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

Date: 2/2/21

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 2/2/21 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.

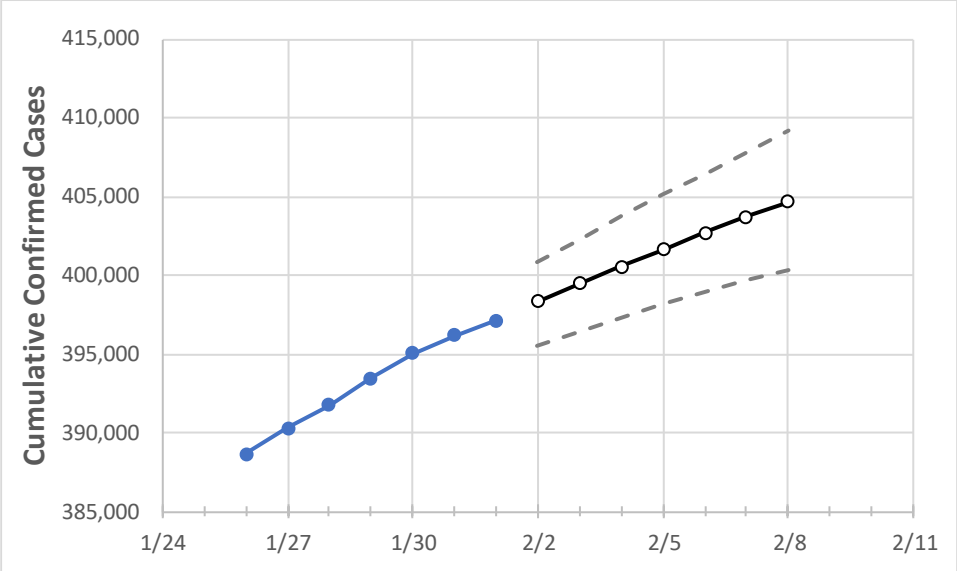
IEM's Modeling Lead

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:						
	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8
Colorado	393,459	395,019	396,185	397,101	398,316	399,452	400,564	401,643	402,687	403,688	404,669

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:						
	1/29	1/30	1/31	2/1	2/2	2/3	2/4	2/5	2/6	2/7	2/8
Adams	45,508	45,618	45,735	45,807	45,908	46,009	46,106	46,200	46,291	46,378	46,465
Arapahoe	44,719	44,881	45,027	45,154	45,294	45,432	45,566	45,700	45,828	45,954	46,077
Boulder	17,108	17,179	17,224	17,263	17,323	17,380	17,437	17,493	17,548	17,603	17,657
Denver	55,377	55,588	55,734	55,835	55,963	56,089	56,212	56,331	56,448	56,560	56,670
Douglas	18,782	18,861	18,920	19,029	19,097	19,162	19,227	19,290	19,353	19,417	19,479
Eagle	4,342	4,375	4,390	4,402	4,425	4,448	4,470	4,491	4,512	4,533	4,552
El Paso	47,491	47,657	47,777	47,842	47,948	48,056	48,157	48,257	48,352	48,446	48,532
Gunnison	1,042	1,051	1,054	1,056	1,066	1,077	1,086	1,097	1,107	1,117	1,127
Jefferson	34,364	34,509	34,593	34,665	34,763	34,856	34,946	35,033	35,123	35,208	35,291
Larimer	17,914	17,999	18,065	18,115	18,184	18,253	18,321	18,387	18,453	18,517	18,579
Pueblo	14,302	14,326	14,339	14,353	14,371	14,388	14,405	14,421	14,437	14,453	14,468
Weld	23,453	23,523	23,586	23,640	23,699	23,756	23,812	23,864	23,914	23,963	24,011

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:		
	1/29	1/30	1/31	2/1	2/3	2/5	2/7
Adams	45,508	45,618	45,735	45,807	46,009 (9,202) [2,208] {1,104}	46,200 (9,240) [2,218] {1,109}	46,378 (9,276) [2,226] {1,113}
Arapahoe	44,719	44,881	45,027	45,154	45,432 (9,086) [2,181] {1,090}	45,700 (9,140) [2,194] {1,097}	45,954 (9,191) [2,206] {1,103}
Boulder	17,108	17,179	17,224	17,263	17,380 (3,476) [834] {417}	17,493 (3,499) [840] {420}	17,603 (3,521) [845] {422}
Denver	55,377	55,588	55,734	55,835	56,089 (11,218) [2,692] {1,346}	56,331 (11,266) [2,704] {1,352}	56,560 (11,312) [2,715] {1,357}
Douglas	18,782	18,861	18,920	19,029	19,162 (3,832) [920] {460}	19,290 (3,858) [926] {463}	19,417 (3,883) [932] {466}
Eagle	4,342	4,375	4,390	4,402	4,448 (890) [213] {107}	4,491 (898) [216] {108}	4,533 (907) [218] {109}
El Paso	47,491	47,657	47,777	47,842	48,056 (9,611) [2,307] {1,153}	48,257 (9,651) [2,316] {1,158}	48,446 (9,689) [2,325] {1,163}
Gunnison	1,042	1,051	1,054	1,056	1,077 (215) [52] {26}	1,097 (219) [53] {26}	1,117 (223) [54] {27}
Jefferson	34,364	34,509	34,593	34,665	34,856 (6,971) [1,673] {837}	35,033 (7,007) [1,682] {841}	35,208 (7,042) [1,690] {845}
Larimer	17,914	17,999	18,065	18,115	18,253 (3,651) [876] {438}	18,387 (3,677) [883] {441}	18,517 (3,703) [889] {444}
Pueblo	14,302	14,326	14,339	14,353	14,388 (2,878) [691] {345}	14,421 (2,884) [692] {346}	14,453 (2,891) [694] {347}
Weld	23,453	23,523	23,586	23,640	23,756 (4,751) [1,140] {570}	23,864 (4,773) [1,145] {573}	23,963 (4,793) [1,150] {575}

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.