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

Date: 1/4/21

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 1/4/21 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.

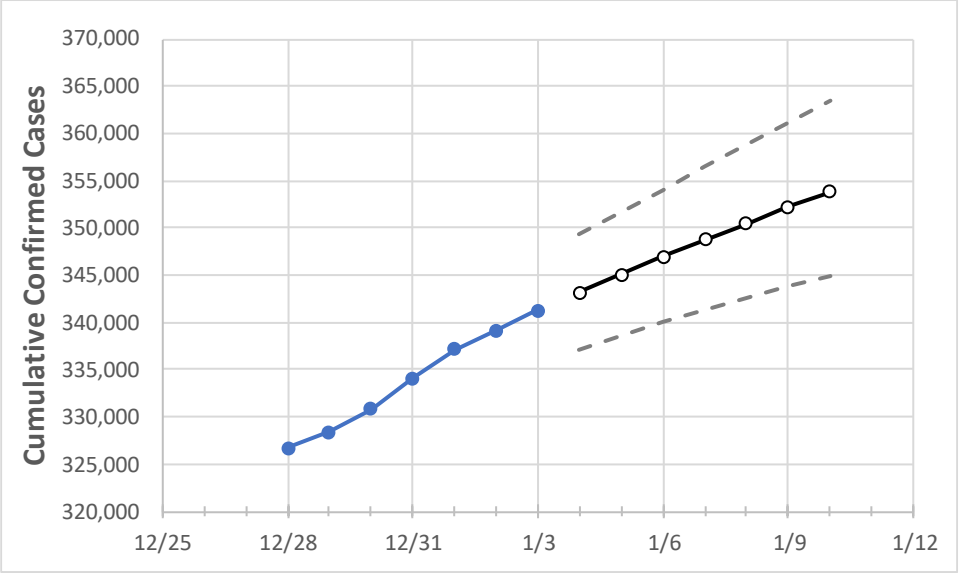
IEM's Modeling Lead

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:						
	12/31	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10
Colorado	334,097	337,161	339,172	341,250	343,187	345,088	346,949	348,771	350,500	352,231	353,880

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:						
	12/31	1/1	1/2	1/3	1/4	1/5	1/6	1/7	1/8	1/9	1/10
Adams	39,917	40,304	40,499	40,737	40,956	41,180	41,398	41,616	41,827	42,045	42,258
Arapahoe	37,961	38,334	38,557	38,799	39,006	39,211	39,414	39,620	39,816	40,008	40,204
Boulder	14,624	14,729	14,796	14,889	14,968	15,046	15,124	15,201	15,275	15,346	15,417
Denver	47,645	48,023	48,246	48,433	48,660	48,880	49,105	49,326	49,542	49,758	49,969
Douglas	15,646	15,783	15,887	15,970	16,063	16,152	16,245	16,332	16,418	16,504	16,586
Eagle	3,374	3,392	3,404	3,426	3,446	3,465	3,483	3,501	3,518	3,535	3,552
El Paso	41,222	41,556	41,838	42,029	42,238	42,444	42,646	42,844	43,022	43,203	43,377
Gunnison	696	714	720	725	733	741	750	759	767	776	784
Jefferson	29,565	29,776	29,915	30,122	30,281	30,440	30,594	30,748	30,894	31,037	31,181
Larimer	15,099	15,232	15,312	15,366	15,439	15,508	15,578	15,645	15,711	15,776	15,836
Pueblo	13,218	13,328	13,375	13,425	13,472	13,517	13,559	13,599	13,637	13,671	13,704
Weld	19,925	20,100	20,222	20,348	20,467	20,584	20,698	20,812	20,926	21,036	21,146

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:		
	12/31	1/1	1/2	1/3	1/5	1/7	1/9
Adams	39,917	40,304	40,499	40,737	41,180 (8,236) [1,977] {988}	41,616 (8,323) [1,998] {999}	42,045 (8,409) [2,018] {1,009}
Arapahoe	37,961	38,334	38,557	38,799	39,211 (7,842) [1,882] {941}	39,620 (7,924) [1,902] {951}	40,008 (8,002) [1,920] {960}
Boulder	14,624	14,729	14,796	14,889	15,046 (3,009) [722] {361}	15,201 (3,040) [730] {365}	15,346 (3,069) [737] {368}
Denver	47,645	48,023	48,246	48,433	48,880 (9,776) [2,346] {1,173}	49,326 (9,865) [2,368] {1,184}	49,758 (9,952) [2,388] {1,194}
Douglas	15,646	15,783	15,887	15,970	16,152 (3,230) [775] {388}	16,332 (3,266) [784] {392}	16,504 (3,301) [792] {396}
Eagle	3,374	3,392	3,404	3,426	3,465 (693) [166] {83}	3,501 (700) [168] {84}	3,535 (707) [170] {85}
El Paso	41,222	41,556	41,838	42,029	42,444 (8,489) [2,037] {1,019}	42,844 (8,569) [2,057] {1,028}	43,203 (8,641) [2,074] {1,037}
Gunnison	696	714	720	725	741 (148) [36] {18}	759 (152) [36] {18}	776 (155) [37] {19}
Jefferson	29,565	29,776	29,915	30,122	30,440 (6,088) [1,461] {731}	30,748 (6,150) [1,476] {738}	31,037 (6,207) [1,490] {745}
Larimer	15,099	15,232	15,312	15,366	15,508 (3,102) [744] {372}	15,645 (3,129) [751] {375}	15,776 (3,155) [757] {379}
Pueblo	13,218	13,328	13,375	13,425	13,517 (2,703) [649] {324}	13,599 (2,720) [653] {326}	13,671 (2,734) [656] {328}
Weld	19,925	20,100	20,222	20,348	20,584 (4,117) [988] {494}	20,812 (4,162) [999] {499}	21,036 (4,207) [1,010] {505}

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.