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

Date: 1/8/21

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 1/8/21 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.

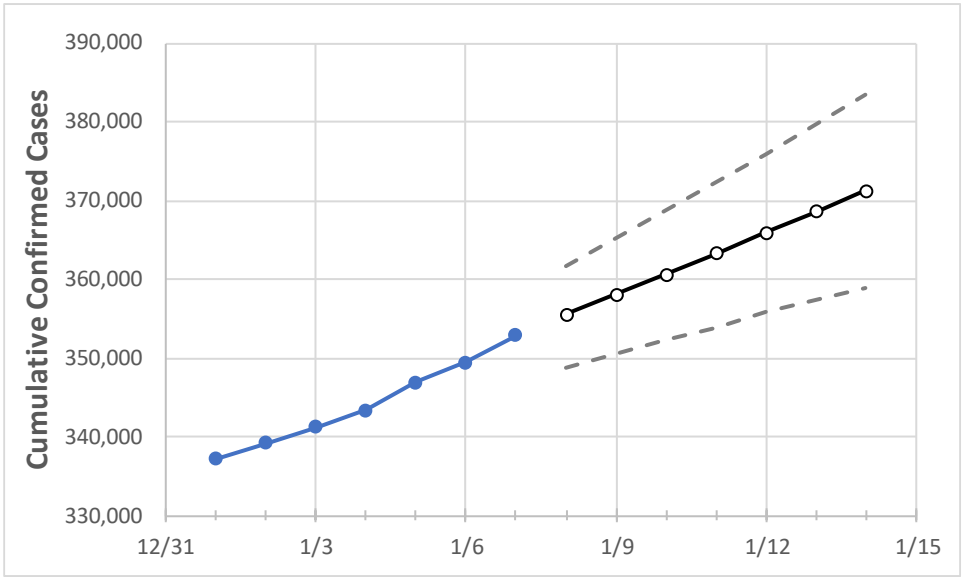
IEM's Modeling Lead

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:						
	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14
Colorado	343,435	346,893	349,450	352,923	355,469	358,076	360,639	363,249	365,885	368,556	371,170

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:						
	1/4	1/5	1/6	1/7	1/8	1/9	1/10	1/11	1/12	1/13	1/14
Adams	41,046	41,312	41,653	41,979	42,274	42,573	42,873	43,177	43,482	43,791	44,104
Arapahoe	39,024	39,439	39,738	40,172	40,473	40,770	41,076	41,381	41,691	42,002	42,311
Boulder	15,011	15,243	15,307	15,443	15,559	15,677	15,796	15,920	16,042	16,167	16,296
Denver	48,605	49,648	49,899	50,556	50,990	51,420	51,875	52,329	52,808	53,287	53,799
Douglas	16,092	16,275	16,373	16,600	16,734	16,866	17,001	17,135	17,272	17,410	17,549
Eagle	3,450	3,512	3,556	3,579	3,610	3,640	3,672	3,703	3,735	3,769	3,802
El Paso	42,325	42,508	42,806	43,156	43,389	43,611	43,837	44,064	44,285	44,489	44,701
Gunnison	727	733	736	742	747	752	758	763	768	773	778
Jefferson	30,268	30,649	30,840	31,096	31,308	31,523	31,736	31,950	32,168	32,390	32,612
Larimer	15,451	15,547	15,740	15,884	15,996	16,107	16,220	16,334	16,447	16,559	16,675
Pueblo	13,523	13,541	13,569	13,634	13,674	13,711	13,748	13,781	13,812	13,843	13,873
Weld	20,483	20,637	21,010	21,170	21,352	21,541	21,733	21,924	22,120	22,318	22,520

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:		
	1/4	1/5	1/6	1/7	1/9	1/11	1/13
Adams	41,046	41,312	41,653	41,979	42,573 (8,515) [2,044] {1,022}	43,177 (8,635) [2,073] {1,036}	43,791 (8,758) [2,102] {1,051}
Arapahoe	39,024	39,439	39,738	40,172	40,770 (8,154) [1,957] {978}	41,381 (8,276) [1,986] {993}	42,002 (8,400) [2,016] {1,008}
Boulder	15,011	15,243	15,307	15,443	15,677 (3,135) [752] {376}	15,920 (3,184) [764] {382}	16,167 (3,233) [776] {388}
Denver	48,605	49,648	49,899	50,556	51,420 (10,284) [2,468] {1,234}	52,329 (10,466) [2,512] {1,256}	53,287 (10,657) [2,558] {1,279}
Douglas	16,092	16,275	16,373	16,600	16,866 (3,373) [810] {405}	17,135 (3,427) [822] {411}	17,410 (3,482) [836] {418}
Eagle	3,450	3,512	3,556	3,579	3,640 (728) [175] {87}	3,703 (741) [178] {89}	3,769 (754) [181] {90}
El Paso	42,325	42,508	42,806	43,156	43,611 (8,722) [2,093] {1,047}	44,064 (8,813) [2,115] {1,058}	44,489 (8,898) [2,135] {1,068}
Gunnison	727	733	736	742	752 (150) [36] {18}	763 (153) [37] {18}	773 (155) [37] {19}
Jefferson	30,268	30,649	30,840	31,096	31,523 (6,305) [1,513] {757}	31,950 (6,390) [1,534] {767}	32,390 (6,478) [1,555] {777}
Larimer	15,451	15,547	15,740	15,884	16,107 (3,221) [773] {387}	16,334 (3,267) [784] {392}	16,559 (3,312) [795] {397}
Pueblo	13,523	13,541	13,569	13,634	13,711 (2,742) [658] {329}	13,781 (2,756) [661] {331}	13,843 (2,769) [664] {332}
Weld	20,483	20,637	21,010	21,170	21,541 (4,308) [1,034] {517}	21,924 (4,385) [1,052] {526}	22,318 (4,464) [1,071] {536}

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.