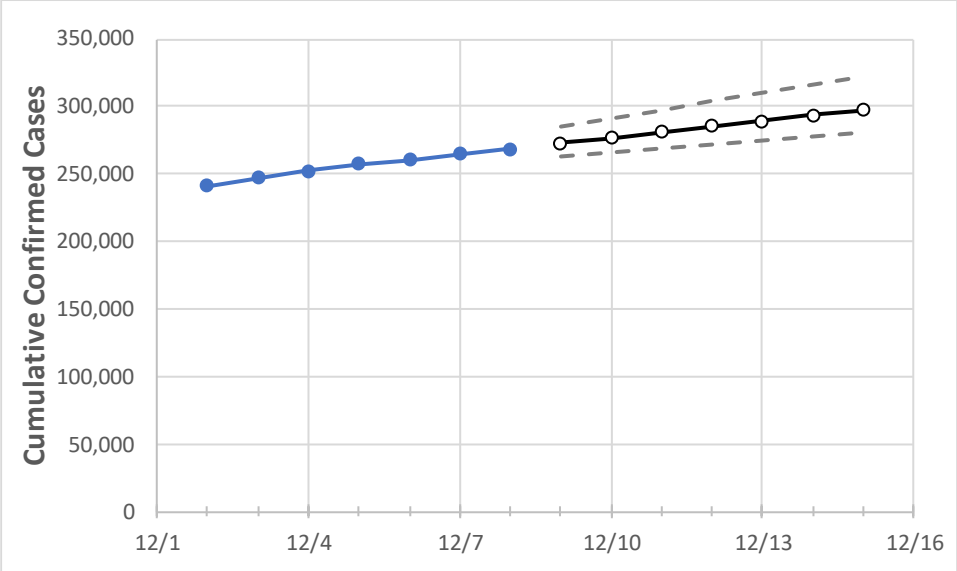
IEM's Modeling Lead

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:						
	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15
Colorado	257,347	260,581	264,618	268,589	272,802	276,998	281,176	285,336	289,477	293,600	297,704

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:						
	12/5	12/6	12/7	12/8	12/9	12/10	12/11	12/12	12/13	12/14	12/15
Adams	32,044	32,334	32,758	33,275	33,697	34,116	34,534	34,949	35,362	35,773	36,182
Arapahoe	29,769	30,170	30,569	30,989	31,438	31,886	32,334	32,781	33,228	33,674	34,120
Boulder	11,949	12,043	12,163	12,365	12,510	12,655	12,798	12,940	13,082	13,222	13,361
Denver	39,327	39,770	40,176	40,458	40,830	41,192	41,545	41,889	42,224	42,551	42,869
Douglas	11,970	12,167	12,349	12,542	12,743	12,943	13,141	13,337	13,532	13,726	13,919
Eagle	2,536	2,572	2,601	2,652	2,684	2,716	2,748	2,780	2,813	2,846	2,879
El Paso	30,761	31,181	31,738	32,288	32,912	33,538	34,165	34,793	35,423	36,055	36,689
Gunnison	495	502	508	512	516	520	525	529	534	539	544
Jefferson	22,830	23,132	23,842	24,203	24,608	25,015	25,423	25,831	26,241	26,652	27,063
Larimer	11,519	11,664	11,825	12,053	12,249	12,444	12,638	12,832	13,025	13,217	13,409
Pueblo	9,749	9,884	10,126	10,360	10,575	10,790	11,003	11,216	11,429	11,640	11,851
Weld	15,486	15,679	15,877	16,199	16,444	16,687	16,930	17,171	17,411	17,650	17,888

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:		
	12/5	12/6	12/7	12/8	12/10	12/12	12/14
Adams	32,044	32,334	32,758	33,275	34,116 (6,823) [1,638] {819}	34,949 (6,990) [1,678] {839}	35,773 (7,155) [1,717] {859}
Arapahoe	29,769	30,170	30,569	30,989	31,886 (6,377) [1,531] {765}	32,781 (6,556) [1,573] {787}	33,674 (6,735) [1,616] {808}
Boulder	11,949	12,043	12,163	12,365	12,655 (2,531) [607] {304}	12,940 (2,588) [621] {311}	13,222 (2,644) [635] {317}
Denver	39,327	39,770	40,176	40,458	41,192 (8,238) [1,977] {989}	41,889 (8,378) [2,011] {1,005}	42,551 (8,510) [2,042] {1,021}
Douglas	11,970	12,167	12,349	12,542	12,943 (2,589) [621] {311}	13,337 (2,667) [640] {320}	13,726 (2,745) [659] {329}
Eagle	2,536	2,572	2,601	2,652	2,716 (543) [130] {65}	2,780 (556) [133] {67}	2,846 (569) [137] {68}
El Paso	30,761	31,181	31,738	32,288	33,538 (6,708) [1,610] {805}	34,793 (6,959) [1,670] {835}	36,055 (7,211) [1,731] {865}
Gunnison	495	502	508	512	520 (104) [25] {12}	529 (106) [25] {13}	539 (108) [26] {13}
Jefferson	22,830	23,132	23,842	24,203	25,015 (5,003) [1,201] {600}	25,831 (5,166) [1,240] {620}	26,652 (5,330) [1,279] {640}
Larimer	11,519	11,664	11,825	12,053	12,444 (2,489) [597] {299}	12,832 (2,566) [616] {308}	13,217 (2,643) [634] {317}
Pueblo	9,749	9,884	10,126	10,360	10,790 (2,158) [518] {259}	11,216 (2,243) [538] {269}	11,640 (2,328) [559] {279}
Weld	15,486	15,679	15,877	16,199	16,687 (3,337) [801] {400}	17,171 (3,434) [824] {412}	17,650 (3,530) [847] {424}

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.