IEM's AI Modeling: Short-term COVID-19 Projections
Date: 1/6/21

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 <u>not</u> 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 1/6/21 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
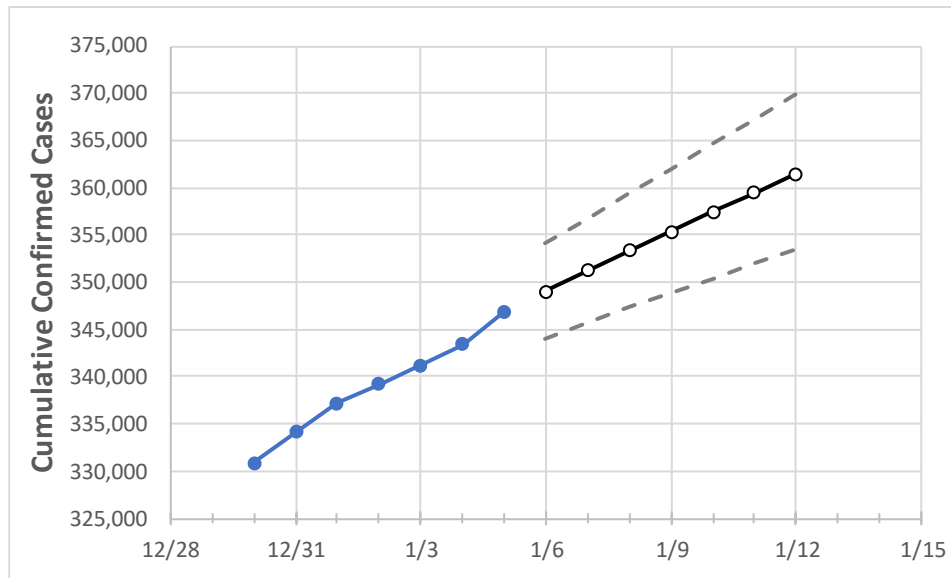
	Actual Confirmed Cases On:				Projected Cases For:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Colorado	339,172	341,250	343,435	346,893	349,051	351,186	353,317	355,389	357,438	359,457	361,471

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:						
	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12
Adams	40,499	40,737	41,046	41,312	41,547	41,780	42,014	42,245	42,476	42,698	42,923
Arapahoe	38,557	38,799	39,024	39,439	39,672	39,904	40,133	40,362	40,585	40,804	41,022
Boulder	14,796	14,889	15,011	15,243	15,353	15,466	15,579	15,696	15,814	15,932	16,052
Denver	48,246	48,433	48,605	49,648	49,911	50,176	50,438	50,697	50,948	51,205	51,457
Douglas	15,887	15,970	16,092	16,275	16,374	16,472	16,569	16,663	16,758	16,852	16,944
Eagle	3,404	3,426	3,450	3,512	3,536	3,559	3,583	3,606	3,630	3,652	3,674
El Paso	41,838	42,029	42,325	42,508	42,715	42,927	43,134	43,333	43,530	43,715	43,894
Gunnison	720	725	727	733	740	747	755	762	769	777	784
Jefferson	29,915	30,122	30,268	30,649	30,814	30,985	31,153	31,313	31,468	31,625	31,776
Larimer	15,312	15,366	15,451	15,547	15,622	15,693	15,763	15,831	15,897	15,961	16,024
Pueblo	13,375	13,425	13,523	13,541	13,586	13,632	13,673	13,713	13,748	13,781	13,815
Weld	20,222	20,348	20,483	20,637	20,767	20,897	21,021	21,147	21,273	21,392	21,511

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:		
	1/2	1/3	1/4	1/5	1/7	1/9	1/11
Adams	40,499	40,737	41,046	41,312	41,780 (8,356) [2,005] {1,003}	42,245 (8,449) [2,028] {1,014}	42,698 (8,540) [2,049] {1,025}
Arapahoe	38,557	38,799	39,024	39,439	39,904 (7,981) [1,915] {958}	40,362 (8,072) [1,937] {969}	40,804 (8,161) [1,959] {979}
Boulder	14,796	14,889	15,011	15,243	15,466 (3,093) [742] {371}	15,696 (3,139) [753] {377}	15,932 (3,186) [765] {382}
Denver	48,246	48,433	48,605	49,648	50,176 (10,035) [2,408] {1,204}	50,697 (10,139) [2,433] {1,217}	51,205 (10,241) [2,458] {1,229}
Douglas	15,887	15,970	16,092	16,275	16,472 (3,294) [791] {395}	16,663 (3,333) [800] {400}	16,852 (3,370) [809] {404}
Eagle	3,404	3,426	3,450	3,512	3,559 (712) [171] {85}	3,606 (721) [173] {87}	3,652 (730) [175] {88}
El Paso	41,838	42,029	42,325	42,508	42,927 (8,585) [2,061] {1,030}	43,333 (8,667) [2,080] {1,040}	43,715 (8,743) [2,098] {1,049}
Gunnison	720	725	727	733	747 (149) [36] {18}	762 (152) [37] {18}	777 (155) [37] {19}
Jefferson	29,915	30,122	30,268	30,649	30,985 (6,197) [1,487] {744}	31,313 (6,263) [1,503] {752}	31,625 (6,325) [1,518] {759}
Larimer	15,312	15,366	15,451	15,547	15,693 (3,139) [753] {377}	15,831 (3,166) [760] {380}	15,961 (3,192) [766] {383}
Pueblo	13,375	13,425	13,523	13,541	13,632 (2,726) [654] {327}	13,713 (2,743) [658] {329}	13,781 (2,756) [662] {331}
Weld	20,222	20,348	20,483	20,637	20,897 (4,179) [1,003] {502}	21,147 (4,229) [1,015] {508}	21,392 (4,278) [1,027] {513}

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.